



***“After Hurricane Sandy: Lessons Learned for Bolstering the Resilience of  
 Health Systems and Services”***

***Hosted by Kostas Research Institute for Homeland Security, Northeastern University & Columbia  
 University’s National Center for Disaster Preparedness***

***Read Ahead Materials***

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# **“After Superstorm Sandy: Lessons Learned for Bolstering the Resilience of Health Systems and Services”**

*Hosted by* The Center for Resilience Studies of Northeastern University &  
The National Center for Disaster Preparedness at the Earth Institute, Columbia University

Lerner Hall (2920 Broadway) Room 555  
Columbia University  
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## **Executive Summaries of Read-Ahead Articles**

**“Hurricane Sandy: Lessons Learned, Again.”** David M. Abramson and Irwin Redlener,  
*Disaster Medicine and Public Health Preparedness*, 2012.

In the wake of Hurricane Sandy, gaps in planning were quickly revealed when it came to providing relief. This was not so much an issue of capacity or capability, as it was of communication and coordination. “Medical humanitarianism” efforts were launched where doctors volunteered to work in mobile medical units and hospital nurses and clinicians volunteered to staff functional needs shelters. But these often heroic efforts could have benefited from better advanced planning. Too often, “resources did not always make it the last mile to reach those in need.” Climate scientists and public agencies have long predicted the potential devastation a storm could bring to the region, warning of “structural damage and impaired operations of communications, energy, transportation, and water and waste infrastructure; reduction of water quality through saltwater intrusion into aquifers; and inundation of low-lying areas and wetlands.” In the end, the “...disciplines of medicine and public health can learn lessons, again, from Sandy: to develop more integrated systems, to practice and train together, and to build redundancy into everything.”

**“Lack of Authority.”** Sasha Chavkin, *The New York World*, February 1, 2013.

Following Hurricane Sandy, there were major challenges associated with delivering disaster relief services to the elderly and disabled in New York City public housing. There is a need for policy reform particularly with regard to clarifying the responsibilities of the New York City Housing Authority (NYCHA), and the City of New York for providing assistance to public housing residents. Primarily non-profit groups delivered health services in the wake of Hurricane Sandy because there were no measures put in place by the NYCHA or other city agencies to reach vulnerable residents who had not been evacuated and who ended up stranded in their homes due to power loss or pre-existing medical conditions. Demographic trends and fiscal challenges are adding to the difficulties for delivering medical assistance to residents in public housing. The NYCHA must contend with large budget deficits that can hinder the ability of the Authority to deliver services, even when the internal NYCHA registry of individuals with functional needs is accurate.

**“The Long Road to Recovery: The Environmental Health Impacts of Hurricane Sandy.”**

John Manuel, *Environmental Health Perspectives*, May 2013.

Hurricane Sandy generated a variety of environmental health threats. Immediate health threats arose from storm surge and fire, with drowning constituting the most common cause of death in the New York metropolitan area. Power loss compromised critical systems such as heating, elevators, life support, and other technologies that presented significant challenges especially for people living in high-rise apartments, especially the elderly or those with medical conditions. Long-term threats include degradation of air and water quality, and mold growth. The loss of power to wastewater treatment plants can significantly pollute the water supply. Sediment deposited by floodwaters combined with debris from damaged and destroyed buildings can degrade air quality. Improper or incomplete restoration of waterlogged houses could lead to significant mold growth, especially in inaccessible wood-to-wood interfaces. Many environmental health impacts are inter-related, and the combination of several threats can pose significant risks to public health in the wake of a disaster.

**“A Hospital System’s Response to a Hurricane Offers Lessons, Including the Need for Mandatory Interfacility Drills.”** Christina Verni, *Health Affairs*, August 2012.

This case study explores the lessons learned when the North Shore–Long Island Jewish Health System, a large, integrated health network in New York, evacuated three hospitals at high risk of flooding from Hurricane Irene in August 2011. The episode resulted in the evacuation, transport, and placement of 947 patients without any resulting deaths or serious injuries. This case demonstrates the utility of having in place a functional evacuation plan, such as the one North Shore–Long Island Jewish Health System developed through its own full-scale exercises in the years following Hurricane Katrina in 2005. In those drills, the health system discovered that it needed to abandon its 1:1 matching of patients to available beds in the region in favor of the group transport of patients with similar needs to facilities that could accommodate them. Despite its overall success, the system identified the need for internal improvements, including automated patient tracking through the use of bar-coded wristbands and identification and training of additional backup personnel for its emergency operations center. Among other changes, policy makers at the state and federal levels should consider mandating full-scale interfacility evacuation drills to refine mechanisms to send and receive patients.

**“Facing Uncertainty - Dispatch from Beth Israel Medical Center, Manhattan.”** Sushrut Jangi, M.D., *The New England Journal of Medicine*, December 13, 2012.

Beth Israel Medical Center lost power from the electrical grid at approximately 9pm October 29, 2012 and activated its emergency back-up generators. NYU Langone and Bellevue hospital lost power and had to evacuate making Beth Israel the only operating hospital in Lower Manhattan. With the intercom and

paging system down, hospital staff used the available Wifi and their smartphones to download an app that allowed them to create an impromptu paging system to respond to codes. During the storm and its aftermath, patients arriving in the Emergency Department doubled in volume. This was primarily as a result of patients who needed crucial prescription refills or essential health services that depended on electric power. This influx was not due to major or serious traumas resulting from the storm. To deal with this volume, the hospital staff triaged patients, set up a group of nephrologists and a dialysis unit, and instructed residents and surgeons to serve in other capacities.

**“Disaster Resilience and People with Functional Needs.”** Sophia Jan, M.D., and Nicole Lurie, M.D., M.S.P.H., *The New England Journal of Medicine*, December 13, 2012.

Many residents with functional needs depend on the electrical grid for various reasons, including refrigerating important medications and powering lifesaving medical devices. During Hurricane Sandy, a great number of these residents who do not reside in institutional settings were turned away from shelters based on the fact that the operators didn’t feel their needs could be met, when, in actuality, they were simply looking for a place to recharge their medical devices. In order to strengthen the resilience of people with functional needs and of the community overall, key policies need to be enacted, including:

- Development of health information systems, such as interoperable electronic medical records
- Development of alternative power sources for critical medical equipment
- Enhancement of technologies that promote social connectedness, which has been shown to improve survival during disasters
- Integration of a position for a disability services coordinator into the Incident Command System
- And the Establishment of strong Public-Private Partnerships for planning, response, and recovery.

**“Identifying Disaster Medical and Public Health Research Priorities: Data Needs Arising in Response to Hurricane Sandy.”** New York Academy of Medicine and the Institute of Medicine. Forum Proceedings. November 16, 2012.

Participants in this meeting included:

- Nicole Lurie, Assistant Secretary for Preparedness and Response, Department of Health and Human Services
- Nirav Shah, New York Commissioner of Health
- Mary O’Dowd, New Jersey Commissioner of Health
- Lewis Goldfrank, Department of Emergency Medicine Professor and Chair, New York University School of Medicine
- Thomas Farley, New York City Commissioner of Health and Mental Hygiene
- Irwin Redlener, Director, National Center for Disaster Preparedness, Professor of Clinical Population & Family Health, Mailman School of Public Health, Professor of Clinical Pediatrics, College of Physicians & Surgeons
- Elizabeth Ryan, President and CEO of the New Jersey Hospital Association
- David Lackey, Texas Commissioner of Health

Key areas of improvement discussed during this meeting were:

- The need for real-time data generation pertaining to hospital and shelter capacity, functional needs populations, etc.
- The need to understand and address the risks of evacuation vs. shelter-in-place
- The need to understand/codify existing disaster preparedness mandates (i.e., generators, fuel)
- The need to establish re-entry/repatriation regulations and procedures
- The need to clearly define and prioritize first responders
- The need for information sharing, particularly between FEMA and other hospitals/shelters
- The need to better address the mental health of First Responders
- The need to generate guidelines regarding rules/waivers for occupancy (how much over is too much), Patient Confidentiality after switching facilities, expanding admitting privileges , etc.

**“NYC Hurricane Sandy After Action: Report and Recommendations to Mayor Michael R. Bloomberg.”**  
Section on General and Healthcare Facility Evacuations. Deputy Mayor Linda I. Gibbs and Deputy Mayor Caswell F. Holloway. May 2013.

When considering the decision to evacuate a health care facility or to issue an order to shelter in place, the risks to the vulnerable populations must be seriously considered. Keeping this in mind, only hospitals and residential facilities in Zone A were ordered to evacuate in advance of Hurricane Sandy. Despite the fact that hospitals and nursing homes are required to have backup power sources, the unprecedented storm surge of Sandy caused flooding and outages that seriously impeded the ability of 5 hospitals and 30 residential facilities to shelter in place during and after the storm. These facilities were evacuated, resulting in competition for bed placements and a stress on patient transportation systems. While no lives were lost as a result of those specific evacuations, improvements can be made to the process as a whole, specifically regarding communications with the residents of flood zones, regional evacuation plans for hospitals, resilience of health systems’ physical infrastructure, and reentry guidelines for healthcare facilities. The following recommendations were made based on the results of general and healthcare facility evacuations during Hurricane Sandy:

- Implement the new Coastal Storm Plan evacuation zones and review the City’s evacuation procedures.
- Increase and refine pre-storm communications and education to vulnerable areas, including NYCHA developments, to maximize evacuation in future storms through OEM’s Ready New York program and other outlets.
- Work with the New York State Department of Health to develop and enforce current and new regulations for licensed residential facilities including hospitals, nursing homes, and adult care facilities that require comprehensive evacuation planning and backup power capacity.
- Ensure healthcare facilities are equipped with and know how to use alternate means of communication (e.g. satellite phones or radios) that remain functional in the event that power outages and downed landlines make other channels unusable.
- Develop guidelines for healthcare facility repatriation that include all necessary inspections and certifications.

**“Emergency Preparedness and Public Health: The Lessons of Hurricane Sandy.”** Tina Powell, MD, Dan Hanfling, MD, and Lawrence O. Gostin, JD., *Journal of the American Medical Association*, November 16, 2012.

Many valuable lessons were learned from Hurricane Katrina in New Orleans and implemented in New York City Hospitals, including moving generators to higher floors, creating more detailed emergency and evacuation plans, and building concrete walls around fuel pumps, which had to be left in the basement as a result of building code restrictions. Despite this, NYC hospitals were unprepared for the 14-foot storm surge and the massive evacuations that were required as a result. What seemed to be missing were clear and consistent criteria to guide evacuation decisions, as well as adequately practiced disaster exercises and retrofitted infrastructure to increase resiliency, as it was considered too cost prohibitive to implement. In order to best remedy the lack of clear and consistent evacuation criteria and practices, healthcare coalitions need to integrate planning that spans the entire emergency response system and incorporates regional as well as local partners.

**“Lessons from Sandy – Preparing Health Systems for Future Disasters.”** Irwin Redlener and Michael J. Reilly, *The New England Journal of Medicine*, December 13, 2012.

Among the medical and public health challenges revealed in the aftermath of Hurricane Sandy was the need to identify and treat a surge of patients with casualties both directly and indirectly resulting from the storm. Additionally, there are potentially serious public health complications arising from the effects of extensive flooding to include risks associated with debris, toxic waste, contaminated water, prolonged power outage, and mold infestations. The restoration of essential supply chains delivering medications, medical supplies, fuel, food, and water is another serious challenge. Finally, access to health care can itself be a disaster casualty, including access to mental health care, especially for those who have inadequate access to care even in non-disaster situations. There are three key principles for recovery. First, consider “the health care delivery system and public health infrastructure as an integrated whole in planning for, responding to, or recovering from large-scale disasters.” Second, apply “lessons from previous disasters to the planning for future events.” Third, incorporate science into disaster policy and planning processes. Going forward, it is essential to take into account the vulnerability of critical infrastructure including public health and medical infrastructure to climate change.

**“Shelter From the Storms.”** Sheri Fink, *The New York Times*, October 27, 2013.

Medical professionals faced difficult choices during Hurricane Sandy as a result of inadequate planning and preparedness. While vulnerable populations and risks are identified, too often emergency plans fail to consider the measures necessary to evacuate or plan for functional needs populations. Federal and state standards on key issues such as building codes and safety standards for hospitals are outdated.

More needs to be done to ensure that new investments into health care infrastructure are sufficient to mitigate future disasters. Fiscal realities, federal privacy rules, and misplaced priorities create obstacles to making this necessary investment. Communities can plan to care for vulnerable residents, but the failure to choose to invest will result in the weakest members of society suffering and dying disproportionately.

**“A Stronger, More Resilient New York.”** Plan NYC, June 11, 2013.

During Hurricane Sandy and its aftermath, disruptions occurred in the systems that provide transportation, fuel supply, and telecommunications. The result was to restrict the ability of hospital staff to get to work and to communicate with local, state, and federal officials. Whether because of flooded generators or lack of fuel reserves, power loss was cited as the most common cause for evacuating a health care facility. Over 2,000 patients experienced emergency evacuations, and only 10 hospitals in NYC were able to remain open. One such hospital, Beth Israel Medical Center, had to rely on runners to give orders, paper charts to stand in place of electronic records, and converting the lobbies into inpatient wards to deal with the influx of patients during a power outage. Over 31 nursing homes were either shut down or partially evacuated, transporting 4,500 residents to Special Medical Needs shelters. Community-based providers, which typically don't have generators, were unable to address immediate medical concerns due to lack of power and communication issues, while home-based care was rendered nearly impossible due to transportation issues and lack of power to elevators.

Initiatives suggested in this report include:

1. New buildings must meet construction code standards for 500 yr flood elevations
2. Installing external emergency power generators
3. Retrofitting existing buildings in 500 yrs flood elevations to meet improved standards
4. Making emergency power systems accessible
5. Improving emergency departments to limit risk for flood damage
6. Increasing flood and storm protection of Bellevue Hospital, which has trauma center
7. Limiting risk of power failures of nursing homes and adult care facilities
8. Requiring new facilities to have emergency power systems
9. Prioritize shelter in place over evacuation of patients
10. Retrofitting existing nursing homes to have emergency power and water sources
11. Implementing grants, subsidized loan program, capped at \$50 million citywide, to assist with costs and financing of improvements
12. Enabling emergency power of nursing homes and adult care facilities to run air conditioning systems
13. Waiving sales taxes for these improvements
14. Improving ability of primary care and mental health facilities to re-open quickly
15. Ensuring emergency power supplies of pharmacies
16. Launching an emergency preparedness website for pharmacies
17. Community-based providers establishing telecommunications for phone consultations
18. Utilizing Electronic Health Records to prevent loss of data
19. Ensuring that computers and servers are not on floors at risk for flooding



**“A Survey of Hospitals to Determine the Prevalence and Characteristics of Healthcare Coalitions for Emergency Preparedness and Response.”** Kunal J. Rambhia, Richard E. Waldhorn, Frederick Selck, Ambereen Kurwa Mehta, Crystal Franco, and Eric S. Toner, *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, Vol 10.3, November 3, 2012.

Previous reports have identified the development of healthcare coalitions as the foundation for disaster response across the United States. This survey of 4,632 acute-care hospitals characterizes the current status of participation by US hospitals in healthcare coalitions for emergency preparedness planning and response. The survey results show the nearly universal nature of a coalition approach to disaster response. The results suggest a need for wide stakeholder involvement, but also for flexibility in structure and organization. Based on the survey results, the authors make the following recommendations:

- Guidance should place emphasis on building response functions of healthcare coalitions
- Guidance should promote the inclusion of EMS and EMA in coalitions and in local EOC
- Ambulatory facilities, long-term care providers, coroners and medical examiners, FQHC’s, primary care practices, physician’s practices, home health agencies, and mental health providers should also be included in Healthcare Coalitions
- Flexibility in organizational structures of healthcare coalitions should be maintained
- Resilience planning should be a part of healthcare coalition strategies and planning

**“The Next Challenge in Healthcare Preparedness: Catastrophic Health Events.”** Center for Biosecurity of UPMC, *Preparedness Report*, January 2010.

A well-prepared healthcare system is one that is able to respond quickly and with agility to mass casualty events of all sizes and sources, including those that cross jurisdictional boundaries, so as to minimize loss of life, suffering, and serious adverse effects on society. Such a system would include every healthcare institution and every community in the country. In a well-prepared healthcare system, every healthcare institution will be integrated into a community-based healthcare coalition that joins public health agencies, EMAs, Emergency Medical Services (EMS), and private non-healthcare partners. Healthcare coalitions would serve both preparedness and response functions in their communities and would be linked together through interpersonal and electronic connections to create regional coalition networks. Healthcare coalitions would have the ability to communicate horizontally, with other coalitions, and vertically, with state, multistate regional, and federal authorities. With healthcare partners and coalitions connected both horizontally and vertically, individual parts of the healthcare system would be able to function autonomously if cut off from outside support and direction. Furthermore, the healthcare system as a whole would be able to adapt if parts became disabled, and after a disaster, the system would be able to recover quickly and resume provision of essential healthcare services to the population.

Recommendations:

- Every U.S. hospital should participate in a healthcare coalition that prepares and responds collaboratively to common medical disasters and Complex Humanitarian Emergencies (CHEs).
- Links should be established between neighboring healthcare coalitions to enable regional exchange of healthcare information and assets during a CHE.
- Out-of-hospital triage sites should be established and healthcare responders should be trained in CHE triage.
- A patient transportation system that harnesses alternative, private sector resources should be created.
- Development of crisis standards of care should be expanded, and their consistent implementation within and across states should be promoted.
- A national framework for healthcare response to CHEs should be developed to guide states, jurisdictions, and local entities in developing concept of operations for medical and public health activities.

## Hurricane Sandy: Lessons Learned, Again

David M. Abramson, PhD; Irwin Redlener, MD

**H**urricane Sandy was a sobering reminder to those of us who call New York home that it is a port city and subject to the whims of wind and water. The storm itself was massive: climatologically, a thousand miles wide at its peak; economically, an estimated excess of \$50 billion in damages. In the New York metropolitan area, 97 people died in the storm, thousands were displaced from their homes, and 2 major hospitals required perilous evacuations even as the hurricane-force winds engulfed the metropolitan region.

Vivid scenes of “medical humanitarianism” played out in the days and weeks after Hurricane Sandy devastated neighborhoods in New York and New Jersey. On streets in Rockaway, Queens, doctors in mobile medical units treated exacerbations of asthma among teenagers who were suffering in cold, dank, and powerless apartments without their rescue medications. The doctors occasionally climbed 15 flights of stairs to make house calls. In a Bronx gymnasium, hospital nurses and clinicians who had volunteered to staff a functional needs shelter were confronted with more than a hundred medically fragile patients from adult homes who suddenly appeared at the shelter without medical records or accompanying staff. In Manhattan, on the night the hurricane made landfall, hundreds of medical students, residents, and nurses were pressed into service to carry hospital patients down darkened flights of stairs as generators failed.

Medical heroism? Perhaps. Or a stark illustration of the preparedness gaps that still exist. Each of these scenarios reflect a failure of systems, some more predictable than others. And each of these scenarios represents practices driven as much by goodwill or desperation as by science and evidence. At least in theory, all of these situations could have been prevented with the right planning.

Many of the issues that emerged during and after Hurricane Sandy were not within the power of either medicine or public health to fix. Some of the storm’s biggest impacts were a consequence of energy failures at both macro and micro levels. The disruption of the region’s fuel distribution network resulted in severe gas shortages, which affected medical and public health workforces, among others, and disrupted the area’s supply chain for nearly 2 weeks. Locally, the energy disruptions had direct effects—at least 8 of the deaths attributed to Sandy in the New York area were the result of carbon monoxide poisoning in households using generators or stoves for heat, and the evacuation of 200 patients from New York University Langone Medical Center was the result of a fuel pump failure.

Another critical issue was the public’s response to risk communications, particularly the mandatory evacuation orders given

for residents along the coast where an extraordinary storm surge was expected and, indeed, materialized. As in the case last year in anticipation of Tropical Storm Irene, substantial numbers of citizens defied the mandate and stayed. This suggests that much work is needed to better understand why people should or should not evacuate pre-emptively, and how to effectively communicate to at-risk populations before and during a crisis.

However, for those of us in the fields of disaster medicine and public health preparedness, the question is, were we ready? During the past decade considerable public investment has been made in standardizing command and communication, assuring appropriate and rapid supply chains, and training the medical and public health workforces to respond appropriately. And yet, in the week after the storm, persistent reports of widespread gaps in the provision of coordinated relief were received from the Rockaways to Coney Island to Staten Island and New Jersey. The question was not one of capacity and capability as much as it was of communication and coordination. Resources did not always make it the last mile to reach those most in need.

Nor was this event entirely unexpected. Just as the fictional 2004 Hurricane Pam exercise in Louisiana foreshadowed the 2005 Hurricane Katrina, a 2011 hurricane evacuation study commissioned by the US Army Corps of Engineers and the New York City Office of Emergency Management had ominous echoes of what was to come. The authors noted that, “The region’s unique and severe vulnerability to storm surge and winds associated with coastal storms cannot be overstated. The region has been impacted historically by major hurricanes but one has not hit in recent history with the levels of population and infrastructure that are now in place. Many residents and businesses while ‘street smart’ regarding every day urban issues, are inexperienced in dealing with the direct impacts of a major storm event.”<sup>1</sup>

Climate scientists have also predicted this storm surge for years. One 2011 report from the Earth Institute mapped a coastal storm event that mirrored Sandy’s footprint. The authors warned of “structural damage and impaired operations of communications, energy, transportation, and water and waste infrastructure; reduction of water quality through saltwater intrusion into aquifers; and inundation of low-lying areas and wetlands.”<sup>2</sup> The handwriting on the wall has been clear.

The recovery from Sandy’s devastation has only just begun. And, unfortunately, true recovery from large-scale disasters is invariably a prolonged and complex challenge that is poorly understood and difficult to accomplish, whether here in the United States or elsewhere in the world. That said, some lessons should

be derived from the experience with Sandy—lessons that should have been learned from past disasters as well. Communication is critical, at all levels and to all who are affected. Directing people to websites or Twitter feeds is of little use if they have no power to charge their cellphone. Coordination did occur, but only in fits and starts; moreover, it often happened outside the conventional channels. Efforts should be made to broaden those coordination channels to include more diverse and emergent groups. Also, as the metropolitan area turns its attention from response to recovery, and the press turns its attention away completely, communities have an even greater need to consider what sustainable redevelopment can look like, and to take seriously an investment in preparedness and mitigation.

The disciplines of medicine and public health can learn lessons, again, from Sandy: to develop more integrated systems, to practice and train together, and to build redundancy into everything, whether electronic medical records or generator fuel pumps. Certainly, this storm will also serve as a test of several recent frameworks, the Centers for Disease Control's Public Health Emergency Preparedness Capabilities, and the Federal Emergency Management Agency's National Disaster Recovery Framework. Both can be refined in light of actual deployments.

Sandy has been a humbling experience for those of us who live or work in New York City, to imagine that the country's largest city, so resourceful and resource-rich, could have met its match so easily. Although the blow has been not so great that it has exceeded the city's grasp to recover. That remains to be seen, but given the city's resilience post-9/11, one can easily imagine the city rebuilding back strongly. It did reveal, however, some of the same vulnerabilities that the world witnessed in Hurricane Katrina. These include the organizational vulnerabilities of agencies, organizations, and emergent groups that still do not communicate well with one another, and the social vulnerabilities that continue to place isolated and marginalized groups in harm's way. Perhaps we will heed the lesson next time.

**Author Affiliations:** National Center for Disaster Preparedness, Columbia University Mailman School of Public Health, New York, New York.

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# The New York World

## Get inside your government

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### Lack of Authority

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The city's public housing agency knew where its disabled and elderly residents lived when superstorm Sandy struck. That doesn't mean it was able to aid them afterward. But who should have?

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#### No Comments

**A woman unable to recharge an electronically powered respirator** she relied on for breathing. **A wheelchair-bound man** trapped without enough medication to stabilize the swelling in his limbs. Homebound diabetes patients who ran out of glucose meter strips and could no longer measure their blood sugar. In the weeks following superstorm Sandy, these stories and many like them trickled out down dark stairways from residents stranded in the city's low-lying, high-rise public housing complexes without heat or electricity.

If the needs of residents were shocking to many New Yorkers, they also weren't news to the New York City Housing Authority (NYCHA).

By the time Sandy struck, NYCHA had already compiled alarming evidence showing that its complexes are home to dense concentrations of elderly, disabled and homebound residents.

What's more, the authority says it knew exactly who the vulnerable residents are and where they lived even before Sandy struck. Even as the city **failed to follow through** on a proposal for a voluntary registry of people requiring assistance in an emergency, NYCHA had developed its own internal database of individuals with special needs such as limited mobility, infirmity or reliance on electronic medical equipment.

Yet neither NYCHA nor other city agencies had put measures in place to reach those residents if they do not evacuate during emergencies. What the city didn't have – and still doesn't – is a plan to ensure that public housing residents get adequate emergency and medical aid when the next storm comes.

"In the end of the day, no one was really paying attention to these high-risk individuals in NYCHA housing," said Dr. Irwin Redlener, the director of the **National Center for Disaster Preparedness** and co-chair of the New York State Ready Commission, a panel of experts appointed by Gov. Andrew Cuomo to recommend policy reforms in the aftermath of Sandy. "It's something that seems to have basically fallen through the cracks because no one seems to have taken responsibility for it."

Multiple city agencies were aware of the needs. A **2011 report** commissioned by NYCHA along with the city Department of Health and Mental Hygiene and Department for the Aging found based on a survey sample that among more than 61,000 senior citizens living in NYCHA developments, roughly half lived alone and fully 79 percent had two or more chronic health conditions. Nearly a third had limitations in their abilities to perform basic daily activities, a rate about five times the national average among older adults.

"Some of these buildings are turning into naturally occurring retirement communities before our eyes," said Nancy Wackstein, the executive director of United Neighborhood Houses, a nonprofit network of settlement houses that works intensively inside NYCHA developments.

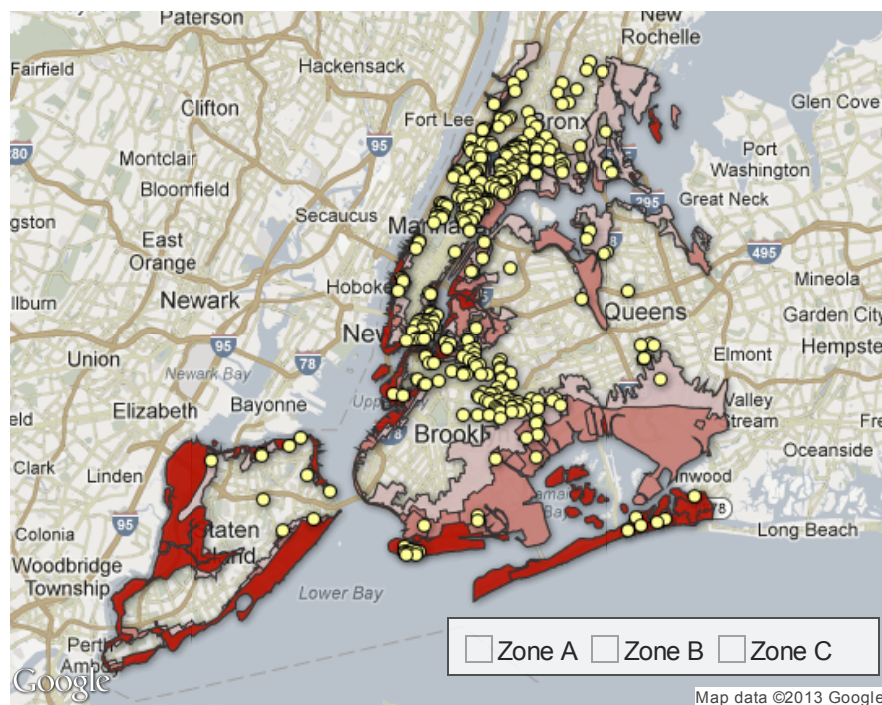
The authority says it contacted residents on its special-needs list before the storm and provided buses for evacuation, but a combination of inadequate evacuation services to meet the transport and shelter needs of the disabled, residents' unwillingness to leave their homes, and the lack of follow-up services after the storm meant that many if not most people on this list stayed in their homes during the storm, and ended up in danger and discomfort. Overall, **only 6,100** New Yorkers took refuge in city shelters during Sandy, while **80,000 NYCHA residents** live in buildings that were directly affected by the storm.

The author of the 2011 report on NYCHA seniors, Lorna Thorpe of the CUNY School of Public Health, said the health needs in public housing were so serious that they required a major influx of city resources even in the absence of a disaster.

"We should be taking all our flagship programs," Thorpe said of the city's health and social service agencies. "It can't be NYCHA alone."

She said her study represented an initial step by NYCHA and other city agencies to develop a picture of health needs in public

Each dot represents a NYCHA public housing development. Areas marked in red are hurricane evacuation zones; Zone A was the city's mandatory evacuation zone during superstorm Sandy. In all, 80,000 residents live in developments that were affected by the storm.



Source: NYCHA, NYC OpenData

housing, with a goal of ultimately developing better programs to address them.

NYCHA said in a statement that it is “responsible for 400,000 residents in public housing,” – without specifying how it defined that responsibility – but noted that it does not provide human services itself.

“NYCHA does not directly provide services to its residents, but rather links residents to services, as needed,” the authority said. “NYCHA does not have medical professionals on staff to deliver health services.”

The office of Mayor Michael Bloomberg did not respond by deadline to requests for details about city plans for emergency aid to public housing residents.

One of the key disputes that has emerged after Sandy is whether NYCHA itself is responsible for the safety of its most vulnerable residents during disasters – and who will step up to the

plate to provide the services it can't.

This unresolved dilemma was on display during a tense City Council appearance on Jan. 17 by Cecil House, NYCHA's general manager. Members repeatedly took House to task for NYCHA's shortcomings in protecting vulnerable residents, who in many cases were stranded for long stretches in cold, dark apartments without relief from the city. It was not until Nov. 9, close to two weeks after the storm's landfall, that city relief teams began going door to door in NYCHA developments.

Melissa Mark-Viverito of northern Manhattan criticized NYCHA for not surveying the emergency needs of its residents as a part of its damage assessments in the days after the storm.

Sara Gonzalez of the hard-hit Red Hook area asked why the city didn't send more emergency response teams into housing developments.

“I just want the Housing Authority to understand that they have an obligation to take care of these people,” declared Councilman Stephen Levin of Brooklyn, whose district included the Gowanus Houses, which **went without power for 11 days** after the storm. “And they did not meet that obligation.”

Yet House's testimony made clear that he understood NYCHA's obligations very differently, because it is a housing agency – essentially a landlord – barely able to meet its responsibilities on that front. NYCHA is **already struggling** with deep deficits, more than 300,000 backlogged repairs, and eroding funding support from the federal government.

In the days after the storm, House said, NYCHA's obligation as a landlord prompted it to begin by assessing physical damage to its buildings. He said NYCHA sent teams to each of its affected developments, but they may not have been visible because they were tackling the power and heat outages that made conditions so hazardous: rather than going door to door, they were likely working on repairs in the basement.

In response to criticism that his agency had not conducted an emergency needs assessment after the storm, he noted pointedly that “public housing residents are part of the city” and subject to the same citywide emergency response as any other resident.

One of the neighborhoods that suffered most from Sandy's impact was Red Hook, home to the city's second-largest public housing complex. In the Red Hook Houses, more than 6,000 residents in 36 buildings lost heat, power or both in the weeks following the storm.



In the days after Sandy's landfall, Red Hook residents said that, as in so many other affected areas, the only aid came from local nonprofits. When volunteers went door to door, they found homebound residents trapped in their apartments not only without enough food but without crucial medical equipment and care.

"The response was not there," said Alisa Pizarro, a tenant of the Red Hook Houses and an organizer with the Red Hook Initiative, a community group that provided food and medical aid to residents stuck in their apartments. "That first week it was just regular folks got together and made this happen. It was not NYCHA or anyone from government."

Red Hook Initiative organizers had a list of 77 tenants in the development whom they provided with medical services in their apartments in the aftermath of the storm. Many were homebound due to chronic conditions such as respiratory illness, diabetes and physical impairments, and organizers found that many in this group had been doing without needed services from city or private agencies even before the storm occurred.

Sandy was not the first time that the city's blind spot regarding vulnerable Red Hook Houses tenants placed these residents at risk after a disaster. Ryan Schiavone, a paramedic who responded to 911 calls in the Red Hook Houses following Sandy, recalled facing similar emergencies in previous storms. He said he responded to repeated calls following Tropical Storm Irene and the blizzard of 2010 from project residents who were unable to access needed medical care or supplies.

"There were people that were on ventilatory equipment that needed very specific types of care that were being overlooked," Schiavone said. "This happened during the blizzard, it certainly happened during hurricane Irene.... The same thing keeps happening over and over again and nobody's getting through."

Yet in Sandy's aftermath, city agencies and elected officials rarely knew what was happening in NYCHA buildings, even as the humanitarian disaster became apparent. Members of the City Council criticized NYCHA at last week's hearing for not sharing an internal disaster preparedness plan with the Council, and not providing its special needs list to elected officials or local community groups in the storm's aftermath.

Brad Lander, a councilman from Brooklyn who assisted relief efforts in the Red Hook Houses, said that nothing he has heard so far in the council's hearings gave him confidence that the city had a plan for who would take charge of addressing disasters affecting public housing projects in the future.

"One of my frustrations here in general is a lingering sense that there's some meaningful distinction between NYCHA and the City of New York," Lander said.

"Especially in a moment of crisis, it's got to be a unified effort."

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Sasha Chavkin

**HEALTH & SAFETY   HOUSING   SOCIAL SERVICES**

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# *The* **Long Road to Recovery**

Environmental Health Impacts *of* Hurricane Sandy

Residents and volunteers keep warm by a fire barrel in the New Dorp Beach neighborhood of Staten Island, 5 November 2012. Power outages persisted through a cold snap that put temperatures in the single digits. © AP Photo/John Minchillo



**B**uilding contractor John Pierciey stands in the gutted interior of a 1950s-era home in Manasquan, New Jersey. Wallboard, two layers of wood flooring, a layer of felt—all of it had to be ripped out to rid the house of mold caused by Hurricane Sandy's storm surge. "This is the sixth house I've gutted in a week," Pierciey says. "Every one is different. You don't know what you're going to find until you take them apart."

So it is with the environmental health impacts of Hurricane Sandy. Every layer of society, every type of building, has felt the impact of the storm, which struck the U.S. East Coast on 29 October 2012. Incidences of death and illness, though small in number compared with some storms, have come in many forms, the effects still unfolding as time goes by.

### Immediate Impacts

Hurricane Sandy was the largest storm ever recorded in the Atlantic Ocean. It reached more than 1,000 miles in diameter and affected states from Florida to Maine.<sup>1</sup> Sandy was responsible for an estimated

234 deaths in 8 countries and caused potentially \$50 billion in property damage in the United States alone.<sup>1</sup> In New York and New Jersey alone, the storm damaged or destroyed more than 375,000 housing units.<sup>2</sup> Months after the storm, power had still not been restored to all areas, and access to towns on the New Jersey barrier islands was limited to contractors and homeowners, and then only during daylight hours. (As of this writing, power has been restored to all customers.)

In terms of immediate impact, the greatest health threat came from the storm surge that swept into densely populated communities along the New Jersey shore, Long Island, and Lower Manhattan. The storm's arrival coincided with a high tide to push onshore a destructive surge of water 12.5 feet high at its peak.<sup>1</sup> Of the 97 deaths recorded in the New York metropolitan area—which includes northern New Jersey and parts of Connecticut—most were from drowning.<sup>3</sup>

Fire posed another hazard. After seawater short-circuited the electrical system in a house in New York's Breezy Point,

wind-swept flames spread to 126 homes. Dozens of fires broke out in other areas as a result of the storm. Amazingly, there were no deaths from any of these.<sup>4</sup>

Astute preparations in advance of the storm saved countless lives. Unlike with Hurricane Katrina, which seemed to capture leaders at all levels unprepared, a wide net of government agencies was on hand to deal with the health and security threats posed by Hurricane Sandy. The National Guard deployed 200 troops to keep order in New York City. The Federal Emergency Management Agency (FEMA) sent Incident Management Assistance Teams to coordinate federal resources to support the states. The U.S. Coast Guard positioned teams along the coast for search and rescue. The Nuclear Regulatory Commission maintained watch over nuclear plants, three of which were shut down during the storm. New York City mayor Michael Bloomberg and New Jersey governor Chris Christie ordered the evacuation of some coastal areas as well as the closure of bridges and tunnels throughout the metropolitan area, along with subway lines, commuter trains, bus



Joseph Leader, vice president and chief maintenance officer of the Metropolitan Transportation Authority, shines a flashlight on standing water inside the South Ferry 1 train station in New York, 31 October 2012. Subway stations and tunnels throughout Lower Manhattan were flooded by Sandy's storm surge. A portion of the Community Development Block Grant Disaster Relief funds authorized in January 2013 will go toward investments in infrastructural resilience against future disasters. © AP Photo/Craig Ruttle

lines, and the three major airports. These closures proved prescient as all road tunnels into Manhattan, except the Lincoln Tunnel, were subsequently flooded, as were subway stations and tunnels in Lower Manhattan.

Immediately following the storm, another wave of agencies sprang into action. The U.S. Department of Health and Human Services deployed more than 500 personnel, including 9 Disaster Medical Assistance Teams from 8 states, to provide care at medical shelters across the area. The American Red Cross opened 171 shelters across 13 states, with thousands of volunteers working alongside paid personnel. FEMA set up 68 Disaster Recovery Centers in Connecticut, New York, and New Jersey where people could apply for assistance and seek information on alternative housing. Within 24 hours, FEMA supplied more than a million liters of water and more than a million shelf-ready meals to the New York National Guard and to volunteers to distribute to those in need.<sup>5</sup>

### Loss of Power

In the days and weeks after the storm, the greatest public health threat was from the loss of power. Sandy knocked out electricity for more than 8.5 million people in 21 states.<sup>6</sup> This loss of power, coupled with the absence or flooding-related failure of backup generators, translated to the shutdown of heating systems, life support,

and other technologies that were vital to people's survival. More than 1,000 patients had to be evacuated from New York metro area hospitals, including New York University's Langone Medical Center, Bellevue Hospital, Coney Island Hospital, and Palisades Medical Center. This was accomplished without any reported losses of a human life.

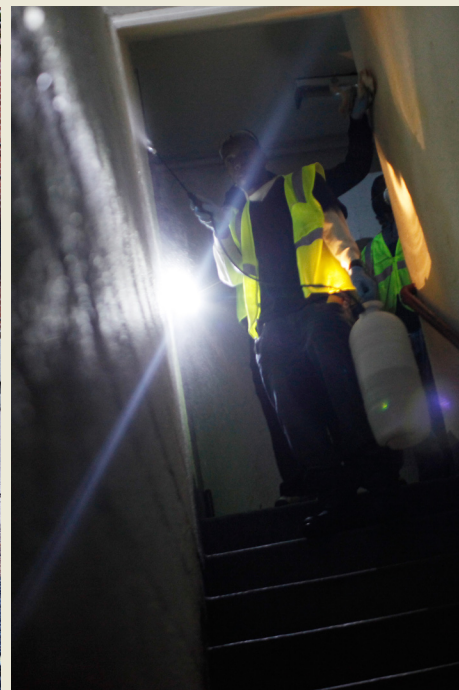
Research animals were not so lucky. At New York University's Smilow Research Center, 10,000 lab rats being used for long-term research drowned when floodwaters inundated the basement.<sup>7</sup> These animals had been specifically bred over a period of years to model human diseases and disorders including cancer, autism, epilepsy, and heart disease. "It's so horrible, you don't even want to think about it," center cancer biologist Michelle Krogsgaard told *ABC News* of the loss of the animals. "All the work we did, all the time and money, we're going to have to start over."<sup>8</sup>

Loss of power presented a distinct threat to people living in the region's many high-rise apartments. In normal times, those living on upper floors consider themselves lucky to enjoy the views. But when the electricity went out in these buildings, the elevators stopped working, and many of those same people—physically unable to descend the stairways—were trapped for days and even weeks on end.

Nastaran Mohit is a volunteer for Occupy Sandy, a nonprofit group coordinating relief efforts to victims of the hurricane. In the days following the storm, she established a "pop-up" medical clinic in the Rockaways that recruited dozens of volunteer doctors, nurses, and mental health professionals to aid the storm victims. The Rockaways is a densely populated peninsula fronting the Atlantic Ocean that was completely inundated with floodwater. It is home to four major public housing projects as well as a number of nursing homes and halfway houses. In the week after the storm, Mohit began sending teams to search out and help residents of these high-rises.

"What they found was frightening," Mohit says. "There were literally thousands of elderly people trapped in the upper floors of these buildings. The hallways were pitch black. Many apartments were without functioning plumbing. People were living in their own feces."

Mohit says many elderly residents suffered from chronic medical conditions—arthritis, high blood pressure, and diabetes. As time stretched on, she says, "We found residents who had gone for weeks without pain or cancer medication. They had to ride it out until we could send runners out to get the proper meds. Even then, a lot of pharmacies wouldn't honor the prescriptions because we didn't have exactly the right information for them to get insurance coverage."



Left: A couple collects water from a fire hydrant on Manhattan's Lower East Side, 2 November 2012. Right: Despite the ongoing lack of power, cleanup must proceed; here, a New York City housing worker cleans and disinfects a Red Hook home, 13 November 2012. The storm knocked out power to more than 8 million people, and prolonged loss of electricity and running water posed a significant problem for many people. Left: © Angelo Merendino/Corbis; right: © Andrew Lichtenstein/Corbis

Two months after the storm, thousands of residents in the Rockaways high-rises were still without functioning elevators. Governmental and private agencies are now providing aid, but volunteers like Mohit continue to fill what they see as a gaping void in the disaster response system. “There is a misconception that if a major storm hits, someone is going to take care of you,” Mohit says. “It’s just not true.”

Every storm in which power is lost for an extended period of time seems to result in tragedies related to carbon monoxide (CO) poisoning. People resort to using gas stoves or ranges to heat their dwellings and portable gas generators to provide homes with electricity. The situation was exaggerated after Sandy, given the sheer number of gas generators purchased and the threat to safety that presented.<sup>9</sup>

“Before the hurricane none of my neighbors had generators, but after Sandy they all did,” says Brian Buckley, a resident of Sea Girt, New Jersey, and executive director of laboratories at the Environmental and Occupational Health Sciences Institute (EOHSI) in Piscataway. Buckley knew his neighbors were running their generators properly because he could hear them running as he walked down the street—“You would only hear them running if they were outside,” he explains.

But not everyone in the affected area knew how to properly use a generator, Buckley says; some ran them in their garages and inside their homes, creating

hazardous CO levels. And Paul Lioy, deputy director of EOHSI, points out, “The proliferation of devices in neighborhoods will change the magnitude of the local CO exposure issue during the next blackout.”

The Centers for Disease Control and Prevention (CDC) had, as of November 6, collected 263 reports of CO exposure from poison control centers—a figure that included 4 deaths—and suspected there might be more.<sup>10</sup> By November 17 local



**Above: Point Pleasant Beach, New Jersey, 7 November 2012. Below: The Breezy Point neighborhood of Queens, New York, 14 November 2012. Hurricane Sandy was the second costliest storm to hit the United States, with damages potentially reaching as high as \$50 billion.<sup>1</sup> According to FEMA, 95% of the 5.25 million cubic yards of debris generated by the storm had been removed by February 1, but demolition of destroyed structures was only 20% complete.<sup>27</sup> Above: AP Photo/Wayne Parry; below: © Scott Houston/Corbis**



authorities were reporting 8 deaths as known or suspected to be caused by CO poisoning.<sup>11</sup>

### Outdoor Air and Water

Outdoor air quality becomes a concern after flooding events when sediment deposited by floodwaters on city streets and sidewalks dries and is kicked up by vehicles and foot traffic. Damaged buildings are demolished, and debris is stacked on sidewalks, trucked away, and sometimes burned. New Yorkers are particularly sensitive to the issue of air quality after initial monitoring by the EPA in the aftermath of 9/11 failed to detect hazardous particles from the collapse of the World Trade Center buildings.<sup>12</sup> These particles included asbestos, lead, mercury, and crystalline silica, all of which are known to contribute to cancer or respiratory ailments.<sup>13</sup>

The New York Department of Environmental Conservation (DEC) routinely monitors air quality around the state to forecast Air Quality Indices. These monitors showed no overall increase in ambient air pollution after Sandy, but they were not located near areas where debris was being gathered

for removal to landfills.<sup>14</sup> So in December, DEC and the EPA set up three additional monitoring stations in areas hardest hit by Sandy. Those monitors showed measurements of fine particulate matter exceeding the EPA's recommended 24-hour standard in several locations, including Lower Manhattan, but only on a few days.<sup>15</sup> There were no exceedances of air quality in New Jersey, according to Jane Kozinski, assistant commissioner of environmental management with that state's Department of Environmental Protection (NJDEP).

Water pollution was a major health concern after Hurricane Sandy. Raw sewage spilled into homes in Baldwin and East



Hurricane Sandy swept hazardous chemical containers from homes and businesses and deposited them into nearby marshland. In this undated photo, a worker with the EPA prepares some of these orphaned household chemicals for disposal. Eliud Echevarria/FEMA



A child plays with donated toys while her family looks through other donated goods in Rockaway Beach, Queens, New York, 4 November 2012. Natural disasters bring out many people's desire to help. However, poorly organized or inappropriate donations can cause a "second-tier disaster" as relief workers struggle to process a deluge of well-meant but unusable items.<sup>28</sup> © Amy Sussman/Corbis

Rockaway, New York, when a sewage plant flooded and could not handle the volume.<sup>16</sup> Jill Lipoti, director of the Division of Water Monitoring and Standards with the NJDEP, says the storm knocked out power or damaged some 80 sewage treatment systems in that state, including the Passaic Valley Sewerage Commission, one of the largest sewage treatment plants in the country. During wet weather, the plant treats up to 550 million gallons of sewage per day. Based on that figure, Lipoti estimates that as much as 2.75 billion gallons of untreated waste flowed from the plant into the nearby bay during the five days the plant was out of commission.

In the days after the storm, the state of New Jersey issued advisories for public recreational waters impacted by sewage. Shellfish waters were closed statewide. Boil-water advisories were issued for affected water supply systems. “If you lose power in your water supply system, you have to issue an advisory to the public asking them to boil their water before drinking because you don’t know if the water has been contaminated,” Lipoti says. All recreational and boil-water advisories have since been rescinded, and most shellfish waters have reopened.

In Lower Manhattan, stormwater flooded five subway tubes, two Amtrak tunnels, and three of the city’s primary roadways. FEMA assigned the pumping out of these structures to the U.S. Army Corps of Engineers (USACE) Unwatering Team, dubbed by the press as the “Unwatering SWAT Team.” In less than two weeks, this team pumped an estimated 275 million gallons of seawater from the major tunnels under New York City.<sup>17</sup> Roger Less, chief of the Design Branch of the USACE Rock Island District, says New York City officials did an excellent job of vacating the tunnels prior to Sandy’s landfall, thereby addressing potential public safety issues while also minimizing water pollution that might have occurred from hydrocarbons escaping submerged vehicles.

### Long-Term Considerations

Of the long-term health threats posed by Sandy, the most significant is mold growth in homes that were not properly remediated after flooding. Indoor exposure to mold has been linked to upper respiratory tract symptoms, cough, and wheeze in otherwise healthy people, and with exacerbation of symptoms in people with asthma.<sup>19</sup> To rid a flooded house of mold, all wet furnishings and building materials composed in whole or in part of cellulose fiber—including wood flooring and wallboard—must be demolished and removed from the house. Wood framing must then be scrubbed free of mold with a detergent solution and dried using dehumidifiers and blowers before

## A Window of Opportunity Improving Energy Efficiency in Sandy’s Wake

Hurricane Sandy is estimated to have damaged more than 375,000 homes, many of which have been gutted to remove water-damaged building components. This situation, anguishing as it is to homeowners, presents a unique opportunity to upgrade the energy efficiency of these buildings.

Improving energy efficiency will not only reduce energy consumption but also reduce greenhouse gas emissions involved in producing that energy.<sup>29</sup>

Because of uncertainties regarding new FEMA regulations for flood insurance, many homeowners have yet to begin reconstruction of damaged or destroyed houses. However building and insulation contractors are reporting that of those who have begun work, many are choosing to add energy-efficient components.

“Of my clients who are rebuilding, most seem to be upgrading energy efficiency,” says John Pierciey, a custom home builder in New Jersey. “As long as you’re going to [rebuild], you might as well do it right.”

Pierciey says the most popular improvements are closed-cell foam insulation sprayed into wall cavities and under floors, and high-efficiency gas furnaces to replace older furnaces destroyed by floodwaters. According to the U.S. Department of Energy, closed cell foam has a higher insulating value (R-value) per inch than fiberglass,<sup>30</sup> and contractors claim that, properly installed, it is more effective at blocking air flow. Furthermore, it has a perm rating of 0.89, which effectively makes it a vapor barrier.<sup>31</sup> Installed in the floor, it can seal off the living area from moisture in the crawlspace.



**A home in Old Bridge Township, New Jersey, is stripped to the framing for cleanup and repairs.**  
© Frank Conlon/Star-Ledger/Corbis

reconstruction begins. Nonporous surfaces affected by floodwater containing sewage can be cleaned with a dilute bleach solution, but Bill Sothern, a certified industrial hygienist with the firm Microecologies, says bleach should not be used on wood.

Following Sandy, an army of contractors and volunteers descended on the flood zones to offer their services in demolition and mold remediation. Interviews with volunteer groups and contractors for this article suggest that most workers were instructed to use respirators when working in these spaces. However, Sothern observed that many workers chose not to follow this recommendation. More significantly, he says, not all mold was removed in these remediation efforts, which could present problems down the road.

Sothern says virtually every one of the 200 flood-damaged homes his company examined prior to remediation had substantial levels of visible mold growth on the underlying structural wood components (studs/sills), which was

revealed when the wet wallboard was removed. Similarly, mold growth on the top and bottom sides of subflooring and on the underlying structural floor joists is a ubiquitous problem. Removing structural components is very expensive, not to mention impractical to perform in the cold of a Northeast winter, and thus has not been common practice for homes flooded by Sandy, according to Sothern. Even if the mold is cleaned from the accessible surfaces, that means some moldy material is bound to remain.

“Under the best of circumstances, if the moldy wood is cleaned and dried out before rebuilding, there will still be mold left in the inaccessible wood-to-wood interfaces,” Sothern says. “And in many cases we know that the homes are being rebuilt without either properly cleaning or drying out the affected wood.”

The impact of these scenarios on airborne mold levels is not well understood, so Sothern—who is also a doctoral candidate at the City University of New York School

of Public Health—and a team at the university have designed a study to examine these associations. The Respiratory Health Effects and Exposure to Mold study would inspect 300 homes in the Rockaways and collect data on visible mold growth conditions, moisture conditions, remediation/rebuild status, and airborne mold levels, and interface these data with the responses to a respiratory health questionnaire. As of this writing, the study has yet to be funded.

“The associations that are found to exist between the environmental conditions and the respiratory health conditions will answer many questions that can help to inform best practices for effectively remediating mold growth on structural wood that frequently occurs as a result of flooding,” Sothorn says.

Ongoing measurements of mold in New Jersey homes are being conducted by a team of environmental health experts from Rutgers University, including Lioy and Buckley of EOHSI, Joan Bennett of

the Office for the Promotion of Women in Science, Engineering and Mathematics, and Gediminas Mainelis of the School of Environmental and Biological Sciences. They have been sampling mold levels in storm-damaged houses before, during, and after remediation to determine the effectiveness of cleanup procedures. Given the varying salinity of floodwaters that impacted homes—salt, brackish, and fresh—the team is eager to see what different types of mold appear as a result. They are also eager to discover how the long lapse in time between remediation (mostly done in the winter of 2012–2013) and reconstruction (just now beginning) has on the reappearance of mold.

“After structures undergo repairs, how will residents know if two to three months later there will be no mold regrowth or residual chemicals present?” Lioy says. “There is no program for postrepair testing. It comes down to residents making an assumption that it is safe to live in their house.”

## Resilience

On Interstate 95, just north of Newark Liberty International Airport, there is an electronic billboard that flashes one word—“RESILIENCE.” Repeated in countless conversations, newspaper, and magazine articles about the storm, the word refers to the goal to build back after the storm in a way that will enable New Yorkers and New Jerseyites to better survive future storms.

Scientists debate whether or not Sandy was caused, or at least worsened, by climate change,<sup>19</sup> but there is little debate that sea levels are rising along the Atlantic seaboard. In 2012 researchers from the U.S. Geological Survey reported that sea level along the 600-mile stretch from Cape Hatteras, North Carolina, to Boston, Massachusetts, rose by 1.97–3.80 mm per year since 1990, or three to four times the global average. Extrapolating from these data, the researchers estimated that sea level along this “hot spot” could rise 20–29 cm between 1990 and 2100.<sup>20</sup>

In the face of this evidence, some argue that humans must retreat from the shoreline or face repeated death and destruction. New York governor Andrew Cuomo has asked the state to allocate \$400 million to buy out homes wrecked by Sandy, demolish them, and restore the land as undeveloped coastline. As of this writing, that bill had not passed. New Jersey has a buyout program known as Blue Acres, targeted to flood-prone properties across the state, funded at between \$12 million and \$50 million per year.<sup>21</sup> In addition to using Blue Acres funds, Governor Christie has committed at least \$250 million in federal Hazard Mitigation Grant Program<sup>22</sup> dollars to buy out properties affected by Hurricane Sandy.

In January 2013 President Barack Obama signed into law the Disaster Relief Appropriations Act, which provides \$16 billion in Community Development Block Grant Disaster Relief funds to repair and restore areas affected by Hurricane Sandy. New York City has submitted to the Department of Housing and Urban Development its Partial Action Plan A, which divides the city’s initial allocation of \$1.77 billion among housing recovery, business recovery, infrastructure and other city services, and increased resilience against future disasters in the neighborhoods hardest hit by Hurricane Sandy.<sup>23</sup> New Jersey has submitted a proposal that focuses its initial allocation of \$1.83 billion on reconstruction, rehabilitation, and elevation of damaged homes, and on supporting businesses in damaged communities through grants, loans, and a tourism marketing campaign.<sup>24</sup>

In the meantime, communities along the Jersey shore and Long Island are building



**A family in Union Beach, New Jersey, cleans up a room in their home, 18 November 2012. Union Beach is a tiny borough—just 2,600 houses, 85% of which were flooded by Hurricane Sandy. The town is also coping with the loss of four firehouses, four fire trucks, an ambulance squad, and 14 police cars, plus the flooding of a K–8 school.<sup>32</sup> In this and many other Jersey shore towns, where permanent populations usually number less than 10,000, locally available resources have been overwhelmed; support from county and state governments, plus volunteers, is essential to response and recovery.**

© Aristide Economopoulos/Star-Ledger/Corbis

or rebuilding dune systems to lessen the impact of future storms. FEMA has drawn up new floodplain maps and established new Base Flood Elevations that call for homes in these areas to be elevated 8 feet above the floodplain.<sup>25</sup> However, the cost of meeting these requirements and confusion about how local governments will interpret them is causing many homeowners to hold off on rebuilding.

“The small town organization that defines the Jersey shore is both a blessing and a curse,” says Buckley. “Each town had its own unique flooding situation—some ocean-driven, some river, some lake, and some mixed. These hazards are being addressed locally by people who understand the local geography and are eager to help each other as best they can, neighbor to neighbor. Unfortunately, they need more help. The mayor of a town of two thousand residents does not have the same resources or carry the same weight as a mayor of a city of eight million.”

For densely populated shoreline communities, many of which are dominated by apartment buildings, it may be unrealistic to think that owners will either abandon their buildings in significant numbers or raise them 8 feet in the air. Hoboken mayor Dawn Zimmer wants federal agencies to

pay for “a more universal solution”—building permanent walls around those parts of the city where storm surge is likely to come from. Zimmer also wants the city to be able to disconnect from the electrical grid when power goes out and transfer to its own minigrig powered by a mix of diesel, solar, wind, and natural gas.<sup>26</sup>

In short, there are no easy solutions to dealing with sea level rise and storms in the New York metropolitan area. In the meantime, the focus remains on getting people back into their homes and apartments, restoring businesses and community infrastructure, and opening beaches to the summer tourists.

**John Manuel** of Durham, NC, is a regular contributor to *EHP* and the author of *The Natural Traveler along North Carolina's Coast and The Canoeist*.

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## Mental Health Considerations

### The Unseen Effects of Disaster

Hurricane Sandy weakened what was already considered to be a fragile mental health care system in New York City. Before Sandy hit, metro area hospitals were already struggling to meet the demand for mental health care. After the storm, the numbers of people seeking care jumped dramatically, while the ability to treat them dropped. Storm surge knocked out several of the city's largest psychiatric hospitals, disrupted outpatient services, and flooded scores of nursing homes (including several in the Rockaways) where many mentally ill people had found housing of last resort.<sup>33</sup>

According to *The New York Times*, Beth Israel Medical Center in Lower Manhattan saw a 69% increase in psychiatric patients in November, far more than it could handle. Maimonides Medical Center, in Brooklyn, reported a 56% increase in psychiatric emergency room visits in the month following the storm. Clergy for churches in New Brighton reported mentally ill people showing up at church rectories begging for socks and underwear.<sup>33</sup>

“The dominoes start falling backwards,” Yves Ades, chief operating officer of the nonprofit Services for the UnderServed, told the *Times* regarding the effects of the storm on the area's mental health system. “It was always a strained system, but it was functioning. Now, it's breaking.”<sup>33</sup>

In response to the widespread mental anguish caused by Sandy, FEMA and other organizations have set up crisis hotlines that people can call to get counseling. FEMA also funded Project Hope, a crisis counseling program of the New York State Office of Mental Health that serves residents in New York City and four other counties. Programwide, Project Hope has hired, trained, and deployed 669 crisis counselors, 371 of whom work in the areas impacted by Sandy, to provide emotional support, education, counseling (individual, group, and family), and group public education, according to program spokeswoman Caroline Burwell. As of March 15, approximately 107,000 New Yorkers have been reached by Project Hope. Burwell adds that LIFENET is a confidential 24-hour referral hotline (1-800-LIFENET) that has been contracted to match Hurricane Sandy victims with a Project Hope provider agency in their community.

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By Christina Verni

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# A Hospital System's Response To A Hurricane Offers Lessons, Including The Need For Mandatory Interfacility Drills

**Christina Verni** (christina.verni@gmail.com) is an independent health and medical writer who has been working with the North Shore–Long Island Jewish Health System for nearly ten years, and a registered dietitian in Raleigh, North Carolina.

**ABSTRACT** This case study explores the lessons learned when the North Shore–Long Island Jewish Health System, a large, integrated health network in New York, evacuated three hospitals at high risk of flooding from Hurricane Irene in August 2011. The episode resulted in the evacuation, transport, and placement of 947 patients without any resulting deaths or serious injuries. This case demonstrates the utility of having in place a functional evacuation plan, such as the one North Shore–Long Island Jewish Health System developed through its own full-scale exercises in the years following Hurricane Katrina in 2005. In those drills, the health system discovered that it needed to abandon its 1:1 matching of patients to available beds in the region in favor of the group transport of patients with similar needs to facilities that could accommodate them. Despite its overall success, the system identified the need for internal improvements, including automated patient tracking through the use of bar-coded wristbands and identification and training of additional backup personnel for its emergency operations center. Among other changes, policy makers at the state and federal levels should consider mandating full-scale interfacility evacuation drills to refine mechanisms to send and receive patients.

**I**n August 2011 Hurricane Irene struck the southeast United States, moved northward along the coast from North Carolina, and came inland as a tropical storm in the Northeast. Because of the storm's massive size—it had a diameter of approximately 500 miles—strong winds and rain pummeled a broad area of the East Coast, causing an estimated \$15.8 billion in damage and becoming one of the nation's ten costliest storms on record.

For health care facilities in the region, the storm posed substantial challenges. The intent of this article is twofold: to share the experience of North Shore–Long Island Jewish Health System so that other health care facilities may benefit from it, and to identify policy changes that

will improve hospitals' ability to respond to emergencies. In particular, the hope is that leaders of similar institutions who read this article will be prompted to revisit their plans and consider instituting a new model for moving patients to predesignated facilities along the lines described below.

The North Shore–Long Island Jewish Health System is a large, integrated system headquartered in Great Neck, New York, with a service area of about seven million people in the New York metropolitan area. It is the third-largest nonprofit, secular health care system in the United States, as measured by its approximately 6,000 beds. It is the nation's sixteenth-largest integrated health care network and the largest in New York State. Additional description of the



system is provided in the online Appendix.<sup>1</sup>

The Joint Commission requires that hospitals and long-term care facilities, including systems like North Shore–Long Island Jewish Health System, have emergency operations plans in place that explain how the facility will evacuate patients either within or completely outside of the building. However, the Joint Commission does not require these institutions to conduct full-scale interfacility exercises to test the viability of the evacuation procedures.<sup>2–4</sup> Prior instances of extreme weather, such as Hurricane Katrina in 2005, drove home the need for facilities not only to have evacuation plans but also to test the feasibility of those plans.<sup>5</sup>

North Shore Long Island–Jewish Health System has sixteen hospitals (fifteen owned, one affiliated) throughout the New York metropolitan area. Three of these—Staten Island University Hospital’s north and south campuses and Southside Hospital in Bay Shore, located on Long Island’s south shore—are in flood-prone zones. North Shore–Long Island Jewish Health System also owns and operates the Center for Emergency Medical Services. The center is the largest hospital-based ambulance service in the New York metropolitan area and one of the largest in the nation. It has more than 500 emergency medical technicians and paramedics who operate about fifty response units, with a total fleet of approximately eighty-five ambulances. The center has unrestricted operating authority to work in the 2,200 square miles of New York City and Long Island, and it annually performs approximately 90,000 patient transports and responds to approximately 115,000 emergency calls. The center also has satellite- and computer-aided communications capabilities that operate around the clock.

When reports of Hurricane Irene first appeared, health system leaders knew that evacuating approximately 1,000 patients from the three hospitals located in flood-prone zones might become necessary. But because of the inherent risks of evacuating patients—especially the elderly, infants, and those requiring critical care—and because the three vulnerable hospitals were important resources within broader emergency response plans, the top priority was determining how to maintain occupancy and preserve patient safety. Evacuation would be a last resort: If it was pursued, system leaders expected the emergency medical network to be in heavy demand, transporting patients to alternative sites of care while continuing normal or increased operations, including responding to 911 emergency calls.

The health system’s Network Emergency Management Division began tracking the hurricane

as part of its normal daily operations. When the high probability of a Long Island landfall became clear on August 23, the health system’s administration activated emergency plans.

Irene was not deviating from its course, so on August 24, the administration opened its Emergency Operations Center at the Center for Emergency Medical Services headquarters in Syosset, New York, and began to evaluate evacuation plans for Southside Hospital and Staten Island University Hospital’s north and south campuses. It also instituted rapid discharge and surge planning at all of the hospitals it owns, sending as many patients home as it could with reasonable certainty of their safety so as to make room for patients who required continuing medical care after arriving from evacuating hospitals. The health system also began emergency leasing and purchasing of equipment and supplies, and it upgraded employee advisories to alerts, detailing personnel readiness actions outlined in its hurricane preparedness checklist.

On August 25, the City of New York issued a mandatory evacuation order for people in all low-lying coastal areas (Zone A) to evacuate by 8 p.m. EDT on August 27; the evacuation area included North Shore–Long Island Jewish Health System’s two Staten Island hospitals. On August 26, the health system leadership decided to proceed with the evacuation of the two Staten Island hospitals as well as Southside Hospital. Elective admissions and surgeries at all other system hospitals were cancelled through August 30 to free up beds for transferred patients. In the late afternoon of August 26, with updated weather information, the City of New York expanded the evacuation order into the next level (Zone B) and moved the deadline up to 5 p.m. EDT on August 27.

### Evacuation Plan Background

Prior to Hurricane Katrina in 2005, North Shore–Long Island Jewish Health System’s evacuation plan had never been tested with a real-life emergency or even a full-scale exercise. In the years following Katrina, emergency management personnel implemented a testing plan involving the actual movement of simulated patients. The evacuation plan was predicated on the notion that staff would identify an empty bed in an appropriate unit at an alternative site for each patient who had to be relocated, and the patient would then be transported to that facility.

After North Shore–Long Island Jewish Health System’s first full-scale exercise in 2006, emergency management leaders discovered that its plan of matching patients to appropriate beds in a 1:1 fashion was not logistically viable in

the short time frame typical of an emergency. The identification process took too long, and the system fell short of appropriate bed counts. Transportation was also impractical with so many scattered delivery locations.

The team addressed shortcomings with patient triage that emerged during the 2006 drill and overhauled the plan. Instead of matching patients to beds on a 1:1 basis, hospitals were designated as receivers of specific types of patients, based on the clinical services each hospital provided and the expertise of its clinical staff. During an evacuation, groups of same-type patients would automatically go to a hospital designated to provide the clinical services required for those patients.

With this surge capacity model, each hospital would know in advance the types of patients it should prepare to receive and have beds, supplies, and staff ready for their arrival. For example, in the revised plan, tertiary hospitals would receive a surge of critical care patients, while community hospitals would receive a surge of general medical and surgical patients. Another full-scale exercise the following year confirmed that the revision was viable.

Between 2007 and Hurricane Irene in 2011, every facility in the health system conducted annual field tests of different components of the plan. Hospitals also took advantage of actual needs to move patients to drill staff on evacuation procedures. No further major changes to the evacuation plan were needed, although the drills did result in minor plan refinements.

It could not be determined whether North Shore–Long Island Jewish Health System's surge capacity model and abandonment of the 1:1 matching system was novel. Evacuation case studies published in the literature lack this level of detail about models and procedures used for identifying beds at receiving facilities.

North Shore–Long Island Jewish Health System emergency management leaders have been consulted by numerous outside institutions and, in the process, have reviewed others' evacuation plans. They report that many plans follow a 1:1 matching system and consider abandoning this system to be only a last resort. Because full-scale evacuation exercises are expensive (institutions must fund these on their own) and not required by the Joint Commission, many institutions will be largely unprepared and ill equipped to handle a complete evacuation in an emergency situation.

### Redesigned Plan Implemented During Irene

Using its redesigned plan, North Shore–Long

Island Jewish Health System safely evacuated and relocated all of its patients by midday August 27, approximately twelve hours prior to Irene's Northeast landfall. Patients were predominantly transported by advanced and basic life-support ambulances, ambulettes, and public and private buses, with a few transports by helicopter. Evacuated patients were tracked at each facility on a master list.

As patients were brought to the staging area and prepared for transport, a transport officer manually checked identification wristbands against charts and confirmed that the patient was about to be transported to the assigned facility and in the appropriate vehicle type. Updated master lists were periodically sent to the Emergency Operations Center for patient tracking purposes. A more detailed account is available in the online Appendix.<sup>1</sup>

A glitch in operations, not unusual in emergency situations, occurred within the City of New York that hampered evacuations of North Shore–Long Island Jewish Health System and other hospitals in the evacuating zones. The glitch was that the city fire department's Emergency Medical Services continued to transport emergency patients to hospitals that were already evacuating their patients to other facilities. Officials of North Shore–Long Island Jewish Health System and other hospitals in the evacuating zones were uncertain whether they were violating the federal Emergency Medical Treatment and Labor Act of 1986 when they immediately transferred the patients they had just received without first screening them. Under this law, any hospital participating in Medicare must medically screen and stabilize any patient it receives, regardless of the person's ability to pay, before it can transfer that patient.<sup>6</sup>

Nonevacuating health system hospitals not only received patient surges according to the evacuation plan, but they also housed many homebound people whose needs could not be met in a shelter, including mechanically ventilated people who feared the loss of power at their homes and walk-ins who simply sought safe haven from the storm. Those people were neither registered nor medically screened upon arrival at the hospital; they were brought to an appropriate area and left to attend to their own needs.

When one person developed symptoms and needed to be admitted to the intensive care unit, administrators were uncertain about whether the lack of a process for thoroughly screening walk-ins seeking shelter was a violation of the Emergency Medical Treatment and Labor Act. A June 2012 guidance from the Centers for Medicare and Medicaid Services (CMS) suggests that this was not a violation, but the agency does

recommend developing protocols for streamlined screening of people who do not seek emergency medical care.<sup>7</sup>

## Unexpected Events

Approximately ten hours prior to Irene's landfall in the Northeast, North Shore–Long Island Jewish Health System received a request from the New York State and Nassau County health departments to accept ninety-four evacuees from a nonsystem hospital and a nursing home in the coastal city of Long Beach, in Nassau County. North Shore–Long Island Jewish Health System planning and operations personnel immediately arranged for an affiliated hospital and an extended care facility that the system owns to receive the hospital and nursing home patients, respectively. Logistics personnel made arrangements to truck in extra beds borrowed from an unaffiliated, shuttered hospital.

Eight hours prior to Irene's Northeast landfall and four to five hours before emergency vehicles were scheduled to stop running because of concerns about road flooding and high-wind tipping hazards, North Shore–Long Island Jewish Health System responded to a request by New York State Health Commissioner Nirav Shah and the New York City Office of Emergency Management to evacuate an additional ninety patients from five nursing homes in coastal areas of Brooklyn and Queens. Using the system's ambulances and public and private buses, North Shore–Long Island Jewish Health System emergency medical technicians evacuated the patients in strong winds, heavy rain, and flooding and relocated them to appropriate facilities in a period of three to four hours.

Administrative challenges persisted. Communication issues between city agencies slowed the evacuation. Road closures enforced by the New York City Police Department delayed ambulances and transport buses until phone communications between health system administration and City of New York officials reached police radio dispatchers, after which city police provided escorts for patient-transport vehicles. One emergency city shelter would not accept patients until city health officials intervened.

## Outcome

In all, North Shore–Long Island Jewish Health System evacuated 947 patients to other health system and non-health system facilities, returned 284 patients to their originating hospitals after the storm, and accepted 245 evacuated patients from non-health system facilities. During the course of the evacuations, one behavioral

health patient became unstable and needed to be admitted to an acute care hospital rather than being transferred to another psychiatric facility. No deaths occurred.

In the weeks following Hurricane Irene, the health system conducted "hot washes"—retrospective reviews of what happened—at its corporate and facility sites, with each part of the system's command structure and each facility then filing reports to document, evaluate, and prioritize procedural and training needs arising from the experience.

## Cost Implications

Health system finance officers estimated the system's overall cost associated with Hurricane Irene to be \$13 million, with approximately \$4 million attributed to labor and supplies and \$9 million to revenue lost from three hospital closures; elective procedure cancellations spanning ninety-six hours (forty-eight hours before and after the storm); patient appointment cancellations; and reduced emergency visits. The health system received \$2.5 million from property casualty and business interruption insurance policy claims, and it is seeking reimbursement from the Federal Emergency Management Agency's Disaster Relief Fund.

## Discussion

**CRITICAL SUCCESS FACTORS** Health system leaders identified several key factors that contributed to their success in this effort. Four of the most prominent are presented below.

► **ESTABLISHED, TESTED, AND VIABLE EVACUATION PLAN:** The critical success factor was the existence of a plan that was practiced and refined through full-scale evacuation exercises. The original 1:1 methodology would have proved ineffective and slowed the entire evacuation effort, posing potential safety risks because patient transfers might not have been completed before Irene arrived. The alternative plan—group transfers of like patients—allowed all evacuations from the three North Shore–Long Island Jewish Health System hospitals to be completed within twenty-four hours, leaving sufficient time before the storm's landfall to fulfill all requests for assistance in evacuating nonsystem facilities.

► **INTEGRATED, COHESIVE NATURE OF THE HEALTH SYSTEM:** Despite its large size, the North Shore–Long Island Jewish Health System is tightly integrated across operational units, key clinical service lines, and, most important, corporate leadership. The Emergency Operations Center was staffed with high-level health system leaders authorized to make decisions on the

spot. They also knew when it was logical and critical to defer decision making in any given instance to leaders in the individual hospitals and other facilities who had the data and on-the-ground access to make the best decisions on issues affecting patient care.

► **PREPAREDNESS OF STAFF:** Low absenteeism among health care workers during the storm was attributed to an advisory by North Shore–Long Island Jewish Health System for employees to prepare themselves, their families, and even their pets according to a hurricane preparedness checklist adapted from the Department of Homeland Security’s national public service advertising campaign known as “Ready.” The hospital system mailed the advisory to all employees’ homes a few years earlier and kept it posted on the system’s intranet. See the online Appendix for topics covered in this checklist.<sup>1</sup> Knowing that their families were prepared and safe during the hurricane allowed health care workers to be physically and mentally present.

► **POSTDISASTER RECOVERY CHECKLIST:** North Shore–Long Island Jewish Health System developed a postdisaster recovery checklist in the days leading up to Hurricane Irene and provided it to the teams of structural engineers, facilities division leaders, and corporate safety officers at each evacuated facility to proactively survey the site for any damage and safety issues that would prohibit the hospital from reopening to patients. The checklist contained a total of sixty action items across key areas, including access, buildings, communications, equipment and supplies, facilities and engineering, infection control, ancillary services, security, patient care areas, and surgery and treatment areas.

Using the completed checklists as evidence of suitability for patient care, North Shore–Long Island Jewish Health System officials requested certification from the New York State Department of Health to reopen. Not only did the state grant the system permission to self-certify and resume operations, but the state adopted the system’s comprehensive checklist to certify the reopening of other evacuated health care facilities.

## Lessons Learned

Although largely successful, the health system used the poststorm evaluation exercises to identify several areas for improvement.

### IMPLEMENT ELECTRONIC HEALTH RECORDS

Although North Shore–Long Island Jewish Health System is already implementing a unified electronic health record system across all of its facilities, the initiative is not scheduled for completion until early 2014.

Staten Island University Hospital’s north and south campuses are currently using a paper system for medical records, with laboratory tests, x-rays, and pathology reports accessible electronically. Because of the advance notification of the storm, medical records staff had sufficient time to print lab reports and send both the lab reports and medical charts with patients as they moved from one hospital to the other. Although no problems stemming from the reliance on paper records occurred, there was a risk that the medical charts could have been lost or misplaced, jeopardizing patient safety. For any emergency in which the advance warning time frame is shorter or nonexistent, electronic health records will be key to maintaining continuity of care and patient safety.

► **INSTITUTE BAR-CODED WRISTBANDS** Similarly, the reliance on manual tracking measures posed a logistical obstacle to staff as they evacuated hundreds of patients, transported many to other facilities, and then arranged for their return. To avoid confusion in the future, the health system plans to expedite its implementation of bar-coded patient wristbands, not just for emergencies but for routine use as well. Establishing a better patient identification system will not only help staff track patients during emergencies but will also improve overall patient safety efforts, such as those targeting medication errors.

► **IMPROVE RELIEF COVERAGE IN THE EMERGENCY OPERATIONS CENTER** Health system leaders are working to identify additional management coverage for the system’s Emergency Operations Center, ensure in-depth training for those providing relief coverage, improve the rotation schedule, and stagger shift changes so that decision makers can get enough rest to prevent fatigue and impaired decision making. Throughout the weather emergency, some staff positions in the operations center had only one backup, so shifts lasted twelve or more hours—too long for optimal performance in such an intense and fast-paced environment.

### IMPROVE DESIGN OF FLOOD-PRONE FACILITIES

During any new construction and renovations, the health system will be moving information technology, power generators, and critical patient service areas, such as radiology, above ground level, with electrical systems built from the top down rather than the bottom up. Heating, ventilation, and air-conditioning systems also need to be designed with connections to backup power supplies to maintain heating and cooling during hurricanes, blizzards, and other weather emergencies.

► **IMPROVE EMPLOYEE COMMUNICATION** Early and repeated communication with patients and their families kept them informed, calm,

and cooperative. Yet mass communication with employees, which included updates on weather and road conditions, could have been more frequent before and during the event. Employee calls into the operations center strained the already stretched and weary staff. The health system is increasing the scope and use of its employee mass communication system for severe weather and other emergencies in the future.

#### **ESTABLISH LABOR POOL FOR EMERGENCIES**

Among the health system's 43,000-plus employees is a corporate staff in the thousands, many of whom are also health care professionals. In early 2011, several months prior to Hurricane Irene, the health system started surveying all employees—collecting detailed information on all licenses and certifications—to better use people's skills during emergencies. In preparation for Hurricane Irene, human resources leadership used outside staffing agencies to supplement workforces where needed. Although the need was minimal, it could have been reduced or eliminated had labor pools of existing employees been fully established.

### **Implications For Federal, State, And Local Policy**

Several policy implications and recommendations arose from the Hurricane Irene experience. The first is a recommendation that federal or state governments require regional interfacility evacuation drills to prepare for storms. Although the Joint Commission currently requires accredited facilities to have emergency plans in place, it does not require them to conduct full-scale interfacility exercises to test the viability of the evacuation component of those plans.<sup>2-4</sup> For optimal effectiveness, evacuation drills must involve the participation of sending and receiving facilities. Furthermore, the drills must be full scale, not "tabletop" simulations. Individual facilities should not conduct evacuation exercises on their own; planning among hospitals and regulatory agencies is essential.

The second policy implication is inherent in a question that remains in the aftermath of the storm: Who has ultimate authority to call for the mandatory evacuation of nursing homes and other nonhospital health care facilities? Had state and local agencies established the lines of authority from the start, delays in decision making would not have jeopardized patient safety during the transfer of frail, elderly nursing home residents in strong winds, rain, and flooding.

An additional question involves a hospital's obligation to shelter nonhospital patients. Granting entry to walk-ins carries ethical and

legal implications, including the hospital's obligation to register and medically screen them under the Emergency Medical Treatment and Labor Act. This is of particular interest in this case study because one person who arrived as a walk-in to a health system hospital ended up requiring medical attention.

Furthermore, as described earlier in this article, there were concerns about potential legal violations involving patients who were not medically screened when they were brought via ambulance to the emergency departments of evacuating hospitals and then immediately transferred. Although CMS issued related guidance in June 2012 in a question-and-answer format,<sup>7</sup> Congress should clarify the policy in a future amendment to the Emergency Medical Treatment and Labor Act.

The fourth implication is that CMS should consider allowing exceptions to penalties imposed on facilities that readmit patients within thirty days of discharge; the exceptions would be for hospitals that release patients during a rapid discharge process stemming from an evacuation. Thirty-day readmission rates for North Shore–Long Island Jewish Health System's hospitals were not appreciably changed by the evacuation event, so the system was unaffected. However, evacuating institutions could be considerably affected in the future because reimbursement penalties for all institutions are scheduled to take effect by the end of the 2012 hurricane season.

Finally, there is a need to establish procedures at the state level for health systems to certify that an evacuated health care facility is ready to accept patients again. North Shore–Long Island Jewish Health System's postdisaster recovery checklist serves as a good model from which to develop the standards to support such a policy.

### **Interagency Coordination After The Storm**

In the months following Irene, North Shore–Long Island Jewish Health System participated in meetings facilitated by the state health department that involved county, city, and state representatives. The meetings—which focused on emergency communication and coordination, lessons learned, and best practices—resulted in four major improvements by the end of 2011. These were the development of the Long Island Patient Evacuation Transfer Form; the Job Action Tool; the Long Island Asset List; and the revised Sea, Lake, and Overland Surge from Hurricanes (SLOSH) Model Maps.

**PATIENT EVACUATION TRANSFER FORM** This new form, to be used by all hospitals and nursing homes on Long Island, includes a standard set of

information that will accompany an evacuated patient in lieu of a complete medical record. Although backup information may also be sent with any given patient, this form eliminates a facility's need to copy entire medical records during evacuation situations.

**JOB ACTION TOOL** This tool includes a checklist of tasks and responsibilities for people assigned to a regional command center during an emergency incident. This role is typically fulfilled by a staff member from the county health department. However, that is not always the case, and consistency and clear direction for this position were needed.

**ASSET LIST** Hospitals and counties on Long Island were unaware of each other's assets—such as particulate filtering respirator masks, ventilators, wheelchairs, blood pressure cuffs, and disposable linens—which made it difficult to share resources during emergencies. Each county now has comprehensive asset lists so that facilities can quickly identify the most likely source of surplus equipment and supplies that they may need during an emergency.

**REVISED SLOSH MODEL MAPS** Developed by the Federal Emergency Management Agency, these maps show areas at risk of flooding based on hurricane category level. Participants at the multi-agency meetings revised the SLOSH model maps to make them more useful to health care and emergency management organizations. The maps now include the locations of hospitals, nursing homes, dialysis centers, ambulatory care centers, and adult homes. Facilities are color coded by type, and the maps also include facility names and bed counts.

## Conclusion

The challenges posed by incidents such as Hurricane Irene should not be understated. Extreme weather events are increasing in number and intensity in all regions of the country. A study described in a white paper from the White House Office of Science and Technology Policy indicated that it is very likely that large-scale changes in climate have influenced, and will continue to influence, many different types of

extreme events, such as heavy rainfall, heat waves, and flooding.

The National Oceanic and Atmospheric Agency labeled 2011 the “year of extreme weather,” reporting twelve extreme weather events in the United States that each caused at least \$1 billion in damages. The previous record was nine, set in 2008. Globally, extreme events have steadily risen over the last twenty years, with the number of meteorological and hydrological events each tripling in that time.<sup>8,9</sup>

In addition to weather-induced incidents, the potential also exists for a public health crisis stemming from pandemics, weapons of mass destruction, and other man-made or natural disasters. Such possibilities are always a threat in the New York area, a reality underscored by the September 11, 2001, terrorist attacks. The people overseeing hospitals and other health care facilities recognize that they are first-line responders during a large-scale emergency, and despite elaborate disaster planning and routine drills, nothing can replicate real-life scenarios.

For North Shore–Long Island Jewish Health System and other regional health care providers, as well as local and state emergency responders, Hurricane Irene provided invaluable lessons on how emergency preparedness and response efforts can be improved. For North Shore–Long Island Jewish Health System, specifically, the system's performance validated the importance of the meticulous emergency planning efforts that have been ongoing for more than a decade.

The most important takeaway lesson from Hurricane Irene is that the best preparation for a successful emergency evacuation is to have a functional plan in place ahead of time—one that has been both tested and refined until emergency management experts are confident of its viability. Effective interagency coordination and communication among local, state, and regional organizations is also vital to the success of large-scale evacuations. Finally, acknowledging and closing gaps in local, state, and federal policies that become apparent only during real-world situations is critical to progress. ■

This article and its online Appendix are drawn in large part from primary research interviews with North Shore–Long Island Jewish Health System corporate and hospital leaders who participated in the actual events depicted in the case study. The author

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## NOTES

- 1 To access the Appendix, click on the Appendix link in the box to the right of the article online.
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## ABOUT THE AUTHOR: CHRISTINA VERNI



**Christina Verni** is an independent health and medical writer and registered dietitian.

In this month's *Health Affairs*, Christina Verni reports on lessons learned when the North Shore–Long Island Jewish Health System, a large, integrated health network in New York, evacuated three hospitals at high risk of flooding from Hurricane Irene in August 2011. Although 947 patients were successfully evacuated without any deaths or serious injuries, the

system identified the need for internal improvements, such as automated patient tracking through the use of bar-coded wristbands. The author also recommends some changes in federal and state policy, including mandating full-scale interfacility evacuation drills so that hospitals can refine mechanisms to send and receive patients.

Verni is an independent health and medical writer who has been working with the North Shore–Long Island Jewish Health System for nearly ten years. In this capacity, she has written articles and other communications about health care and medical research for both the system's employees and the general public. She

previously worked on global and national public health communication projects in Washington, D.C., with the Department of Health and Human Services, White House policy offices, and international public health organizations.

Verni, who is also a registered dietitian, served on the editorial board of *Pulse*, a sports and wellness publication of the Academy of Nutrition and Dietetics. She is the coauthor of a 2007 book on fertility and twinning. She received a bachelor's degree in nutritional sciences from Cornell University and a master's degree in journalism from Indiana University.

a hospital is forced to halt, it's not just the patients who are evacuated.

Everyone is justly proud of the remarkable feat that occurred during the hurricane. The selfless and seamless cooperation among clinicians, administrators, staff members, facilities workers, National Guard troops, and emergency of-

ficials was nothing short of extraordinary. Every single patient was safely and smoothly transferred. Repair crews are working feverishly to repair the damage, and we expect to have some of the Bellevue clinics running within a few weeks. But it is hard to restrain our heartache at seeing this grande dame of hospitals

drained of its lifeblood of medical activity.

Disclosure forms provided by the author are available with the full text of this article at NEJM.org.

From New York University School of Medicine and Bellevue Hospital, New York.

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## Facing Uncertainty — Dispatch from Beth Israel Medical Center, Manhattan

Sushrut Jangi, M.D.

Around 9 p.m. on October 29, 2012, the bright lights at Manhattan's Beth Israel Medical Center flickered and went out. Dr. Harris Nagler, hospital president, stepped out onto 16th Street to find every building around him in shadow. "I remember feeling a kind of awe," he says, "that despite all of the complex variables, meteorologists predicted this almost to the minute, and there it was in front of us, happening." Hurricane Sandy, one of the largest Atlantic hurricanes on record, had arrived. A few blocks away, New York Downtown Hospital and the Manhattan VA Medical Center had been evacuated, and New York University (NYU) Langone Medical Center and Bellevue Hospital were on high alert.

Coming back inside, Nagler found the corridors dim. Like the other hospitals nearby, Beth Israel had fallen off the electrical grid. Fortunately, the generators had come online. "We were outside of Zone A, farther away from the river than everyone else" (see map). Ordinarily, Beth Israel was a 900-bed teaching hospital serving the West and East Village and parts of Gramercy, Chelsea, and China-

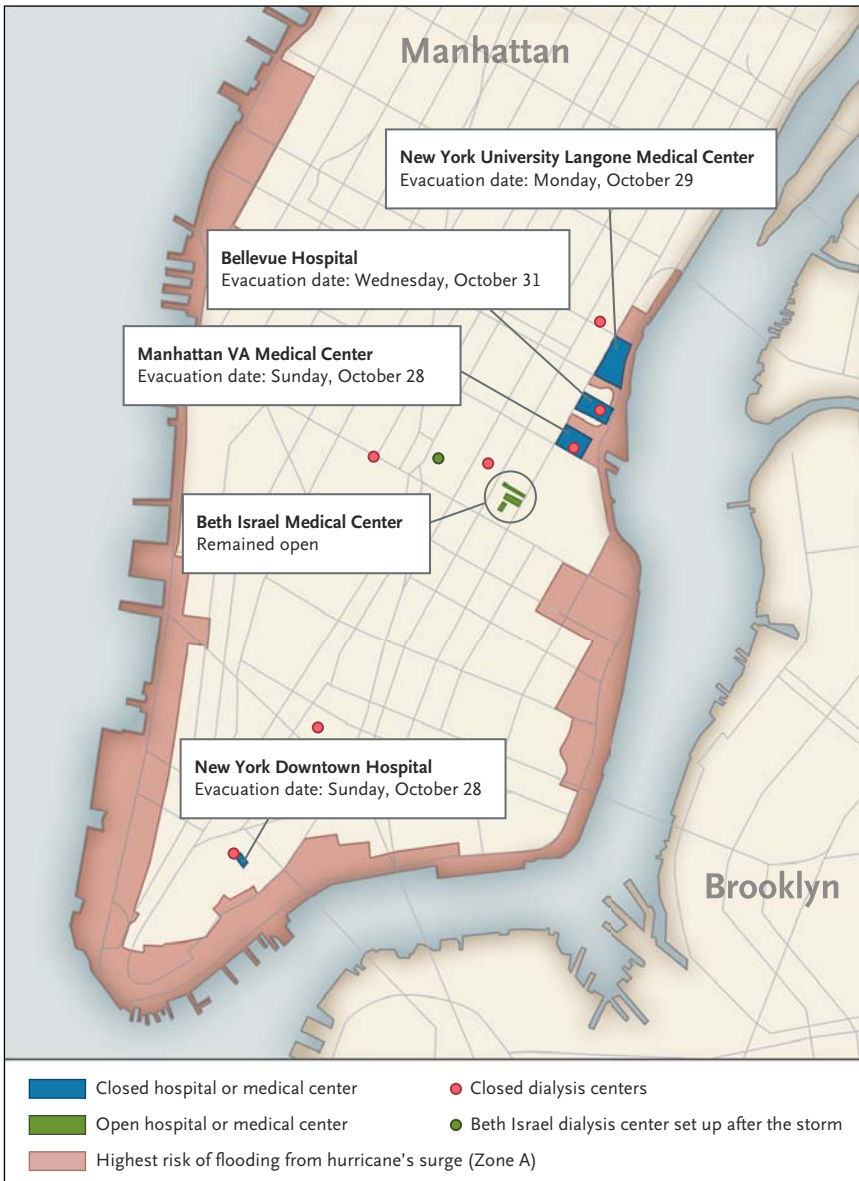
town. Now, communications from the Greater New York Hospital Association brought troubling news: NYU Langone and Bellevue were likely to evacuate. Beth Israel had become Lower Manhattan's only running major hospital.

In the emergency department (ED) downstairs, ED chairman Gregory Husk was unsettled. One of Beth Israel's towers had lost generator power; the building housed a maternity ward and a geriatric psychiatric facility, and transfers to St. Luke's were being considered. The emergency bays, for now, were quiet. But Husk knew that the sicker patients always came later. He had worked in this ED through a litany of disasters — the first World Trade Center attack, September 11, a 2003 blackout, Hurricane Irene, and now this. "We learn something from each disaster," he says, "but no two are ever the same." Each event has its own moving parts, requiring fresh ingenuity. "At first, patients couldn't get here," he said. "Landlines and cell phones were out, so they couldn't call 911." A flooded subway and an off-line bus fleet meant the transportation network had vanished. But by Halloween

night, nearly all ambulances serving Lower Manhattan were dispatched to Beth Israel.

Husk was unsure what kinds of patients he would see. On September 11, he remembers an ED with enough staff to trip over — but the anticipated flood of patients never came. This time, on October 31, the ED reached double its normal volume. One hundred more ambulances than usual began arriving each day. "Bellevue is a Level 1 trauma center, but mysteriously, even with Bellevue closed, traumas didn't increase," Husk said. What they saw, in large numbers, were patients who had lost power and relied on electricity for essential health services. "Folks had run out of oxygen, failed nebulization, were ventilator-dependent, or had missed multiple dialysis sessions." Lacking these services, patients presented with shortness of breath, asthma exacerbations, and life-threatening hyperkalemia (see graph). Others presented with carbon monoxide poisoning from trying to heat their homes with kitchen stoves. Elderly patients stranded in apartments on high floors with no functioning elevators or who had lost access to





### Hospitals and Dialysis Centers in Lower Manhattan.

their home health aides were carried down darkened stairwells on stretchers and brought to the ED. With nearby pharmacies closed and refrigeration capacity lost, many patients arrived seeking prescriptions for essential medicines. At one point, with 27 patients in the ED awaiting dialysis, Husk knew it was time to innovate.

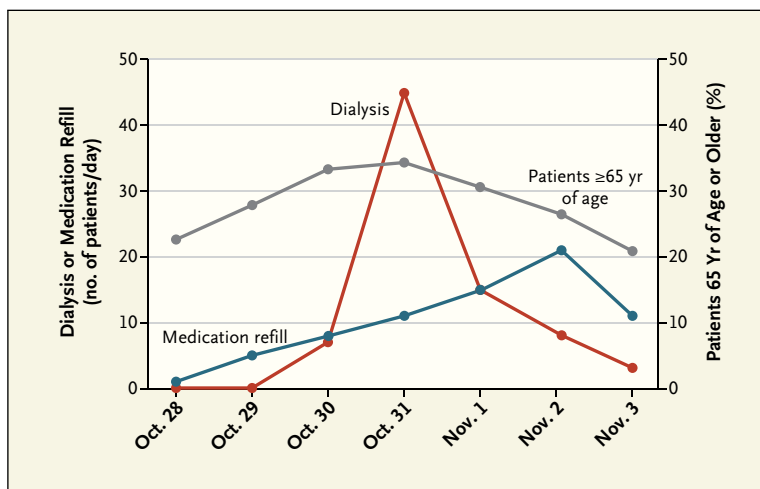
He called in nephrologist James Winchester and his team to pur-

sue an unusual plan. All seven dialysis units in Lower Manhattan had lost power; they had no light, no working phones, and no way to run reverse-osmosis units. "These patients were very frightened," said Winchester. "For the first time in their lives, they couldn't turn on dialysis." So Beth Israel transformed its ED. A medical student stationed near triage collected stat potassiums with a blood gas machine. A physician

assistant shuttled results to the nephrology team. "Patients who had potassiums above 5.8 got immediate Kayexalate, insulin, and glucose," said Winchester. "If [their potassium] didn't come down, they were triaged into the hospital for dialysis." To save time, patients in renal failure were pulled in groups into the "grieving room," where emergency physicians usually give bad news. The staff conducted group interviews to ensure that patients with critically elevated lab values were safely triaged. Meanwhile, two generators inched through gridlocked streets, taking 4 hours to come from 88th Street to the outpatient dialysis unit nearby. A lack of medical records, language interpreters, and information on patients' viral status complicated matters. At one point, dialysis patients were coming into the ED every 3 minutes. Amazingly, the cadre of nephrologists camped in the ED, a makeshift triage protocol, and the salvaged dialysis unit turned the hospital into an effective dialysis provider for all of Lower Manhattan.

On the wards, chief medical resident Reza Samad was also improvising. The command center had opened a new medical ward, and housestaff on ambulatory rotations were called in to help. "We had psychiatry residents serving as medical interns," Samad said. Housestaff were everywhere, answering phones, doubling as custodians, secretaries, and cooks. Surgeons were transformed into medicine ward attendings, managing asthma exacerbations. Primary care physicians who hadn't been on the wards in years were running teams.

"Then we went off the grid. We lost the paging system and the intercom," Samad said. "So we came up with a spontaneous



Distribution of Patients in Beth Israel's Emergency Department after Hurricane Sandy.

network.” Since the Wi-Fi was still working, residents downloaded a telephony app onto their phones and used it to send urgent text messages. At one point, the system brought several residents together for a code in a dark room. By the glow of headlamps and bobbing flashlights, a resident began resuscitation while others prepared to place a central catheter. While Samad tried to sustain morale, duty-hour limits were no longer top priority — though the influx of outpatient providers helped residents get some rest. Like the boundaries defining a resident, a medicine ward attending, a housekeeper, a surgeon, and a social worker, the lines defining work shifts had blurred.

Nagler recalls that when he first became Beth Israel's president, he “got on the subway one morning and was thrust against the front of the subway car, pushed against the window by the crowd, and the view in front of me was pitch black except for the gleam of the tracks.” He remembers this image every time he faces the unexpected, hopeful he will find a path forward. When I visited the hospital 5 days after Sandy, the lights were back on, but in a sense Nagler still felt like he was on that subway, hurtling toward an uncertain destination. Many nearby hospitals remain closed, and high volumes continue. And even after this crisis ends, another unpredictable event is bound to occur, and whether

it's a hurricane, a terrorist attack, or an infectious disease outbreak, it will pose its own obstacles.

As Manhattan works to repair itself, local clinicians find that part of their job is to evolve under duress, trying to provide good care under dynamic circumstances. One NYU hospitalist, lacking patients in her own hospital, visits evacuated patients at their new facilities, bridging gaps in the medical record. She is navigating a foreign landscape, but most health care professionals will encounter such unfamiliar terrain sometime during their careers.

Nagler returns to his musing on meteorology. The weather and medicine are similar in many ways, he remarks, both full of complex variables that produce unpredictable outcomes. But the hospital managed to meet such outcomes with creative and rapid solutions. Nagler looks out the window onto 16th Street. The sun has emerged, briefly, over Manhattan, and somewhere nearby an ambulance siren wails.

Disclosure forms provided by the author are available with the full text of this article at NEJM.org.

Dr. Jangi is an editorial fellow at the *Journal* and a hospitalist at Beth Israel Deaconess Medical Center in Boston.

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## Lessons from Sandy — Preparing Health Systems for Future Disasters

Irwin Redlener, M.D., and Michael J. Reilly, Dr.P.H., M.P.H.

Within hours after Hurricane Sandy's landfall, doctors and staff at one of New York City's premier medical centers realized that something was go-

ing terribly wrong. Lights were flickering, critical devices essential to life support for more than 200 patients, many in intensive care units, were malfunctioning.

A decision had to be made by hospital leaders, senior public health officials, and emergency responders: tough it out in a hospital without power or attempt a perilous

# Disaster Resilience and People with Functional Needs

Sophia Jan, M.D., M.S.H.P., and Nicole Lurie, M.D., M.S.P.H.

When Hurricane Sandy pummeled the northeast and mid-Atlantic states in October, uprooting trees and causing massive flooding, at least three large hospitals were forced to evacuate after emergency generators failed. Governors of 10 states declared emergencies and requested federal aid. As in the super derecho that swept through the Midwest and mid-Atlantic 4 months earlier, millions of residents were left without power.

One alarming consequence of these storms was their effect on residents with functional needs — those who are dependent on home nursing, personal care attendants, or electric medical technologies. Some residents depend on the electrical grid for refrigerating critical medications or for powering lifesaving medical equipment. Many residents, particularly those requiring ongoing respiratory care, streamed into emergency rooms to receive respiratory treatments, refill oxygen tanks, or recharge batteries. Some residents whose medical needs had not escalated but who needed to recharge medical equipment were turned away from shelters whose operators believed their needs could not be met in a general shelter.

Through initiatives launched under the Affordable Care Act, our health care system will increasingly enable the 54.4 million Americans with functional needs to remain in their homes and social environments.<sup>1</sup> Experts in disaster preparedness highlight the need to build community disaster resilience and reduce long-term vulnerability.<sup>2</sup> They also empha-

size that having strong systems in place for day-to-day use is essential for dealing with emergency situations.<sup>3</sup> With or without a major emergency, the ability of people with functional needs to remain in their community setting depends on a stable electrical grid and a resilient system of service agencies, such as home health and hospice care agencies, personal care assistants, and suppliers of medical equipment. Numerous reports highlight the vulnerability of our physical and social infrastructure<sup>4,5</sup>; some key policies can help to strengthen them.

The first strategy for building community resilience for people with functional needs is to continue to support the development of health information systems. For example, in 2011, using incentive payments authorized under the Health Information Technology for Economic and Clinical Health (HITECH) Act, St. John's Regional Medical Center in Joplin, Missouri, converted to electronic health records. Three weeks later, a tornado severely damaged the hospital and forced it to evacuate. Yet dispersed patients continued to obtain prescriptions and receive scheduled treatments because their electronic health records remained accessible.

Residents with functional needs also have frequent engagement with nursing homes, independent living facilities, home health agencies, and suppliers of durable medical equipment, many of which continue to rely on paper medical records and forms. Supporting the development of interoperable electronic records for use

among these agencies will not only allow them to obtain critical information in the event of a power outage, but also enhance routine coordination of care for people with functional needs.

Like smart phones and tablets, which have revolutionized the way people with disabilities communicate, new technologies can also substantially enhance quality of life for residents with functional needs, and they can be lifesaving in the event of a disaster, particularly for residents who cannot easily be moved. Through “innovation challenges” — which can leverage open innovation and the public's broad knowledge to solve a defined problem — public and private organizations can support the development of technologies that contribute to resilience. Such technologies might include alternative power sources (e.g., manual cranks or batteries powered by human waste) for critical medical equipment, safer home generators, and signaling devices enabled by global positioning systems, which can let medical-equipment suppliers or emergency responders know when critical medical supplies or battery backups are running low.

Supporting the development of technologies that enhance social connectedness, which has been shown to improve survival during disasters, can also contribute to community resilience. One such effort is the Lifeline Facebook Application Challenge, sponsored by the Office of the Assistant Secretary for Preparedness and Response of the Department of Health and Human Services, which leverages social media by

asking friends to check in on each other and provide assistance in the event of a disaster, formalizing these roles and responsibilities through a Facebook app.

Another way federal, state, and local municipalities can build community resilience is to invite residents with functional needs to participate in the process of emergency preparedness and response planning and to view such residents as community assets rather than vulnerable populations or liabilities. San Francisco, for example, regularly partners with its Centers for Independent Living on planning for emergencies. The centers were created by people with disabilities and normally provide information and referral services, peer counseling, and training in skills for independent living. The city also integrated a position for a disability services coordinator into the structure of its Incident Command System, a tool for the command, control, and coordination of emergency response used by nearly all disaster-response agencies. The coordinator's role is to assess whether residents' functional needs are being met and to draw on the expertise and resources of the city's large Human Services Agency and its multiple community partners through activation of memorandums of understanding.

Central to building community resilience is the development of strong partnerships between government and nongovernmental organizations for planning, response, and recovery. Many states have established partnerships between emergency management teams and businesses to improve situational awareness and resource sharing. California has passed legislation requiring the

inclusion of private businesses in governmental disaster planning and has signed memorandums of understanding with organizations such as the California Grocers Association, the California Utilities Emergency Association, and Walmart to provide critical supplies and infrastructure during an emergency. The American Red Cross of New England partners with Unifit, a regional provider of natural gas and electricity, to issue joint messages about safety and preparedness. Such partnerships could be expanded to include providers of services for people with functional needs. By sharing data, states could use these partnerships to share and jointly maintain registries of people with functional needs, in order to help in setting priorities for emergency response and power-restoration efforts. Such data sharing may not only enhance the ability of emergency managers to provide critical supplies and services during emergencies, but also help to improve more routine coordination of the multiple services for these residents.

Finally, there are policies that states and the federal government could implement to promote community resilience with regard to people with functional needs. For example, government could promote more widespread adoption of both business-continuity plans for critical agencies and data sharing among agencies and emergency management and utility companies by including related provisions in both federal grant guidelines and publicly reported quality measures. States could use their licensure and certification processes to promote more widespread adoption of reliable emergency power sources by dialysis centers and acute and

long-term care facilities. Maintenance of emergency generators and related equipment could also be included as part of public-reporting and quality measures for hospitals and nursing homes. Some states have such requirements now — Maryland and Texas, for instance, require that dialysis centers have access to an emergency generator.

As more and more people with functional needs remain in their homes and other noninstitutional settings, the strategic development of technologies and policies that decrease our dependence on traditional power sources and enhance information sharing and inclusionary planning will help improve community resilience.

The views expressed in this article are those of the authors and do not necessarily represent those of the Department of Health and Human Services.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

From the Robert Wood Johnson Foundation Clinical Scholars Program, Departments of Medicine and Pediatrics, Perelman School of Medicine; and the Leonard Davis Institute of Health Economics, University of Pennsylvania; and PolicyLab, Children's Hospital of Philadelphia — all in Philadelphia (S.J.); and the Office of the Assistant Secretary for Preparedness and Response, Department of Health and Human Services, Washington, DC (N.L.).

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# **Identifying Disaster Medical and Public Health Research Priorities: Data needs arising in response to Hurricane Sandy**

November 16, 2012

New York Academy of Medicine  
1216 5th Avenue  
New York, NY 10029

## Meeting Objectives:

- Explore challenges faced during preparation, response, and recovery to Hurricane Sandy
- Identify gaps in knowledge that are impacting preparedness and response
- Develop a set of priorities for near term research, based on Hurricane Sandy and other recent disasters, that may inform future disaster preparedness, response, and recovery plans

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## **I. Statement of Need and Meeting Objectives**

### **NICOLE LURIE**

Assistant Secretary for Preparedness and Response  
Department of Health and Human Services

Dr. Lurie, Assistant Secretary for Preparedness and Response, explained that the impetus of the meeting comes from past events: realize not organized to do science in the midst of a crisis. During an event (like the hurricane), you can't see knowledge gaps, which if addressed could allow for better response in the future. We want to identify priorities for new knowledge in a timely basis, so that we're not in the same situation again. During Sandy, we are seeing knowledge gaps again. This meeting was organized in one week, thanks to Dr. Jo Ivey Boufford and staff at The New York Academy of Medicine and the Preparedness forum and staff at the Institute of Medicine. Some said, "we're still in the event; it's too soon." But felt that if you wait, it never gets done or gets done too late.

This meeting is not an after action review. The hope is that at the end there is a set of identified needs for new knowledge that have to be identified now or the opportunity will be missed. We want to come out of the process with identified needs and priorities. We have not yet identified funding, but have invited some local funders and have been talking to federal agencies. Researchers have already been looking for funding, but want to prioritize needs before money is distributed.

## II. Panel: Front Line Experiences – where there are data and research needs

### NIRAV SHAH

Commissioner of Health

New York

Dr. Shah framed his presentation in terms of his questions.

- How do you capture the resiliency of a community? We've seen different rates of recovery – has to do with who your neighbors are, pre-existing connections between people. This information can be used to identify what can be done (including things not directly related to health) to strengthen the resiliency of communities.
- What are the risks versus benefits of evacuation versus sheltering in place? There are real risks to evacuation but were not able to quantify them. Need to understand these types of risks.
- Don't know of anyone who died during evacuation but also don't know what happened after people were transferred (e.g. were there increased heart attacks?)
- How do you best support the workforce, especially those who were personally impacted? Working with large unions, helped managed somewhat during this storm. Need to understand implications of moving patients on the health care workforce – how do you relax regulations regarding certification/licensure so workers can work outside their home institution (can go where their patients are)
- What disaster-preparedness mandates are required? Who should be mandated to have generators? Should hospitals be required to buy their own gas stations.? Should every dialysis center have a generator (yes)?
- “Repatriation” – Nursing homes wanted their patients back when their generators were working, even though they were not yet on the grid and a snow storm was coming. When is it safe to return patients from hospitals to nursing homes? Hospitals need space (as some are closed). When should the system of transfers be unfrozen?
- There are complex systems problems around fuel. Even if the rule is first responders get access to fuel first, the question remains, “Who is a first responder?” Home health care workers ? Yes, think so. Or should transportation personnel and ConEd get fuel first, so they can fix roads and power.
- Out of crisis comes opportunity. Question: How do you take advantage of the situation to move people from nursing homes to lower levels of care, which would be the better option from the population health perspective? You have to make plans for the disaster, but you should also make plans for recovery. Should all the closed facilities be reopened?
- Dr. Shah thought that these types of events help to move towards population focused health, as opposed to healthcare. He asked how can we take advantage of crisis where people forget the politics and red tape and do things from population perspective?

- Wish we had guidelines regarding what rules you can throw out. For example, a facility can go over capacity, if stays at a level that is safe and there is appropriate staff. You can go from 100 to 120 - but some facilities went from 300 to 700 beds. Question: You do want to do everything you can to save lives, but how can you quantify levels at which safety is threatened?
- We need a plan in case there is a bad flu after an emergency. With every hospital in Manhattan above capacity, what would we do? We plan for the worst, but we do not plan for the worst on top of the worst.
- We can do better with social network technology. People want to help and can help. The Brooklyn Armory, through social networking sites, was able to get people hundreds of kosher meals to people that were staying there.
- Need to get laws changed regarding patient confidentiality. NYU patients were transferred to Columbia Presbyterian (which is good), but if the Columbia providers don't have access to the patient's records, that's a problem.

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## **MARY O'DOWD**

Commissioner of Health  
New Jersey

Dr. O'Dowd opened by endorsing Dr. Shah's points and commending him for his honesty.

- Prestorm: There are questions about where when and how the storm is going to hit, which impacted planning, decision making, and resource allocation. The information they were getting from the national weather service was changing. You can rely on the fact that reality is different from what's expected. A lot of effort goes into putting resources into areas you are expecting to be affected.
- Would like to know more about what it takes to evacuate, including the length of time and the risks involved. In NJ, the decisions are made by the facility administrator and local disaster preparedness person. Question: at what point should state override the locally made decisions? Can learn from the experience of NYU and from Palisades Medical Center, which also evacuated the morning after the storm.
- Need to know more about the internal capability of health care facilities. They knew what health care facilities were in the zone that was likely to be hit by Sandy, but they didn't know how they would deal with flooding.
- Need to know where were the home health dependent people are. Know where health facilities are, but don't know about all the people in the community who require power for medical devices and will be coming into the ER when they lose power.
- Gas was a real problem in NJ. What does it mean to be a first responder (with priority access to fuel)?
- Creation of "Medical Needs Shelters" represents a difficult decision in multiple ways. First, there is a lag time to set them up. Second, there was lack of clarity about need to know who was

coming and what they were presenting with. A lot of patients didn't want to go to them, because they were too far from their homes. Meanwhile, the people impacting the health care system and response were the people that were fine at home if they had power, but not without because they need oxygen (for example). NJ had a lot of medical staff at medical needs shelters waiting for patients to arrive, but the patients didn't come.

- Found that you can't segregate "Medical Needs" from general population in shelters. Question: Are we able to do a health care assessment in the shelters— to identify even those with general, chronic condition needs. Also need to identify people with a spectrum of mental health issues.
- Don't know the needs of staff, particularly among first responders. Not evaluating whether we are meeting or even recognizing the needs of first responders. Even the DOH people who are working through this, may also be victims.
- Need to know the significance of public health and environmental health issues. Don't know how much damage there has been to businesses and homes. Don't know how many people will not be able to fix their homes. People will not get assistance from FEMA for repair of second homes (there are a lot of these on the NJ shore). They might not have the money to do the repairs themselves.

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## **LEWIS GOLDFRANK**

Professor and Chair

Department of Emergency Medicine

New York University School of Medicine

- Three of the hospitals that closed in the storm (NYU, Bellevue and VA), in combination, had very high volume –maybe a million patients annually. Bellevue had maybe 2000 outpatient visits per day. All together they had maybe 500 ER visits per day. Since neighboring hospitals (St. Vincents and Cabrini) are permanently closed, these 3 hospitals had large increase in demand. Now with these hospitals closed, other hospitals will be overwhelmed.
- Bellevue had very specialized services , particularly with respect to mental health. These are not the kind of patients other hospitals will want.
- Questions:
  - How to increase ambulatory care and ER capacity at other hospitals to make up for the closure.
  - How to increase capacity elsewhere for daily outpatient services – dialysis, methadone, DOT for TB, etc.
  - How to maintain responsibility (and continuity) when sending your patients elsewhere for care?
  - How do you communicate when power, internet, and phone lines are down. How do you transfer electronic medical records without power. How do you read records without light?



- How do you redeploy providers? VA providers can go to another VA hospital and do the same job – for others it is hard to change institutions. Union membership and rules are reasons (but not the only reasons) for staff transition difficulties.
  - You can see an increase calls to 212-poison for carbon monoxide and gasoline poisoning after the storm.
  - Need other kinds of call centers (based on the poison call model) to provide information.
  - Need to augment public health surveillance.
- 

### **THOMAS FARLEY**

Commissioner of Health and Mental Hygiene  
New York City

- Haven't had too much of a chance to think yet, so these are spur of the moment thoughts. Feel like we have good data systems in NYC and feel we know about the current health status of residents, but don't have the real time data, which you need in an emergency.
- Syndromic surveillance from hospital ERs is very useful. Hospitals send a feed to DOH each day of what they saw the day before. After Sandy, ERs saw people overdue for dialysis – that was a big spike. Also saw a spike in hypothermia immediately after the storm – that was probably people that got wet. Later, there were just a few cases a day, even during the nor'easter. The greatest need was related to medication interruptions; people were coming into the ER to get a new prescription.
- In Coney Island and the Rockaways they were worried about elderly and others being stuck in high rises without power or transport, so sent out a team to knock on doors and check on residents. High rise building outreach efforts -> National Guard, paramedics and health dept staff doing door to door visits to assess medical needs (concerns due to loss of heat and power) and determine occupancy. In 6 days worked knocked on 36,000 doors. Found about 1/3 occupied. 36 people needed to be evacuated due to medical problems. They were worried that it would be a lot worse than that. Hard to generate data on what happened to people. Involved manual work, collecting information door to door.
- Trying to get a sense of health care services in affected areas. They're getting a lot of calls – a lot of people sick and there is not enough medical care. Providers are reporting that they are getting a lot of people calling for med refills. They are not hearing about a lot of health problems resulting from the storm.
- Would like to know how many people living in the Rockaway's now. Need real time information on electricity, power, water and other services available. Haven't been able to pool real time EHR data in affected areas.
- Have a lot of good data, but for anything that changes on a day to day basis, we need real time data and do not have good systems for that.

- Real time population denominators (e.g. how many people are occupying a given area). The population in affected areas changed after storm and the department doesn't know now what the percentages are without knowing an accurate denominator.

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## **IRWIN REDLENER**

Director, National Center for Disaster Preparedness

Professor of Clinical Population & Family Health, Mailman School of Public Health

Professor of Clinical Pediatrics, College of Physicians & Surgeons

- Issue of what falls under health needs in a disaster is complicated— food and gasoline become health necessities.
- Do need more information – thought whether it's for research, policy or practice is murky.
- Noted the extraordinary heroism in dealing with hospital evacuations.
- Initial response to Sandy was rapid. Federal government's response was very affective compared to Katrina. Government agencies tended to work very well as individual agencies. May need some better coordination between agencies. Do very well in surprise sub-crisis: even though evacuations happened, during the events the processes were really remarkable. Performance of people on the ground amazing.
- Need more information on infrastructure problems. There were surprisingly fragile hospital infrastructures. At NYU, it wasn't the generators that were the problem, but the fuel access for the generators. Seems like you could protect the fuel pumps.
- Evacuation of Zone A didn't work well. People didn't leave. There was fear of looting. People didn't want to take children to shelters, if the children had asthma. There were rational and irrational reasons for staying.
- Prolonged downtime of electrical services – becomes a health issues
- There were Supply chain problems (gas shortages, etc.)
- There were perceptions of erratic, random response by some voluntary agencies. People felt the deployment was not systematic. We need to know what didn't work and what to do about it.
- The disaster is not over. Environmental issues remain. There will be widespread mold. People are going back to houses that are soaking wet. The Gowanus canal overflowed – the water in it is very toxic. What will the impact of that be? You can't ignore the psychological trauma – particularly among the vulnerable, including children.
- There will be prolonged, unresolved instability for people. There will be instability in housing, school, and financial issues. There will be discontinuities in ambulatory care.

### Wishlist:

- Need more rigorous assessment of hospital infrastructure resilience – Need this information to make decisions about evacuation.
- Need to know why people did or did not evacuate. Need to understand the varying reasons, so as to plan differently

- Recommended a “health cluster strategy.” Whoever is on the ground in a community should be in the room together every morning to identify gaps and see how to fill them. There should be a decision-making process every morning until the crisis is resolved.
- Health and hospital workers do not feel prepared to deal with a disaster. They don’t know: will people even show up to work? If you know the reasons people might not show up, you can minimize the impact.
- Google has disaster mapping – shows services and needs. But, we didn’t have information on health care services and where they are every day.
- Want to have access to FEMA database describing who received services, because those are the people that we will want to track over time
- Would like more specific information about disaster case management capacity and effectiveness – need population surveys about perception of services
- Vulnerable populations – want to know: how well did we prepare for those that are medically fragile, homebound, have chronic medical conditions, are in the middle of treatment. Need to know how to locate and service them. A lot of people came for prescription refills but didn’t have all the details regarding their medications. How accessible are the medical records? Are they in the cloud or on a computer that got flooded?
- Need real partnerships between researchers and providers etc – this would be necessary for better results.

**ELIZABETH RYAN**

President & CEO

New Jersey Hospital Association

- In NJ – contact is with local offices of emergency management – some are better than others. Need to examine effectiveness of communication between health care providers and these offices.
- Fuel was the number one problem, number one reason for calls – staff couldn’t get to work to provide services. Needed a fuel plan. Question: should it be mandated that gas stations have generators?
- A few days after the storm, everyone ran out of oxygen, meds, etc. There were walking well coming into ER’s who just needed supplies. The medical shelters weren’t utilized enough.
- They were getting patients and providers from NYU and Bellevue. Some providers had admitting privileges at NJ hospitals. Taking on nurses was not a problem, but for physician assistants, licensing was a problem. Need to look at credentialing regarding disaster planning.
- Workforce issues: One of largest systems has 250 homeless employees.
- Tracking recovery necessary as many homes destroyed are second homes ineligible for FEMA reimbursement.
- Behavioral health issues were a challenge
- Tracking FEMA grants is a good idea, but that’s not everyone who is affected. Will have to track remediation in houses with a lot of mold.

**III. Discussant: Reflection Based on Previous Disaster Response and Recovery**

## DAVID LAKEY

Commissioner of Health

Texas

- Bringing lessons learned from involvement with numerous hurricanes.
- A common issue was nursing homes: their evacuation strategies failed. They all planned to evacuate to the same place and didn't realize that those places would be over capacity. There was an issue of coordination. While sheltering people in gymnasiums, there were thousands of empty nursing home beds elsewhere in the state. They didn't have information to know where the beds are. Or, there might have been payment issues regarding certain placements.
- Folks in medical needs shelters are very ill. Some were approaching 300 lbs., so you need different cots. Put case management in the shelters, so can move people as quickly as possible out of shelters. The people staying in shelters for a long time were the people that were homeless to start. You do want to get people out of the shelters - if they stay too long, bad things happen. Need policies in place – also need meds, medical equipment, etc.
- There are challenges in figuring out when to evacuate – because some patients are very vulnerable (like NICU patients), so evacuation is very risky.
- Compared to TX, in the Northeast you need to address problems regionally because multiple states are involved.
- Questions:
  - How do you deal with loss of level 1 trauma centers?
  - How to get information on what's going on at the local level? What are the immediate health needs?
- Through the CASPER Teams – (Community Assessment for Public Health Emergency Response) in partnership with CDC have started to go out into the community to get better awareness, but still in beginning stages.
- In TX, they've gotten better at getting people out before the storm. Where people died following Hurricane Ike, was in the clean up – there were chain saw injuries, poisonings from stoves used to get heat in the house. There were health problems from preventable causes after the storm. So, you need to get public health messages out to people (with warnings) after the storm.
- Dialysis centers were not prepared after Ike. They did not have capacity to provide all the needed service. When the dialysis centers go out, you have a short time to get services before bad things happen to patients. TX did mandate that dialysis centers have a generator or a hook up for immediate attachment of a generator, as well as a system for clean water.
- Mental health: first responders have mental health challenges. People are working 24/7, while also being victims of the storm.
- People with schizophrenia and major depression do not do well if their environment changes; they do not do well in shelter. Mental health providers now have in their contract what the expectations are around care in an emergency.
- People with substance abuse issues do not do well in shelters. They do not do well 2 days after losing their drug supply.

- TX had been very reliant on volunteers for services in an emergency, but is not anymore. A lot of people are willing, but if the volunteers are affected by the emergency they will not be able to assist. Now, TX has contracts with private sector services – with pharmacies, ambulances, companies spraying for mosquitoes.... Including many coming from out of state.
- Need to figure out why people do not evacuate. There are good reasons – e.g. asthma.
- Want to know well did the DMAT teams and FMS's meet your needs. Did they have capability to deal with obese individuals, individuals with chronic disease?
- In TX, people evacuated get sensor bands – even their pets have bands. That way you can track where people are and do not lose track of them.

#### **IV. Discussion/questions for panel**

- Were problems with communication between health care providers and shelters so the health care sector didn't know where their patients were.
- Are there differences in receipt of federal assistance by location and if so, why?
  - Dr. Shah response – felt that there was a push on the federal side to deploy things (DMAT) that were not needed and so would be distracting.
  - NYS OEM response: Had 4500 national guard and 7000 regular army on the ground. Had a number of DMATS – moved to where most needed. Still have some on the ground. FEMA has 4000 people on the ground. There was not one request to FEMA or HHS that was not met. Put staff where most needed – evacuating nursing homes, providing care to responders. Evacuated 27 nursing homes at the peak. Have not heard of any demands from hospitals and nursing homes that went unmet. Absolutely could have done things better but did well.
  - NJ response to the question: NJ had national guard at the table from the beginning. NJ had a large area – 4 different counties. There is a challenge, when do you ask for federal resources? You need to understand what they can do and what they require. Need to have power and water to bring in some federal resources, so couldn't accept them. Feel that there needs to be a mini-size version of services, to better meet needs. A better understanding of what these resources can and cannot do, would help to make decisions.

## V. Identifying Research Priorities: Breakout Discussions

Charge: Identify research questions that need to be deployed now or the opportunity will be lost. Focus on improved health outcomes.

### Research Area 1: Health care facilities preparedness-infrastructure and plans

#### **Research Priorities Identified:**

1. Why did things fail in healthcare organizations, where were the near-misses and what was done to prevent them, and how did decisions impact functioning? (*Group = High Priority*)
2. What criteria inform decision-making on evacuation? (*Group = Low Priority*)
3. What is the relationship between hazard vulnerability assessments and how well a healthcare organization functioned? (*Group = Low Priority*)
4. What are the interdependencies among key components of the socio-technical system? (*Group = Low Priority*)

#### **Discussion:**

1. **Why did things fail in healthcare organizations; where were the near-misses and what was done to prevent them; and how did the decisions made impact the functioning of the facilities?**

The group thought that the issue of near-misses was not something that is usually considered, but could provide fruitful information for future response. This should be examined now while people's memories are fresh.

2. **What criteria should inform decision-making on evacuation?**

The group thought research should be done now on the outcomes of the evacuations to inform future decision-making.

3. **What is the relationship between hazard vulnerability assessments and how well healthcare organizations functioned?**

Each healthcare organization does its own HVA. Is there a correlation between the HVA and how well an organization fared? For example, if one organization rated flooding as more likely/serious, were they better prepared and did they have better outcomes?

4. **What are the interdependencies of the key components of the socio-technical system?**

Systems research should be done to better understand how the different pieces of the system are related, and how failures in particular components in turn caused other components to fail. Some group members noted the unexpected ways in which this happened: e.g., the generator was moved upstairs, but having a non-waterproof fuel pump in the basement still turned out to be a critical issue that triggered failure in multiple other components of the system.

## **Research Area 8: Evacuation and on-boarding of patient populations**

### **Research Priorities Identified:**

1. How were decisions made to: (*Group = High Priority*)
  - a. evacuate a health facility
  - b. prioritization of patient movement
  - c. what were the health outcomes of patients
  - d. what resource was used to move them → Transport and level of care during

Additional notes:

- Consider adding govt level decisions
  - Did decision makers use guidelines, tools, literature to assist them?
2. How did individuals decide to either evacuate or remain in their home? (*Group = High Priority*)
    - a. Influencing factors on decision (beliefs, recommendations by government, communities, etc)
    - b. Who left/who stayed
    - c. Who comprised shelter populations- did the shelter's resources meet population needs- including health outcomes of individuals?
  3. What tools were used to track patients? (*Group = High Priority*)
    - a. What technologies were used? By whom?
    - b. Where did we lose track of individual patients?
    - c. What databases/sources of information (including non-traditional eg social media) were available? How was it used?
    - d. What new tools/systems were developed during response? How were they used? Effective?

Additional note:

-Need data on patients AND people coming to recovery centers

### **Discussion:**

1. How were decisions made to evacuate and repatriate health facilities?
  - a. What data elements were used to guide the evacuation and repatriation of health facilities.
  - b. How were patient movements prioritized?
  - c. What are health outcomes of people that were evacuated?
  - d. How were they moved, what transportation resources were utilized.
    - i. Depending on when a patient was moved and how, what was their health outcome
2. At an individual level, who decided to stay in homes and who decided to evacuate and who decided to stay in a community?
  - a. Why were these decisions made? What factors influenced person/family's decisions?
  - b. What were demographics of people in each group (those that stayed and those that left)?
  - c. How well did resources match the needs at shelters?

- d. Who were in shelters? Where there were shelters, were they used and by whom?
- e. What did you need in shelter that you did not have
- 3. How was technology used to for health assessments and track patient movement?
  - a. Were any new tools developed that should be standardized for future responses?
  - b. Of the data collected, how did it correlate with predicted health outcomes?
  - c. Did the predictive models align with the distribution of individuals, especially those with special needs?
    - i. If not, how can the models be refined in the future be more predictive/accurate?
  - d. Who had access to the data and technologies? How can the data be better standardized to enable improved real-time situational awareness

## **Research Area 2: Mental and behavioral health**

### **Research Priorities Identified:**

1. What are the effective population based behavioral health “stealth” interventions (use quasi-experimental designs to evaluate) (*Group = High Priority*)
2. What are characteristics of resilient communities? How to predict, target, promote? (*Group = High Priority*)

### **Discussion:**

#### **1. What are the effective population based behavioral health “stealth” interventions (use quasi-experimental designs to evaluate)**

What are more effective ways of preventing MH effects?

Are there good behavioral health practices/interventions – population based?

- Data needs
  - population based data
  - Data on Mental Health utilization
- Mental Health recognition issues
  - Mental health recognition different in different communities
  - Need to recognize cultural and linguistic issues
  - Population surveys may be used to monitor PTSD & depression
  - ID ongoing MH issues – when doing physical assessments
- Displacement Issues
  - Effort to define who is displaced and what happened /outcomes
  - What are population based meanings of displacement
  - Populations displaced for longer time (based on geography)
  - Displacement is not only homes – also workplaces, schools, and major components of identity formation
- Providers/Training Interventions
  - Train lay crisis workers?
  - Train teachers & counselors to ID and intervene – do they work?



- Intervention Settings
  - How are schools being used?
  - Recovery centers – parent training modules – does that work?
  - MH support in shelters
    - Taskforce to help get people back into their communities
- 2. **What are characteristics of resilient communities? How to predict, target, promote?**
- Need to identify what increases resilience.
  - Resilience measures inform how to support those in need.
  - One study suggests that pre-event exposure may improve resiliency.
  - Can compare populations who prepare themselves (people experienced with Hurricanes) to those who didn't prepare themselves.

**Research Area 3: Health care worker issues (group expanded to include 1<sup>st</sup> responders/emergency managers)**

**Research Priorities Identified:**

1. Longitudinal tracking of individuals for effects of stress/perceived lack of support on mental health, substance abuse, attrition/career changes, home/family effects (*Group = High Priority*)
2. Evaluating workers' vulnerabilities (physical and mental) in relationship to tasks they are performing during/post crisis and exposures (environmental and mental stressors) (*Group = Low Priority*)
  - What are impacts on mental and physical health?
  - vulnerabilities including preexisting disease, pregnancy, SES, ethnic disparities
3. Are the health effects, data needs, analysis tools different for workers servicing underserved populations vs general populations (*Group = No Priority*)
4. What factors support resilience of workers? how can we use knowledge of these factors to improve resilience of workers? (*Group = No Priority*)
  - family support/status
  - previous disaster experiences and training
  - financial security

**Discussion:**

1. **Longitudinal tracking of individuals for effects of stress/perceived lack of support on mental health, substance abuse, attrition/career changes, home/family effects**

- Lots of burnout/stress in workers at baseline. Increases during disasters. What are long-term consequences on workforce (people leaving profession or changing jobs)? What about effects on individuals (substance abuse, mental health, family life)
- Tools that can be used now? Surveys? Who to target (hospitals, EMS, nursing services, mobile health units)
- Displaced health trainees (residents and fellows) -> impact on education?

## **2. Evaluating workers' vulnerabilities (physical and mental), tasks they are performing during/post crisis, exposures (environmental and mental stressors)**

- Understanding needs of ancillary staff (e.g. clerks, janitors)
  - less likely to report to work during a crisis.
  - No fuel rationed to ancillary staff!
- Assessing physical and mental health effects experienced by workers. Need to know:
  - Worker vulnerabilities (preexisting conditions – asthma, pregnancy, mental health issues)
  - What tasks are workers performing?
  - What are the environmental conditions they're working in? What are they being exposed to?

## **3. Are the health effects, data needs, analysis tools different for workers servicing underserved populations vs general populations**

- How are workers servicing underserved populations different from those servicing the general population? Different stressors? Are there different data needs for these two groups?

### **Research Area 4: Surveillance: epidemiology and situational awareness**

#### **Research Priorities Identified:**

1. Shorten environmental threats- through surveys and data mining can we compare validity of information coming in through surveillance systems? (*Group = Low Priority*)
2. Look at social media strategies compared to other surveillance- what is seen as necessary and what ends up as background noise? (*Group = High Priority*)
3. Is there some kind of system (eg website) that can be set up after an event to receive and filter information from groups responding and providing care on the ground? (*Group = Low Priority*)

#### **Discussion:**

### **1. Shorten environmental threats- through surveys and data mining can we compare validity of information coming in through different surveillance systems?**

- Real-time information needs
  - Syndromic surveillance from ED coming in can provide great situational awareness

- Daily Rx fills – can track different things
  - CASPER teams can be deployed to go in and track events/issues (when no power) but going door to door takes tremendous resources
  - Assess costs of different methods of tracking/surveillance
  - Does imbalance of landlines vs. cell phones skew data?
  - Using cell phone activity to track storm lead up
- 2. Look at social media strategies compared to other surveillance- what is seen as necessary and what ends up as background noise?**
- Where is social media useful for surveillance?

**Research Area 5: Provision of services to populations impacted AND Preparedness among and impact on disadvantaged populations**

[Note: This group’s “flip chart” was not legible to participants (who therefore did not prioritize any of its issues) nor a clear reflection of the discussion. It is included for completeness but table notes should be used as source.

**Research Priorities Identified:**

**Assumption:** need to shift frame (for a lot of people) that focuses on institutions and facilities as data sources because 1. People are getting services at home and community not in hospitals primarily 2. Urge to “shelter in place” or with family. What info to collect now because it will be less valid/reliable later.

1. Substance (*Group = No Priority*)
  - a. Current, past, future, intended location
  - b. Factors affecting location areas- broad decision making
  - c. Social networks
  - d. Current/past health and function/outcomes short- long term
  - e. Immediate stressors
  - f. Cohort willingness
2. Who collects/what do we have already? (*Group = No Priority*)
3. How do we coordinate the data? What worked well- best practice (*Group = No Priority*)

**Discussion:**

Data collection from individuals and community providers necessary because people get services at home and chose to shelter in place or with family.

**1. Substance**

- To focus on the question of immediate information needs: what is the health care use of patients from the 3 closed hospitals – where are the patients going, where are they getting care?

- In emergency preparedness – haven't acknowledged transition in the health care system. Assumptions around facility needs, not around the needs of people. The health care system is moving out of an institutional care model, but we're still thinking about hospital generators.
- Simple needs assessment questions would add some rigor to the impressions about the systems that get interrupted (oxygen, dialysis)
  - Question: How to help people that have medical needs that require power – refrigeration, oxygen, ice.
  - Question: should landlords with x% seniors be mandated to have some emergency preparedness.
- Again mentioned that it is important to understand why people didn't evacuate. And to find the people that are not getting services, even in an emergency.
  - How do people make decisions about evacuation, how do they make decisions about where to go?
  - This was considered a question for now: people will be able to talk about how they made the decision – also might be more willing to talk. Later, they might not be available. Also, it might be easier to find people while they are displaced and seeking services.
  - The NJ experience about people not going to medical shelters because of where they are located is telling.
  - There has been so much attention to facilities, and that's critical. But the horror stories are around people that stayed home. People that died are primarily older people. People want to find their families. They don't want to leave them. On the other hand, a lot of vulnerable populations might be detached from family. They might lack family connections.
  - Suggested that there is a lot to learn from the people contacted as part of emergency response. One thing you see is that the urge to go back to home is very strong. Should find out: what are their familial connections, medical connections, other supports (like meals on wheels – did they not leave because they thought it was coming).
- Another set of research question is about health care outcomes – e.g. pregnancy outcomes - whether high or low risk to start. Recommendation for developing a cohort to examine short term outcomes. Also short term outcomes for people with chronic conditions that might have had issues with medication access. With the ongoing syndromic surveillance there are a variety of disaster sensitive conditions to look at this, including heart attacks. Can look at outcomes later, but lose the opportunity to define the denominator... that's the part that has to be done now.
  - Single most significant long term issue for vulnerable populations – mental health issues.
    - Now collecting information on the immediate stress – will then be able to look at long term outcomes
- Recommendation: Social network analysis – to know who relies on family members, on providers. In the end, always focusing on the most isolated and vulnerable (in terms of identifying needs)
- Summary of questions:

1. How do people make the decisions that they did – what factors influenced decisions?
2. Where vulnerable populations before, where are they now, and where do they plan to go next?
3. What are the organizations that are best suited to identify at risk populations?
4. What makes a person vulnerable or at risk, including health status (things like weight, health conditions)? Who are the most at risk – and where do they live? What are the outcomes for the most vulnerable populations?
5. What are the social determinants of vulnerability? Can find the people with health risks, because they will come for health care. But, may not find the people who need food.
6. What do we need to know about the services people were accessing?
7. How do outcomes differ depending on where people started (i.e. in a facility or not)

## 2. Who collects/what do we have already?

- VNS has a large population and database and have been collecting information on all services provided. Will definitely do time series, case control comparing effected and non-affected areas. VNS has a very rich clinical and functional assessment so can look at outcomes. Biggest asset is that do have mobile workforce. Could use their workforce to collect data.
  - VNS patients are very vulnerable, - largely minority, a lot of HIV.
- This is one of the research questions –who is out of the system?
  - There are people not in the system now or ever – why?
  - Donors met with Commissioner for Aging in NYC. Talked about the fact that there are a lot of people who are not in the system that are frail and isolated. As soon as the family member who helps care for them can't get there – they have a problem. But no one knows about them. That's a longer term problem. Relevant distinction – those in the system and those not.
  - Right now, identifying people that are not in the system is occurring in the community, door to door. People are asking, who do you know in the community that's in need?
- The TX commissioner mentioned using contractors, including people from all over the country. It could be in the contract that are collecting and submitting data.
- Question: How does the Red Cross, FEMA, VNS, etc data hook together. FEMA has people looking at IT innovations now – for better integration. FEMA does link into 311, so they can find out where trees are down. Suggestion that whoever is going around, ask 4 -5 basic questions: Do you need medical care, oxygen, wheelchair, food? Do you have a doctor or nurse you can call? FEMA person at the table said that FEMA does collect that data – don't know what they are doing with it. Want to use the data to change the outcomes in the future.

## 3. How do we coordinate the data? What worked well- best practice

- The public housing population is very vulnerable. There is a lack of coordination of information regarding their needs. A doctor in this group (MS) went through, doing door-to-door visits. He

felt it would have been great to have had a handheld device to send data to the cloud. They were hearing that there was another group of doctors coming through before or after this group.

- there are systems in place for data collection, but the issue is getting them integrated so the information is usable.
- Need to consider: “How immediate does the data collection need to be for reliability?” Don’t want to add to anyone’s burden unnecessarily now.
  - We’ve already missed the opportunity to collect data from door to door visits.
- Much of the data is available (or not). Hard to link housing data to health data (all the data collected by all the different systems).
- EMT data is probably the best data available – recorded during an event.

## **Research Area 6: Long term recovery**

### **Research Priorities Identified:**

1. Displacement/ Relocation (D/R) (*Group = High Priority*)
  - a. What are the health/mental health or well being /functional effects of different D/R strategies- which have the least?
  - b. How to maintain community social networks? Impact?
2. How do we rebuild smarter? (*Group = High Priority*)
  - a. “new normal” – disaster risk reduction
  - b. Decrease vulnerability
  - c. Increase accessibility
  - d. What indicators?
  - e. Needs of individual communities
3. What environmental health needs arise in long term recovery? (*Group = Low Priority*)

### **Discussion:**

#### **1. Displacement/ Relocation (D/R)**

- Group discussed people on Medicaid and public assistance. If they relocate to another state, they may lose their benefits. Need effective case management. Seems to be that a medical approach to case management is not always a good fit. What skill sets do case managers need?
- Group discussed the importance of social connections and how you keep those in place for those who are displaced.
- Which displacement strategies have the least adverse impact?

#### **2. How do we rebuild smarter?**

- What are we recovering towards? Opportunities to reduce vulnerability in the future

- Group talked about what is the new state? How do you embed smart thinking moving forward?
  - How can we ensure accessibility for the whole community? Build in physical, programmatic, communication accessibility. Can make the community stronger and make system changes
  - There is a difficulty with the conversation—are we talking about the situation in NY or whatever community is/can be affected. Also noted that there were 4 or 6 communities affected with different capacities but the response was geographical. There are different populations involved (some who rely on public housing, some with second homes). Question- What do we need to know about the neighborhoods to be able to put a plan in place? It is not enough to assume geography. Group discussed having a tailored recovery program
  - Group also discussed the question of do we rebuild homes intended for summer inhabitants but were rehabed for permanence (may not have been the most suitable for permanent inhabitation)? There are some ethical questions involved
  - Also have to think about what are the needs and preferences of the affected people?
  - We do not have continuous data collection processes. Need to prepare ourselves as we will see more of this in the future. A lot of data is held in nongovernmental agencies and small CBOs. In NYC,7 “restore centers” were set up by the Mayor last week. Can look into setting up a research component.
    - Mentioned there is a National Preparedness Goal set by Pres Obama a year ago. How do we, as a part of the research at the recovery stage, connect it to the President’s goal?
  - Group discussed a need to define research ethics to help people right now. Also, there are ethics of research and ethics of long term recovery. There is a need to capture ephemeral data.
- 3. What environmental health needs arise in long term recovery?**
- How do you address environmental health needs of people in recovery (issues of mold, debris, toxic releases)

### **Research Area 7: Risk communications including social media**

#### **Research Priorities Identified:**

1. Evacuation Decision-Making (*Group = High Priority*)
  - a. Primary info sources
  - b. Personal experience of past events
  - c. Rank influences

- d. What would you do differently
- 2. Who is the community influencer? (*Group = No Priority*)
  - a. Message- what would influence you next time?
  - b. Expectations

**Discussion:**

**1. Evacuation and Decision Making**

- Risk communication needs to be informed by beliefs and perceptions - Need to understand basic notions of decision making especially under pressure
- Data to improve messaging
  - Need to Survey impacted populations
  - Map out where people didn't evacuate
  - Examine nature of decisions; evidence; deviation; risk assessment
  - Communication influence -> decision making process
    - What were the primary information sources
    - Influencers; ranking?
- Immediate Questions
  - Who are the evacuees/non-evacuees
  - What are the reasons preventing people
  - What are message people did/didn't receive?
  - Information sources?
  - Role of personal/past experiences in making decisions, particularly evacuation decision; other preparations (i.e. Irene – false alarm effect)
  - Rank of influences
    - Influence for evacuation/decisions
  - What would do differently
- Perceptions of vulnerability
- Perception of needs and resources
  - Medical needs shelter
  - Family needs and preferences
- Evacuation and decision making in life & death scenarios
  - perceptions of evacuated pop; impacted pops; general pops
  - (have not zeroed in on other specific health outcomes)
- Policies and rules for risk assessments and communication models by agencies and how they align with lay people's own models
  - Policies related to risk assessment models differ from lay people's own model including cases of emergency
  - Agency models also differ with each other

**2. Who is the community influencer? - Sources of information**

- Need for communications in most dire situation



- Access?
  - access to social media – there is a divide
- Utilization patterns?
- Messengers?
  - Primary source of info
  - Trust - Most trusted sources of info/influencers
    - Who do communities look to
    - Social network connection
      - Ex: barbershop; stores; neighbors
  - Spokesperson(s)
  - Mass media influences/criticisms
- Future targets for messaging
  - Who should be targeted for information
  - Targets to be messengers
    - Who in community can shape behaviors
- Assess social media usage
  - Where/who/content
  - Do not know if Twitter and Facebook analysis being done by others
  - What is the reliability of information on social media
    - Who can verify/manage social media info Real-time?
  - Use of social media by government?
- Language/cultural competency – factor for sources of info

### 3. Messaging

- What is the message – real/perceived
  - How were messages interpreted
  - Message choices in scenarios of conflicting or unclear information
- What was the content of the message
  - Language; semantics?
- Expectations
- Katrina messaging trends in media/forecasting present
- Community resiliency assessment can inform messaging
- Elements of communication
  - Knowledge generation
  - Dissemination
  - Quantity; clusters
- Types of messages
  - Technical; formal/informal; celebrity spokesperson; government; personal experiences
- Prospective Research/Study (down the road) on how people make decisions in disasters
  - Prospective analysis
    - Establish comparison groups
    - Give participants prospective scenarios

- Need baseline data of how decisions made by lay people
  - Set up conditions, including emergency conditions
  - Across age populations
- Data needs
  - Rich, qualitative data across populations
    - Can also quantify
  - Interviews (telephone)
  - Give scenarios for participants to think through

## **VI. Report Back and Discussion with Attendees: Missing Topics**

- Research on social and community networks
- How best to use NGO and private funding that comes in after a disaster
- What is the impact of hospital preparedness exercises? What did people learn from exercises? Do they help hospitals in an actual emergency?
- Are people being moved into more restrictive environments (data collection that needs to be done now)
- Evaluating the impact of contributions by individuals and philanthropy. Need to know the role and how it might be influenced in the future
- Psychological trauma on the healthcare workforce – important because if severe will lose people
- Need to address research ethics – don't want to slow down urgent needs but needs to be addressed up front
- What are the spontaneous self organizing networks – where did they get the resources, how did they put them in place.
- People off the grid, now may surface because of the emergency situation. Opportunity to learn from them.
- Generate comparisons among similar populations (socioeconomic, ethnicity)
- What happens in political office regarding decisions about who gets help. We don't know how those decisions made. Getting oral history of political decision making
- Physical and environmental factors that affected community resilience
- How did people who are dependent on power fare – e.g. those with motorized wheelchairs

### Common themes and primary areas across groups

- Evacuation decisions – factors impacting decisions, including role of social and family networks
- Measuring and identifying resilience
- Will lose track of people who have been evacuated and displaced – if not done now, will lose track of them.

## **VII. Discussion: Next Steps - N. Lurie**

- Need to think more about knowledge transfer and needed policy (e.g. mandated generators for types of institutions)
- Need to focus on immediate needs for baseline data

- Need to think about getting data to evaluate natural experiments/interventions
- Next steps – work on summary & will send out to people
- ID viable funding sources (rapid funding mechanisms that can be put in place)
- Will have a national IRB in place for health emergencies (although don't know how it will coordinate with local IRBs)

#### **VIII. Participants: Wrap-up Thoughts**

- Although it is important to focus on the immediate needs, long term research needs also need to be discussed, including data available.
- FEMA needs to give people access to data they are collecting, although there are lots of privacy and other issues.
- Need to have a meeting similar to this one to get the public's input on similar questions.
- For all these people that want data – should coordinate so that not asking similar questions over and over again.
- Journal of Urban Health will have a special issue on this.
- NLM is trying to make sure that information is available (through pubmed and elsewhere) so that people can use it for best practices
- NLurie: Will be looking at other venues to continue the discussion



**NYC**

# Hurricane Sandy After Action

Report and Recommendations  
to Mayor Michael R. Bloomberg

May 2013

Deputy Mayor Linda I. Gibbs, Co-Chair  
Deputy Mayor Caswell F. Holloway, Co-Chair

# General and Healthcare Facility Evacuations

## By the Numbers

- There are approximately 99,000 buildings in the Hurricane Sandy surge zone housing 405,000 residential units and more than 1 million people.
- 26 NYCHA developments – home to more than 45,000 residents – are in Hurricane Evacuation Zone A.
- There are 6 acute-care hospitals, 1 psychiatric hospital, 22 nursing homes, and 18 adult care facilities in Zone A.

Mayor Bloomberg issued a mandatory evacuation of Coastal Storm Plan Evacuation Zone A, including neighborhoods added following Hurricane Irene, on October 28 in response to revised storm surge projections from the National Weather Service. Only the second general population evacuation in the City's history, the evacuation order required 375,000 New Yorkers to leave their homes and communities in advance of the storm. Many residents of Zone A heeded the evacuation order and left. However, thousands of people did not leave the evacuation zone; tragically, 43 New Yorkers lost their lives to the storm.

Healthcare facilities are regulated by New York State, and the State Department of Health and the City Department of Health and Mental Hygiene (DOHMH) worked side-by-side in the Healthcare Evacuation Center at OEM in the days before the storm to prepare healthcare facilities for anticipated storm

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<sup>3</sup> See 10 NYCRR § 711.3(e)(3) (providing that if a health facility is located in a flood plain, the State health commissioner may require the facility to comply with various requirements, including that the health facility is “designed and capable of providing services necessary to maintain the life and safety of patients and staff if floodwaters reach the one-hundred year flood crest level,” and that the facility include “[e]lectrical service, emergency power supply, heating, ventilating and sterilizers”). See also id. §§ 713-1.10(c) (generator requirements); 713-2.22(h) (requirements for emergency electric services); and 405.24(g) (emergency and disaster preparedness requirements for hospitals).

<sup>4</sup> NYC Health Commissioner Dr. Thomas A. Farley explained this issue further at a recent City Council hearing:

In advance of Irene, all of the hospitals and most of the chronic care facilities in Zone A were evacuated, as instructed by myself [Commissioner Farley] and the State Health Commissioner [Nirav Shah, M.D., M.P.H.] In total, at least 7,000

impacts. State regulations require that hospitals and nursing homes have a backup power source to allow them to shelter in place and continue services in the event of an outage;<sup>3</sup> adult care facilities are not subject to these requirements. The decision to order a general evacuation of healthcare facilities to protect against the potential risks of an approaching storm (or for any reason) must be balanced against the inherent risks of the evacuation itself to vulnerable populations: regardless of whether the storm strikes, the act of evacuating hospital patients and elderly and infirm populations can exacerbate existing conditions and increase mortality rates among those evacuated.<sup>4</sup> These risks were a substantial consideration before Mayor Bloomberg ordered a general hospital evacuation in advance of Hurricane Irene, and while there were no deaths associated with healthcare evacuations in connection with that storm, the challenges posed by the evacuation were a focus of the City's after action review of Hurricane Irene storm response.

As Sandy approached, the City used the best available forecast data and instructed hospitals in Zone A to discharge those patients who could safely be discharged and to reschedule elective surgeries. New York Downtown Hospital, which is not in Zone A but was at a high risk of losing power, voluntarily evacuated before the storm. Patients at other hospitals in Zone A who could not be safely discharged were instructed to shelter in place, as were those in residential healthcare facilities. Sandy's unprecedented storm surge caused widespread power outages and flooding that ultimately compromised the ability of five hospitals and approximately 30 residential facilities to shelter in place throughout the storm and its aftermath. Those facilities were evacuated and patients and residents were taken to alternate locations, in some cases for extended periods. Although these large-scale evacuations were completed without patient fatalities, several improvements can be made to this component of storm response operations.

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people were evacuated from these facilities. While these evacuations were conducted safely, it was clear from our conversations with facility operators that they believed the evacuations put their patients at risk.

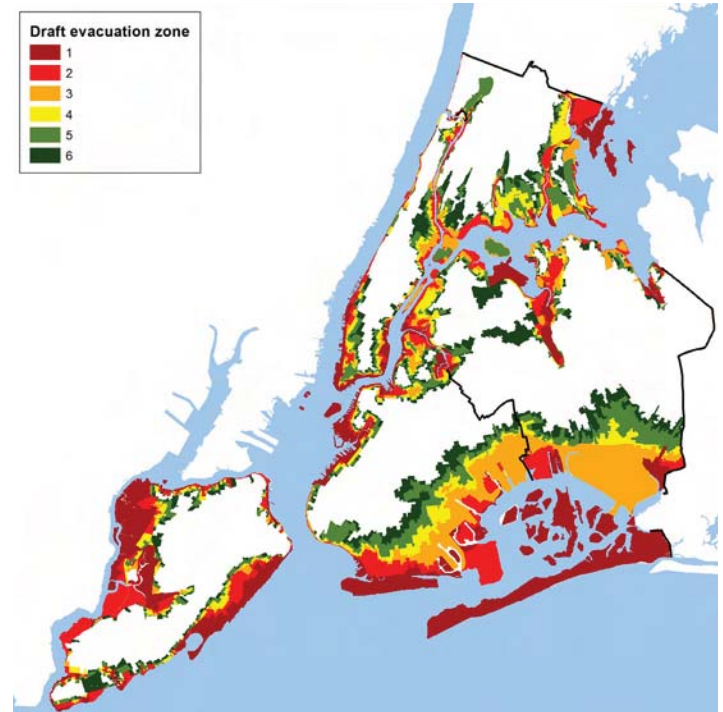
Emergency Planning and Management During and After the Storm: Emergency Preparedness and Response at the City's Healthcare Facilities: Oversight Hearing Before the New York City Council Comms. on Health, Aging, and Mental Health, Developmental Disabilities, Alcoholism, Drug Abuse, & Disability Services (Jan. 24, 2013) (testimony of Thomas A. Farley, MD, MPH, Commissioner, New York City Department of Health and Mental Hygiene) (hereinafter *Farley Testimony*). See also Dosa D, Hyer K, Thomas K, et al. To Evacuate or Shelter in Place: Implications of Universal Hurricane Evacuation Policies on Nursing Home Residents, 13(2) J Am Med Dir Assoc. 190.e1 (February 2012).

## General Evacuation

The Coastal Storm Plan (CSP) delineates three evacuation zones, A, B, and C. Zone A includes the City's coastline and low-lying areas most vulnerable to a coastal storm. Under the CSP, Zone A is to be evacuated in the event of a Category 1 hurricane; the Mayor ordered an evacuation of Zone A in advance of Hurricanes Irene and Sandy. Zones B and C cover additional low-lying areas that are vulnerable to more extreme storms (a Category 2 hurricane and above). The zone system in the CSP was developed using Sea, Lake, and Overland Surges from Hurricanes (SLOSH) maps generated by the U.S. Army Corps of Engineers (USACE), and are primarily based on (i) coastal flood risk resulting from storm surge—the “dome” of ocean water propelled by the winds and low barometric pressure of a hurricane; (ii) the geography of the City's low-lying neighborhoods; and (iii) the accessibility of these neighborhoods by bridges and roads. Amended to include City Island, the Rockaways, and Hamilton Beach after Hurricane Irene, Zone A includes 375,000 people and 26 public housing developments.<sup>5</sup> Sandy's track, including the leftward hook it took that put the City in the direct path of the storm's most dangerous onshore winds and record storm surge, caused inundation that significantly exceeded the boundaries of Zone A.

Before Sandy, the National Weather Service updated its storm surge model to account for bigger and slower moving storms, as well as improved elevation and high tide data; OEM was in the process of reviewing and updating the City's evacuation zones when this storm hit. Based on this updated model and the recommended interpretation of hurricane category, storm bearing, the size of the storm, and other information the City receives from the National Hurricane Center and the National Weather Service before a coastal storm, the City is revising its hurricane evacuation zones for the 2013 hurricane season. The new zones 1 through 6—which will replace Zones A, B, and C—include an additional 640,000 New Yorkers not included within the boundaries of the former zones. The increased number of zones will give the City more flexibility in targeting areas to evacuate in advance of a predicted storm. The map above illustrates the projected new evacuation zones 1 through 6; the City plans to release detailed information about the new evacuation zones in June 2013 and will make this information available to residents on NYC.gov and 311, as well as through additional outreach.

## Projected New Hurricane Evacuation Zones



Note: The exact borders of the new Hurricane Evacuation Zones are still being finalized. This graphic represents the proposed Evacuation Zones, which are currently under review. The new zones will be finalized and released in June 2013.

The New York City Housing Authority (NYCHA) has a particular responsibility to provide safe shelter for its residents and to protect its buildings and infrastructure. A recommendation of the Irene after action review was to strengthen NYCHA's communications with the resident population and develop NYCHA-specific evacuation plans to incorporate into the Coastal Storm Plan. In advance of the storm, NYCHA made 33,000 calls to 19,000 families, posted flyers in multiple languages, and worked with the NYPD to make announcements with bullhorns from marked vehicles with flashing lights in order to encourage residents to evacuate before elevators and other building systems were powered down. NYCHA and the NYPD also provided 200 buses to help residents evacuate and continued to transport residents outside of Zone A until it was no longer safe for first responders to be on the roads.

Despite extensive communications before the storm, many residents of Zone A chose not to leave their homes. To gain some understanding of residents' decisions to evacuate or remain in their homes, the City conducted a survey of Zone A residents.<sup>6</sup> Among the key findings are that prior to the storm, 88% of Zone A residents surveyed knew that they lived in a hurricane evacuation zone, and 78% knew that they lived in Zone A. In addition, 71% of Zone A residents reported hearing an announcement to evacuate from a public official. Yet those who knew they lived in a vulnerable area and received an official instruction to evacuate were only slightly more likely to evacuate than a resident who reported that they did not receive such an instruction (78% vs. 68%).

<sup>5</sup> Press Release, New York City Office of the Mayor, Mayor Bloomberg Issues Order for Mandatory Evacuation of Low-Lying Areas as Hurricane Sandy Approaches (October 28, 2012), available at <http://on.nyc.gov/QXldWv>.

<sup>6</sup> The City's polling firm purchased a sample list of all adults identified as residing in the census blocks that compose Zone A. It set quotas by borough and paid careful attention to field the survey evenly and weight by borough, gender, age, and race to resemble the Census 2010 adult population of Zone A. The survey is reliable for understanding the views and opinions of the adult population of Zone A and making decisions based on those opinions. The entire survey is attached as Appendix B.

This suggests that the decision to evacuate is based on more factors than a mayoral order.<sup>7</sup> The most significant factors contributing to a decision not to evacuate include a belief that the storm would not be strong enough to pose a danger (22%); a belief that the resident's home was sufficiently elevated to prevent flooding (11%); and a general belief that the resident's home was well built (8%). Of those surveyed, 29% reported evacuating after the storm. Among residents who evacuated before or after the storm, 67% evacuated for more than 48 hours, 78% stayed with friends, and 2% stayed at a City evacuation shelter. This survey will become an important tool for refining how the City communicates with residents in evacuation zones not only prior to coastal storms, but year-round.

### NYCHA Numbers

- NYCHA made 33,000 calls to 19,000 units, posted flyers in multiple languages, and worked with the NYPD to make announcements with bullhorns from marked vehicles with flashing lights.
- NYCHA employees knocked on 3,436 doors of residents who are mobility impaired or who require life-sustaining equipment as well as the doors of 7,680 seniors in Zone A during the weekend preceding the storm.
- NYCHA and the NYPD provided 200 buses to help residents in zone A evacuate.

## Recommendations

4. **Implement the new Coastal Storm Plan evacuation zones and review the City's evacuation procedures.**
  - Develop a building- or development-specific evacuation zone determination for NYCHA properties within the new evacuation zones.
  - Review pre- and post-storm evacuation routes that account for the possibility of road and bridge closures or flooding.
5. **Increase and refine pre-storm communications and education to vulnerable areas, including NYCHA developments, to maximize evacuation in future storms through OEM's Ready New York program and other outlets.**
  - Ensure that communications clearly explain the importance of following an evacuation order or other official instructions.
  - Provide direction on what to bring, such as medications and important documents, and reinforce that people may have to leave home for more than three to five days.
  - Publicize the homebound evacuation system to New Yorkers who cannot evacuate without assistance, clients of the City's paratransit services, and people with disabilities.
  - Coordinate with advertising companies for use of digital billboards to display evacuation and other information.

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<sup>7</sup> The survey found that 44% of these residents had initially remained in place and evacuated after the storm.

## Healthcare Facility Evacuations

Many of New York City's medical facilities are concentrated close to the waterfront. From Hospital Row on Manhattan's East Side to the adult care facilities in the Rockaways, coastal storms present a disproportionate risk to an already vulnerable population.<sup>8</sup> Although hospitals and nursing homes are required by State regulation to have evacuation plans and redundant power capabilities to allow sheltering in place,<sup>9</sup> the impact of Hurricane Sandy and the duration of the widespread power outage was more than some facilities could bear. Five hospitals and approximately 30 nursing homes and adult residential facilities evacuated during and after the storm, either to other facilities or to Special Medical Needs Shelters (SMNS), a last-resort option when placements at other residential care facilities identified in evacuation plans—which frequently operate near full capacity—are not available. The number of evacuations also stressed patient transportation options and created competition for bed placements in the absence of a regional evacuation plan to coordinate these scarce resources. In total, City and State officials helped safely evacuate approximately 6,300 patients from 37 different healthcare facilities without a single fatality.<sup>10</sup>

Following the storm, the City sourced as many generators as possible to protect life and safety and to prevent additional healthcare facility evacuations. However, communications with many facilities was difficult due to power and telecommunications outages and uneven overall situational awareness, which limited the City's ability to address the needs of particular locations quickly. Facilities were repatriated as they came back online, but this process was not as orderly as it should have been

because there are no guidelines for healthcare facilities to reopen after an evacuation, such as a structural certification from the Department of Buildings (DOB), letters from certified contractors to verify essential utility connections, and inspection from the relevant healthcare oversight entity. Overall, there is substantial room for improvement for facilities to harden their infrastructure, improve their plans to shelter in place, and develop plans to safely move patients and their medical charts to appropriate alternative facilities before, during, or after a severe weather event.

## Recommendations

6. **Work with the New York State Department of Health to develop and enforce current and new regulations for licensed residential facilities including hospitals, nursing homes, and adult care facilities that require comprehensive evacuation planning and backup power capacity.**
  - Establish protocols that leverage other facilities in the region to avoid reliance on Special Medical Needs Shelters for facility evacuations.
  - Develop a patient tracking system to track evacuees.
7. **Ensure healthcare facilities are equipped with and know how to use alternate means of communication (e.g. satellite phones or radios) that remain functional in the event that power outages and downed landlines make other channels unusable.**
8. **Develop guidelines for healthcare facility repatriation that include all necessary inspections and certifications.**

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<sup>8</sup> According to research undertaken by the NYC Special Initiative for Rebuilding and Resiliency (SIRR), 20% of hospitals citywide, 34% of adult care facilities; 19% of nursing homes, and 11% of other residential facilities are in the 1-in-100 year flood zone or the 1-in-500 year flood zone.

<sup>9</sup> See *supra* note 2.

<sup>10</sup> Farley Testimony, *supra* note 5.



## ONLINE FIRST

# Emergency Preparedness and Public Health

## The Lessons of Hurricane Sandy

Tia Powell, MD

Dan Hanfling, MD

Lawrence O. Gostin, JD

**B**EFORE DAWN ON TUESDAY MORNING, OCTOBER 30, IN the midst of flooding and damaging winds from Hurricane Sandy, New York University's (NYU's) most fragile patients, premature infants, were carried down 9 flights of stairs in the dark and transported to hospitals on dry ground.<sup>1</sup> Although the infants arrived safely, the mid-storm evacuation of these critically ill patients was concerning. A safer daylight transfer before flooding overwhelmed southern Manhattan would have been preferable. The Veterans Affairs (VA) New York Harbor hospital evacuated patients before the storm.<sup>2</sup> Bellevue, New York's flagship public hospital, evacuated patients in the immediate aftermath of the storm when the backup power supply failed.<sup>3,4</sup> These neighboring hospitals each made different decisions about when to evacuate. Across the New York City metro region, many hospitals, nursing homes, and assisted living facilities were evacuated, most of them after the storm hit, making this the central public health challenge of this calamitous event.

It is a familiar story—a superstorm comes ashore, infrastructure is overwhelmed, and health care facilities evacuate patients, with major delays in returning to normal functioning. Afterwards, policy makers evaluate lessons learned for the next disaster, but similar missteps are often repeated. Why did some health care facilities with the same risk level evacuate while others did not? Although the 2 storms were different in many ways, it is instructive to compare Hurricane Katrina with the still-unfolding events of Sandy.

### Success Amidst Failure

The emergency hospital evacuations of 2 of Manhattan's landmark medical facilities—NYU Langone Medical Center evacuated 300 patients during the storm, and the next day Bellevue Hospital evacuated 700 patients—struck a similar chord to the catastrophic loss of medical infrastructure in New Orleans in 2005. Ad hoc decisions made in the midst of crisis cost patients their lives during Katrina and were second-guessed in the courts.

Unlike during Katrina, New York hospitals during Sandy had more detailed emergency plans and access to better-positioned backup generators, many placed on high floors

to protect against flooding. Fuel pumps in some hospitals were left in basements because of building code restrictions but were encased in concrete to protect against floods. Indeed, NYU engineers prepared the hospital against an unprecedented 12-ft flood, but not the actual 14 ft that Sandy delivered, causing pumps to fail.

As a result of post-Katrina planning, New York hospitals had capabilities to manage evacuations, demonstrating a measure of success. Hospital staff had transport equipment to move patients within the facility; the federal Ambulance Contract developed in the wake of Katrina brought 350 additional ambulances to the city and ensured rapid response by emergency medical service transport units; the Department of Health and Human Services deployed more than 1000 disaster medical personnel to assist in the response and recovery; and the Federal Emergency Management Agency (FEMA) placed urban search and rescue teams nearby as the storm came ashore.

What seemed to be missing, however, were clear and consistent criteria to guide evacuation decisions. The Institute of Medicine (IOM) has stressed the importance of advance planning and protocols, with the ability to remain flexible in the face of new information.<sup>5</sup>

Evacuation decisions are complex—a decision to evacuate prematurely places patients at risk, whereas waiting too long can have devastating consequences. Hospitals are faced with a variety of factors, many of which are in tension—ranging from patient safety and lost revenue to communication and logistical capabilities. It is impossible to know the reasoning of hospital administrators during Sandy, but the VA acted decisively ahead of the storm, while 2 neighboring hospitals evacuated under far-from-ideal circumstances—which, in hindsight, appeared to have been the less optimal choice.

At least 1 New York hospital failed to learn a critical lesson from Katrina—planning for the transport of physically disabled or obese patients. Bellevue left 2 overweight patients sheltering in place<sup>6</sup> when elevators failed, although a

**Author Affiliations:** Montefiore Einstein Center for Bioethics, Albert Einstein College of Medicine, Bronx, New York (Dr Powell); Inova Health System, Falls Church, Virginia (Dr Hanfling); and Department of Emergency Medicine, George Washington University (Dr Hanfling) and O'Neill Institute for National and Global Health Law, Georgetown University (Mr Gostin), Washington, DC.

**Corresponding Author:** Lawrence O. Gostin, JD, O'Neill Institute for National and Global Health Law, Georgetown University Law Center, 600 New Jersey Ave NW, Washington, DC 20001 (gostin@law.georgetown.edu).

timely preemptive move to a room on a lower floor might have minimized this risk.

Hospitals receiving evacuees had prepared for surge capacity. Consistent with IOM guidance, these hospitals shifted delivery of care along a continuum from conventional to contingency response, utilizing facilities to deliver care functionally equivalent to normal operating conditions.<sup>5</sup> Hospital lobbies served as patient reception areas, hallways accommodated patient beds, staff-to-patient ratios changed so that staff cared for more patients, and medical documentation requirements were adjusted. These strategies enabled hospitals to deliver care in a severely affected city.

### Common Failures

The difficult lessons learned from Katrina did not result in hardened medical facilities capable of withstanding catastrophic flooding. Joint Commission accreditation standards updated after Katrina were designed to enable facilities to function alone for 96 hours, emphasizing backup power generation resistant to flooding and monthly capability tests. Yet these recommendations proved insufficient. Hospitals rarely placed their own vulnerabilities at the center of mandated disaster exercises, in part because of the ongoing need to provide patient care.

In the aftermath of Sandy, hospitals were unable to ensure continuity of operations, which is a hallmark of successful disaster plans. The Joint Commission urged the redesign of infrastructure for future hospital construction but considered retrofitting existing infrastructure cost-prohibitive. The latest disaster in New York City should reopen discussion regarding needed investments. The cost-benefit calculus must include the long-term impacts. Delayed reoccupancy of storm-damaged facilities has major public health implications, including limited access to care, financial strain on local facilities, and stress on regional health care systems that must accommodate the loss of medical capacity.

Both Katrina and Sandy highlighted the difficulty in attaining “situational awareness”—the data and insights needed to make strategic planning and response decisions. Loss of communications due to power failures, combined with inaccessibility to affected communities, caused delay in recognizing the fragile state of nursing homes, assisted living facilities, and hospitals. Public health authorities did not take charge to coordinate strategic decisions. Notably, before the storm, hospitals assured the mayor that “they were ready for whatever comes.”<sup>7</sup>

### The Future of Emergency Preparedness

Natural disasters are chaotic. Leaving crucial decisions to health care facilities results in inconsistent action, potentially adverse to patient and public interests. Public health

and emergency management agencies should develop protocols, ensure capacity, and guide crucial decisions in a disaster. Public officials, in collaboration with facilities, should decide whether to shelter in place or risk transfer of fragile patients. The secretary of Health and Human Services should consider issuing an early public health emergency declaration to reduce legal concerns and regulatory constraints.

Investments to strengthen health care infrastructure to withstand catastrophic events may seem unrealistic under current fiscal restraints. However, the financial and public health consequences of failing to invest will result in predictable hospital failures in the next disaster. Where possible, investments should be coordinated across multiple institutions, using health care coalitions to ensure resiliency. For example, a joint venture linking neighboring Manhattan hospitals with shared equipment, supplies, infrastructure, and training would yield significant financial and health advantages. Although there are major barriers to cooperation among private, city, and federal authorities, harmonization of planning and response is essential to ensure patient safety.

Facilities will require additional resources—financial, material, and intellectual—to meet the challenges of disaster response. Investments should help ensure the operation of health care services during and after a disaster. Communities cannot avoid natural and man-made disasters, and the next event could be still more catastrophic. Federal, state, and municipal authorities can better prepare for the next disaster and have a duty to do so.

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ases that favor the treatment arbitrarily designated as new. Investigators seeking to demonstrate superiority should design a superiority trial.

Scott Abercgg, MD, MPH

**Author Affiliation:** Pioneer Valley Hospital, Salt Lake City, Utah (scottaberegg@gmail.com).

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**In Reply:** We appreciate the concerns expressed by Dr Abercgg but disagree with his argument. We do not think that noninferiority trials require symmetry in their interpretation. A noninferiority trial is conducted to see if a new treatment is as good as a reference treatment in the sense that a specific potential magnitude of inferiority ( $\delta$ ) is contradicted by the trial's data.

If the upper limit of a 2-sided 95% confidence interval for the treatment difference is below  $\delta$ , then the authors can claim evidence of noninferiority. The strength of evidence can be expressed by the *P* value for noninferiority, which tests for departure from the null hypothesis that the true treatment difference is at least  $\delta$ . The appropriate choice of  $\delta$  during trial design is key, as was discussed in our article.

The accumulation of knowledge over time means that asymmetry is inevitable. For whatever reasons, the reference treatment did get there first, so insights on any new treatment's acceptability have to build on that situation. We see no problem in having both noninferiority and superiority hypotheses in the same trial; they examine the evidence to contradict a treatment difference of at least  $\delta$  (in the wrong direction) and a treatment difference of zero, respectively. Both are readily apparent from where the 95% confidence interval lies relative to  $\delta$  and zero.

It would be strange to rewrite the rules for superiority trials whereby statistical significance had to be set relative to a predeclared superiority of magnitude  $\delta$ . That is unworkable and confusing. The current logic is that one first determines the statistical strength of evidence (*P* value) for superiority as well as the likely effect size informed by the confidence interval.

Subsequent debate then focuses on whether the magnitude of benefit is clinically meaningful, taking account of issues such as the individual patient's risk profile, possible adverse effects, and costs. The magnitude of a minimal clinically important difference will also be relevant to sample size calculations prior to starting the trial.

We sympathize with the views expressed regarding the role of noninferiority trials. To some extent they are rather artificial, given that the specific choice of  $\delta$  has no universally

agreed validity, but we think that their formal interpretation is helpful provided it is assessed in light of a totality of evidence gathered both from the current trial and previous studies.

In rare circumstances, a therapeutic trial is similar in concept to a bioequivalence trial; a requirement that the new drug has no greater effect than the comparator in terms of efficacy (clinical equivalence) may be justified on the grounds that greater efficacy may be accompanied by higher rates of adverse effects.

We think that noninferiority trials have a useful role, but we are not promoting their use. Rather we wish to ensure that if a trial is designed as having noninferiority, then the authors should describe adequately what they did.

Stuart J. Pocock, PhD

Gilda Piaggio, PhD

Douglas G. Altman, DSc

for the CONSORT Group

**Author Affiliations:** Medical Statistics Department, London School of Hygiene and Tropical Medicine, London, England (Drs Pocock and Piaggio) (stuart.pocock@lshtm.ac.uk); and Centre for Statistics in Medicine, University of Oxford, Oxford, England (Dr Altman).

**Conflict of Interest Disclosures:** The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

## Hospital Evacuation Decisions in Emergency Situations

To the Editor: In the Viewpoint on emergency preparedness and public health, Powell and colleagues<sup>1</sup> commented that some hospitals in Hurricane Sandy's path lacked clear and consistent criteria to guide evacuation decisions. Even though the Centers for Medicare & Medicaid Services and the Joint Commission require that all hospitals have evacuation plans, often such plans are limited to the mechanics of an evacuation and provide little guidance for making the critical decision of whether to evacuate or shelter in place.

The decision to evacuate requires consideration of many variables, including critical infrastructure vulnerabilities (eg, heat from a municipal steam plant that is also in harm's way), power for life support equipment, how to safely move patients to street level without elevators, transportation options/routes that may be impassable after a storm, and other contingencies that can be identified ahead of time, then repeatedly reassessed as the storm approaches and the situation evolves. The plan should also guide the evacuation to facilitate repatriation; reopening an evacuated and damaged hospital is directly linked to the way in which it was evacuated.

The most senior administrators of each hospital should be familiar with the data and plans upon which an evacuation decision would be based and use the best available guides for decision making, before and after an evacuation. Carefully designed and vetted tools to assist these decisions were developed with funding from the Department of Health and Human Services in the years after Katrina and are available online.<sup>2,3</sup> These tools can help decision makers recognize specific harbingers requiring an evacuation and prioritize considerations that must be addressed prior to evacuation and repatriation.

The Hospital Evacuation Decision Guide<sup>2</sup> distinguishes between “pre-event evacuations” in advance of an impending disaster, when the hospital and surrounding environment are not yet significantly compromised, and “post-event evacuations” after a disaster has damaged a hospital and the surrounding community. The Hospital Assessment and Recovery Guide<sup>3</sup> is a 45-page checklist covering 11 separate areas of hospital infrastructure that should be evaluated prior to safe reoccupancy of an evacuated and damaged hospital. An earlier version of this checklist was used to assess hospitals in New Orleans, Louisiana, after Katrina.

If dire predictions are correct and more storms like Sandy occur in the future, these tools should help hospital administrators prepare to make difficult evacuation decisions and assess their damaged facilities after the event.

Andrea Hassol, MSPH  
Paul Biddinger, MD  
Richard Zane, MD

**Author Affiliations:** Abt Associates Inc, Cambridge, Massachusetts (Ms Hassol; andrea\_hassol@abtassoc.com); Massachusetts General Hospital, Boston (Dr Biddinger); and Department of Emergency Medicine, University of Colorado School of Medicine, Denver (Dr Zane).

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**In Reply:** We concur with Ms Hassol and colleagues that facility-specific planning for hospital evacuation, both pre- and post-event, must be encouraged as a fundamental tenet of emergency planning.<sup>1</sup> However, as evidenced by the disjointed and asynchronous decisions taken by 3 health care facilities in close proximity of each other in the immediate approach to and aftermath of Hurricane Sandy, local and regional planning for sentinel events must be more consistent. Facility-specific planning is likely to lead to fragmented and diverse decision making.

The effects of hospital and nursing home evacuations fall not only on the facility and its patients but also on the entire community. It is laudable that the evacuations of hundreds of patients and staff during Hurricane Sandy resulted in few adverse events for patients. However, consistency and thoroughness in planning for and executing patient evacuations require more than individual facilities having decision-making processes. What is required is integrated planning that spans the entire emergency response system and incorporates all regional partners. Without this integration, the health system cannot ensure safe outcomes for patients requiring evacuation during a catastrophic event.

Regional planning can best be achieved by health care coalitions that have become the fundamental substrate for preparedness efforts.<sup>2</sup> “A primary purpose for any healthcare coalition is to promote optimal situational awareness for its member organizations through the collection, aggregation, and dissemination of incident information.”<sup>3</sup> Despite serving different patient constituencies, these 3 hospitals faced similar operational, economic, and political pressures with regard to the decision to evacuate. Moreover, each had been influenced by decisions taken in response to the 2011 storm, Hurricane Irene, during which evacuations were mandated yet the storm surge never materialized. Had the 3 Manhattan hospitals collectively considered the decision to evacuate during this last storm, would they still have made such different choices?

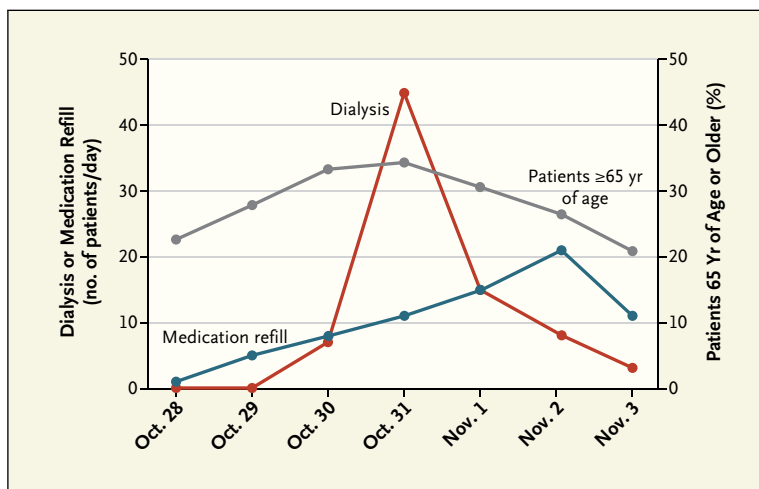
The Institute of Medicine’s proposal to develop indicators and triggers for the establishment of crisis standards of care<sup>4,5</sup> highlights the importance of being prepared to transition care across the continuum from conventional to contingency to crisis response. The hospitals in New York City that evacuated patients, and those that received them, clearly had to make such a transition. The proposed crisis standards-of-care framework can also be very useful in helping the entire emergency response system develop an integrated approach to the complex tasks required to meet the challenges arising from catastrophic events. Indicators that were available to all the health care facilities in New York City in the lead up to the storm’s landfall included both predictive and actionable information that was interpreted and acted upon differently by 3 different institutions. Fragmented approaches in the future could lead to harms to patients and the community. Moreover, standards for evacuation of skilled nursing facilities will certainly require careful review and overhaul. Coordinated plans and integrated decision making will go a long way to mitigating the potential dire consequences that could arise during future forced health care facility evacuations.

Dan Hanfling, MD  
Tia Powell, MD  
Lawrence O. Gostin, JD

**Author Affiliations:** Inova Health System, Falls Church, Virginia (Dr Hanfling); Montefiore Einstein Center for Bioethics, Albert Einstein College of Medicine, Bronx, New York (Dr Powell); and O’Neill Institute for National and Global Health Law, Georgetown University, Washington, DC (Mr Gostin; gostin@law.georgetown.edu).

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Distribution of Patients in Beth Israel's Emergency Department after Hurricane Sandy.

network.” Since the Wi-Fi was still working, residents downloaded a telephony app onto their phones and used it to send urgent text messages. At one point, the system brought several residents together for a code in a dark room. By the glow of headlamps and bobbing flashlights, a resident began resuscitation while others prepared to place a central catheter. While Samad tried to sustain morale, duty-hour limits were no longer top priority — though the influx of outpatient providers helped residents get some rest. Like the boundaries defining a resident, a medicine ward attending, a housekeeper, a surgeon, and a social worker, the lines defining work shifts had blurred.

Nagler recalls that when he first became Beth Israel's president, he “got on the subway one morning and was thrust against the front of the subway car, pushed against the window by the crowd, and the view in front of me was pitch black except for the gleam of the tracks.” He remembers this image every time he faces the unexpected, hopeful he will find a path forward. When I visited the hospital 5 days after Sandy, the lights were back on, but in a sense Nagler still felt like he was on that subway, hurtling toward an uncertain destination. Many nearby hospitals remain closed, and high volumes continue. And even after this crisis ends, another unpredictable event is bound to occur, and whether

it's a hurricane, a terrorist attack, or an infectious disease outbreak, it will pose its own obstacles.

As Manhattan works to repair itself, local clinicians find that part of their job is to evolve under duress, trying to provide good care under dynamic circumstances. One NYU hospitalist, lacking patients in her own hospital, visits evacuated patients at their new facilities, bridging gaps in the medical record. She is navigating a foreign landscape, but most health care professionals will encounter such unfamiliar terrain sometime during their careers.

Nagler returns to his musing on meteorology. The weather and medicine are similar in many ways, he remarks, both full of complex variables that produce unpredictable outcomes. But the hospital managed to meet such outcomes with creative and rapid solutions. Nagler looks out the window onto 16th Street. The sun has emerged, briefly, over Manhattan, and somewhere nearby an ambulance siren wails.

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Dr. Jangi is an editorial fellow at the *Journal* and a hospitalist at Beth Israel-Deaconess Medical Center in Boston.

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## Lessons from Sandy — Preparing Health Systems for Future Disasters

Irwin Redlener, M.D., and Michael J. Reilly, Dr.P.H., M.P.H.

Within hours after Hurricane Sandy's landfall, doctors and staff at one of New York City's premier medical centers realized that something was go-

ing terribly wrong. Lights were flickering, critical devices essential to life support for more than 200 patients, many in intensive care units, were malfunctioning.

A decision had to be made by hospital leaders, senior public health officials, and emergency responders: tough it out in a hospital without power or attempt a perilous



patient evacuation as an epic disaster unfolded.

With little time to lose, the “go” order was given, followed by frantic calls to high-ground hospitals identifying beds for receiving New York University–Langone Medical Center’s critically ill patients. St. Luke’s–Roosevelt, Mt. Sinai, New York Presbyterian at Columbia, and many other hospitals responded immediately, opening beds, readying emergency admission procedures, and briefing staff.

Two days later, the story was repeated. Bellevue Hospital, which had been operating without sufficient power and with failing generator fuel pumps, was also evacuated, sending more than 700 patients to other facilities around the city.

The NYU hospitals’ stories were extraordinary. Doctors, nurses, support staff, first responders, and National Guard troops rose to the occasion, with bucket brigades transporting fuel to generators on high floors and slowly, carefully maneuvering fragile patients down dark stairways into the storm, where ambulances were waiting to move patients to the receiving hospitals.<sup>1</sup> That all this took place without loss of life or

immediately apparent medical consequences was remarkable.

But questions about why these extreme measures were necessary will have to be answered in the months ahead. Although the first question may be how to prevent power failure, the nuances of backup and redundant power generation are not generally within the expertise of health professionals. And in fact, the generators themselves were probably fine; the problem appears to have been that fuel pumps supplying the generators were in the basement, highly susceptible to breakdown from flooding.<sup>1</sup> Ways of ensuring resiliency of backup power equipment will certainly be investigated later. For now, it’s important to understand what medical and public health challenges are to be expected after megadisasters such as Hurricane Sandy.

The first order of business is always to identify and treat storm-related casualties requiring urgent attention.<sup>2</sup> Initial reports indicate that emergency care systems in New York and most of the affected region functioned well during and immediately after the storm. However, when major medical centers are incapacitated, the stress on remain-

ing facilities may be extreme. Accommodations must be made for both a disaster-related surge in patients and the usual intake of patients with unrelated urgent medical and surgical needs.

Second, potentially serious public health complications may follow large-scale storms with extensive flooding. Though not inevitable, the possibility of the rapid emergence of such secondary public health threats demands sophisticated surveillance. Dangerous debris can clog streets and pose serious hazards to pedestrians. Breakdowns or overflows in sewer systems and water-treatment plants can result in contaminated drinking water and waterways. Toxic wastes and miscellaneous carcinogens from Superfund sites can spread over wide areas, exposing storm survivors to latent dangers.

In fact, overflow from the toxin-filled Gowanus Canal in Brooklyn is already a concern that will require close monitoring.<sup>3</sup> Prolonged lack of power and heat, a real problem in the first 2 weeks after Sandy, became dangerous for the elderly, homebound patients, and small children, especially those living in low-income housing projects. There are already signs of dangerous mold infestations in dwellings soaked by rain and floods. Also, more injuries are expected in the weeks after such disasters, as homeowners attempt to repair houses or property.

Third, essential supply chains must be restored. The most obvious and critical concern is ensuring that patients receiving life-critical medications or supplies have uninterrupted access.<sup>4</sup> Visits to shelters in the region revealed that many people lacked backup medication supplies or prescriptions. Patients — and

AP Photo/John Minichillo

shelter managers — often had little information about how or where to obtain these necessities. Then fuel shortages plagued storm-ravaged communities as gas stations lost power and the fuel supply chain was disrupted. Anecdotal reports of problems obtaining food and water were widespread. As a result, medically vulnerable patients have been at heightened risk, though quantifying the consequences of these shortages is challenging.

Finally, access to health care, often a casualty of large-scale disasters, has been a major challenge in Sandy's aftermath. Offices, clinics, and hospitals were damaged, some irreparably. Some health care providers leave the community before or after such events, at least temporarily. For hundreds of thousands of people who have inadequate access in the best of times, some of whom have serious chronic conditions, disasters greatly exacerbate problems in receiving comprehensive or timely care. Mental health problems are a common consequence of disasters. Loss or injury of loved ones, highly disrupted neighborhoods, and severely damaged property represent extreme stressors for many people and pose even greater risk for children and for people with preexisting psychological or behavioral problems. Most regions have serious shortages of resources for addressing such problems.

We have moved beyond immediate response to Hurricane Sandy into an early recovery phase. But new challenges will be added to the to-do list for a highly stressed health care system. Long-term shelters will be established, and displaced persons may be housed

far away from their original communities, placing further demands on local hospitals and providers. Many resources initially provided by neighboring states and the federal government will be withdrawn, though we hope that some elements of the hospital system that were shut down by the storm will be back in service.

As we move forward, some key principles should be kept in mind. It's essential, for instance, to consider the health care delivery system and the public health infrastructure as an integrated whole in planning for, responding to, or recovering from large-scale disasters. And details matter. Safe placement of backup electrical generators is insufficient if resiliency of fuel supply is inadequate. A reliable system whereby ambulatory patients can sustain their medication supplies may save lives. Knowing where homebound, frail persons are located can make it possible for responders to check on health status and supplies of food and water.

We must also do better in applying lessons from previous disasters to the planning for future events. The analysis of the aftermath of Hurricane Katrina and the flooding of New Orleans warned planners about virtually all the health system problems that we've faced in the aftermath of Hurricane Sandy.

Although experience is a great teacher, science can and should also inform disaster policy. Too often it does not. Careful tracking of important health and mental health problems that confound recovery, for instance, may lead to appropriate interventions that can help reduce morbidity associated with the inevitable next catastrophe.

Finally, two key realities make us more vulnerable to future disasters. Critical infrastructure, from levees to the electrical grid, is aging and increasingly fragile, ever more subject to breakdown with massive consequences for human health and safety.<sup>5</sup> And many scientists are convinced that climate change, with resultant changes in sea level and weather patterns, will make more frequent and severe storms a grim reality in the years ahead. Since these two powerful factors represent imminent threats to the public health, it's fair to ask what role our profession will play in influencing the political process to ensure that we invest in upgrading critical infrastructure and implement policies that will slow the process of climate change.

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From the National Center for Disaster Preparedness, Mailman School of Public Health, Columbia University, New York.

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**The New York Times**

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# Shelter From the Storms

By **SHERI FINK**

WHEN the floodwaters rose around New Orleans hospitals after Hurricane Katrina in 2005, doctors wondered whom to rescue first. Sick babies? Critically ill adults? The elderly?

More than seven years later, as Hurricane Sandy hit New York City, Bellevue Hospital's basement filled with millions of gallons of floodwater from the East River. The physician heading the intensive care unit was told that most backup power was likely to fail. She would have six power outlets. Which of her 50 patients should get one?

Doctors faced these impossible choices because our creaking medical infrastructure leaves American hospitals, nursing homes and high-rises for the elderly vulnerable to even the most foreseeable disasters. Plans to get patients out of harm's way are also inadequate.

Since Sandy hit a year ago, hard-working health and hospital officials have made good progress in defining the risks, but less headway in actually implementing solutions. We need to do more. Over a third of the beds in New York City's hospitals and nursing homes and more than half of those in adult care facilities are in hurricane evacuation zones. Vital mechanical elements remain unprotected in basements or on lower floors.

Sandy displaced more than 6,400 patients. Some were evacuated in the midst of the storm, without medications or records, and family members could not find them. The disaster forced the closing of six city hospitals and 26 residential care facilities. It resulted in an estimated billion dollars in hospital emergency response costs and another billion dollars in repairs.

Outpatients, too, suffered. Doctors' offices, pharmacies and dialysis and methadone clinics were inundated or lost electricity. Thousands of disabled and elderly residents were trapped for weeks in high-rises without power, elevator service or heat. A class-action lawsuit has been brought against the city on behalf of hundreds of thousands of disabled New Yorkers for alleged defects in planning. This May, the Department of Justice filed a statement in support of the disabled residents, noting that "emergency plans throughout the nation" failed to account for their unique needs.

So now what? We need both immediate and long-term solutions. On a federal level, the Centers for Medicare and Medicaid Services should release long-delayed emergency preparedness requirements. C.M.S. should also adopt updated life safety code standards from 2012 that require new health care facilities to protect electrical components. Amazingly, the government is still



relying on weaker standards from 2000.

States and localities can also impose more stringent building codes. New York City and New York State have proposed that any newly constructed hospitals or those undergoing significant renovations be floodproofed to a 500-year flood standard and that air-conditioning be able to run on emergency power. This needs to be replicated elsewhere. Rural areas, which have fewer hospitals, making them less replaceable, need help, too.

As ambitious as they are, New York City's building plans exempt existing hospitals from compliance with even the most important new standards until 2030. That deadline was set in light of fiscal realities, according to one city official.

But priorities create realities, and deadlines slip. Hospital owners need to do the right thing. After the 1971 Sylmar earthquake killed dozens at California hospitals, the state introduced strict hospital seismic safety codes, bolstering them in 1994. But as of last fall, many older California hospital buildings, including 545 of those most at risk of collapsing, had not yet been retrofitted, replaced or removed from service.

In New York, some damaged hospitals are only now applying for FEMA assistance to harden infrastructure. Made sooner, public and private investments could have prevented prolonged closings and saved hundreds of millions of dollars. We can learn from mistakes — the mayors of both New York City and New Orleans allowed hospitals and nursing homes to keep patients in place for serious storms. Before the current hurricane season, New York State health officials surveyed facilities' ability to "shelter in place" and accept other patients, but they haven't analyzed the data yet or used it to redraw plans. The state health department recently implemented a bar-coded wristband system to track patients in an emergency. Similar solutions have been used elsewhere and should be considered nationwide.

New York City officials have also proposed a database of vulnerable residents and their emergency needs. Obstacles include finding funding and navigating federal privacy rules that make it difficult to share vital information. These laws should be amended to prioritize saving lives.

Residents of vulnerable areas must recognize our own roles in protecting ourselves and our communities. We must all plan to care for our families and our neighbors.

At Memorial Medical Center in New Orleans, after the levees failed, doctors chose to rescue babies, pregnant women and critically ill adults first, and they designated certain elderly and very sick patients to go last. The heat rose and the power failed. Roughly 20 of the remaining patients were medicated with morphine or a powerful sedative, or both, before they died. Doctors told me they hastened their deaths in desperation.

At Bellevue, the physician in charge of the I.C.U. helped choose which six patients to position at

the functioning power outlets. But quick thinking saved the day. When the basement fuel pumps failed, volunteers carried fuel to backup generators on the 13th floor, keeping power running until every patient could be evacuated.

Flexibility is crucial, but making adjustments to a well-practiced plan is easier than rank improvisation. Federal Hospital Preparedness Program funding dropped from nearly a half-billion dollars a year a decade ago to \$332 million today. Failing to invest more is a choice: when disaster strikes, we will allow the weakest members of our society to suffer and die disproportionately. Why are we taking that chance?

*Sheri Fink is the author of "Five Days at Memorial: Life and Death in a Storm-Ravaged Hospital."*



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# Healthcare



Kings County Hospital Center in Brooklyn illustrates the size and complexity of hospital campuses.

Credit: HHC

**New York City's population of 8.2 million includes people with a wide range of health needs. Many—in relatively good health—see their doctors infrequently, but all count on them to be available if they get injured or become sick.**

Over 1 million New Yorkers, on the other hand, are in poor health—which could include those who have chronic conditions such as diabetes and high blood pressure—and these individuals depend on regular, ongoing medical care. Furthermore, there are 800,000 New Yorkers under the age of five or over the age of 80 who are more vulnerable to illness and injury and more likely to need life-saving medical care.

A vast, complex healthcare system has evolved to meet the needs of New York's diverse population, and Sandy caused disruptions across that system. The storm completely shut down six hospitals and 26 residential-care facilities. More than 6,400 patients were evacuated through efforts coordinated by the Healthcare Evacuation Center (HEC). Providers who remained open strained to fill the healthcare void—hospitals repurposed lobbies as inpatient rooms, adult care facilities siphoned gas from vehicles to run emergency power generators, and nursing home staff lived on-site for four or more days until their replacements arrived. Flooding and power outages forced community clinics, doctors' offices, pharmacies, and other outpatient facilities to close or reduce services in the areas most impacted by the storm.

Sandy not only put unprecedented stress on the provider system; it placed the health of medically fragile individuals at risk. There were an

estimated 75,000 people in poor health living in areas that were inundated by floodwaters and an estimated 54,000 more in communities that lost power. These groups faced additional health risks during the storm and were less capable of gaining access to appropriate care. For example, lack of heating in their buildings could have caused new health conditions, and those who lived in high-rise buildings might have been unable to leave their homes if elevators were not functioning. Furthermore, the unpredictable storm conditions increased the risk that any New Yorker could require life-saving medical care.

In keeping with the overarching goals of the Special Initiative for Rebuilding and Resiliency—to minimize the impacts of climate change and enable quick recovery after extreme weather events—the City will make the healthcare system more resilient. To ensure that hospitals, nursing homes, and adult care facilities can operate continuously during extreme weather, the City will require that new facilities be built to higher resiliency standards and existing providers are hardened to protect critical systems. To reduce barriers to care in impacted communities, the City will seek to keep the lines of communication open between patients and their providers and enable affected community-based providers to reopen quickly after a disaster. Making our healthcare system more resilient will benefit our most fragile populations—and all New Yorkers.

## How the Healthcare System Works

New York City's healthcare system is a web of interdependent providers, each supplying specific medical services and care to patients. Providers can be grouped into four broad

categories: hospitals, residential providers, community-based providers, and home-based providers. Patients typically enter the healthcare system through community-based providers (such as doctors' offices) or hospital emergency departments. Depending on their medical needs, patients may then be directed to other providers for appropriate care.

### Hospitals

Hospitals play a crucial role in the healthcare system, caring for those with the most acute medical conditions—patients for whom a delay in care can be life-threatening—as well as performing hundreds of elective surgeries and procedures every day. There are 70 acute care and psychiatric hospitals in New York City, providing both inpatient and outpatient services. Some hospitals specialize in particular medical conditions (such as cancer, orthopedics, or pediatrics) or are devoted to specific groups of the population, such as veterans.

Most hospitals have emergency departments (EDs) where people can seek care as walk-in patients or arrive by ambulance. Some EDs play a unique role in the 911 system, serving as designated regional trauma and/or burn centers. These EDs are staffed around the clock with multiple specialists, allowing them to handle a variety of serious trauma cases, such as a brain injury sustained in a car accident. In all, New York City hospital EDs see on average over 8,000 patients every day.

Many patients enter hospitals' inpatient care units through either the ED or referrals from their outpatient providers. After treatment, if intensive rehabilitation is needed, patients may be transferred to nursing homes or discharged

with referrals to visiting nurse or aide services for home-based supportive care. Over time, as their conditions stabilize, some patients may no longer need the same level of services, while others may continue to require long-term care at home or in a facility.

Hospitals can be very large institutions, with up to 1,000 inpatient beds. While some hospitals occupy a single building, many have multiple buildings on a campus. Whatever their specialization or physical configuration, hospitals are required, under New York State Department of Health (NYSDOH) regulations, to take steps to ensure patient safety under normal conditions as well as during emergencies. For example, emergency generators must be able to switch on in less than 10 seconds. This ensures that power is not interrupted for essential services, such as life-sustaining equipment for babies in neonatal units or those relying on ventilators to breathe during surgery.

### Residential Providers

New York City's 1,400 residential-based providers care for over 80,000 patients at any given time. Included in this category are nursing homes, which offer skilled nursing for the elderly and very frail in need of ongoing medical attention, and adult care facilities, which primarily support residents who require help with basic daily tasks such as meals or bathing. Other residential providers offer treatment, care, and supportive housing for individuals with substance abuse problems, developmental disabilities, or other behavioral or mental health challenges.

Some patients are admitted from hospitals and other healthcare providers for short-term rehabilitation and only stay with a residential provider until they are able to return to their own homes. These include stroke patients learning to speak again, hip replacement patients taking their first steps after surgery, and people with drug addictions participating in rehabilitation programs. Others, such as those who are frail or have severe lifelong disabilities, live in residential facilities on a long-term basis. If patients develop acute medical conditions while in residence, they are often transferred to hospitals for short-term care.

Residential facilities vary in size and configuration. Some nursing homes and adult care facilities resemble large homes or apartment buildings, while some look more like hospitals. Other residential facilities—including those for substance abuse treatment and developmental disabilities—tend to be much smaller in size. Citywide, other residential providers have four times the number of buildings as nursing homes and adult care facilities. However, in total these providers care

for only half as many residents. No matter the size of the facility, all providers must look after the health, safety, and well-being of their residents.

### Community-Based Providers

The healthcare services that keep most New Yorkers well on a day-to-day basis—screening for illness, managing chronic disease, and dispensing medication—are delivered primarily through community-based providers. These providers offer services from over 10,000 buildings across the five boroughs and are the most common entry point into the healthcare system. In the majority of cases, these providers are the ones with which patients interact most frequently.

Included in this broad group are large community clinics that provide primary care, mental and behavioral health services, and other outpatient services to hundreds of people every week. Other community-based providers include private doctors' practices for primary and specialty care, dialysis centers, hospital-affiliated outpatient providers, independent clinics and treatment centers, and retail pharmacies. New Yorkers collectively make 15 million visits to primary care doctors annually as well as millions more visits to specialists and pharmacies. Though the space arrangements of these providers vary widely, many providers are tenants occupying commercial buildings or first-floor retail spaces.

### Home-Based Providers

Home-based providers make up a small—but growing—segment of the healthcare system. Visiting nurses and aides provide care and assistance to over 100,000 New Yorkers in their own homes. These providers dispense medication, dress wounds, monitor medical conditions, and help with meals and bathing. Most patients are visited a few times a week, but

some are visited daily and rely on their nurses and aides for the same type of life-sustaining care that is provided in a nursing home. Many patients start receiving home-based care after being discharged from a hospital or upon referrals from their community-based providers.

### Regulatory Framework of the Healthcare System

Healthcare providers are primarily regulated by the New York State Department of Health, the New York State Office of Mental Health, or the New York State Office of Alcoholism and Substance Abuse Services. These agencies regulate providers' facilities and the provision of care, including licensing and construction of new facilities, the addition of inpatient beds, the creation of discharge procedures, and the approval of emergency changes to standard medical protocols.

Though New York State laws are comprehensive, New York City healthcare providers must also adhere to other regulations. For example, to receive reimbursement from Medicare, the primary payer for patients over 65, providers must follow the Centers for Medicare & Medicaid Service's regulations. In addition, New York City requires that provider buildings meet local fire safety and building codes, and that their kitchens meet the food safety standards of the New York City Department of Health and Mental Hygiene (DOHMH). Healthcare providers are regularly inspected by State and City inspectors to ensure compliance. Furthermore, many providers subject themselves to stricter operational or building standards to gain accreditations from external associations such as The Joint Commission, a nonprofit organization that accredits healthcare institutions nationwide. All hospitals in New York City are accredited by The Joint Commission, which requires additional contingency measures to address temporary failures of critical systems.



Visiting Nurse Service of New York has a staff of 12,000 visiting nurses and aides.



Coney Island Hospital staff survey the flood-damaged basement after Sandy.

Credit: HHC

## Coney Island Hospital During Sandy

Coney Island Hospital in Southern Brooklyn serves a community of nearly 750,000 people. It has 371 beds for comprehensive inpatient medical services, and its emergency department (ED) sees an average of 1,500 patients every week. The facility is operated by the New York City Health and Hospitals Corporation (HHC). Due to its location, the hospital is vulnerable to extreme coastal storms. Therefore, hospital staff always monitor the weather and have extensive plans in place for emergencies.

On Saturday, October 27, two days before Sandy hit, the hospital's Incident Command and Emergency Operations Center was fully activated. The hospital began a rapid patient discharge process and pre-evacuated 33 patients on ventilators and life support to other hospitals outside the floodplain. The patients in the older Main Building, which is less than a mile from the ocean, were relocated to upper floors in the newer Tower Building.

At around 9:30 p.m. on October 29, the hospital and surrounding community lost power. However, the hospital's lights remained on as emergency generators kicked in. The storm surge pushed water from the ocean, Sheepshead Bay, and Coney Island Creek inland, flooding the ED with five inches of water within minutes. Acting quickly, hospital staff safely moved 25 stretcher patients from the ED to higher floors.

With the inundation of the entire hospital campus, the generator room began to flood. To save the hospital's generator from irreparable damage, engineers shut it off, plunging the hospital into total darkness for more than four hours. During the peak of the storm, there was no communication with the outside world, but the staff valiantly cared for patients using flashlights and battery-powered medical devices.

Meanwhile, many residents of the surrounding community who had not evacuated turned to the hospital for shelter, including four adults and two dogs delivered by a police boat. A total of 60 displaced residents were housed in the hospital auditorium.

After the storm passed and the water receded, hospital staff switched the emergency generator back on. Over the following 12 hours, the hospital evacuated all remaining patients—more than 220—to other facilities. During this process, staff relied on point-to-point radio communication with the nearest HHC facility, Kings County Hospital, which then relayed messages to other facilities.

It took almost five days to pump out over 10 million gallons of water from flooded basement areas. Nevertheless, hospital personnel instituted emergency repairs and clean-up, which allowed the hospital to reopen with limited outpatient clinical services two days after the storm. Comprehensive inpatient care services were partially restored by mid-January.

## What Happened During Sandy

New York City's healthcare system is designed to handle fluctuations in demand as healthcare needs vary seasonally. However, the cascading closures of providers during and after Sandy strained the system citywide. Because of the closures, providers that remained open had to operate beyond normal capacity, which was difficult to sustain for extended periods. To ensure they were able to address the most acute medical needs, some providers that remained open reduced certain services they offered—for example, postponing non-emergency surgeries or suspending outpatient procedures.

Disruptions in citywide systems—transportation, fuel, telecommunication, and power—had a noticeable but short-term impact on the healthcare system. Transportation outages and restrictions, as well as fuel restrictions, made it difficult for healthcare staff to travel to workplaces in the first week after the storm. Telecommunication breakdowns meant that impacted providers were unable to communicate with patients, and also made coordination with City and State officials for response efforts more challenging. Power outages closed some community-based providers for up to a week, while flood damage closed a limited number of providers for much longer, necessitating repairs and the replacement of destroyed equipment.

Across the city, five acute care hospitals and one psychiatric hospital closed. This resulted in the emergency evacuation of nearly 2,000 patients coordinated by the HEC, in addition to an unknown number of patients who were transferred within provider networks or were discharged before or after Sandy. Of these, three hospitals closed in advance of the storm: New York Downtown (Manhattan) closed after notice of a potential pre-emptive utility shutdown, while the Veterans Affairs New York Harbor Hospital (Manhattan) and South Beach Psychiatric Center (Staten Island) closed due to concerns about flooding. Three other hospitals—New York University's Langone Medical Center (Manhattan), Bellevue Hospital (Manhattan), and Coney Island Hospital (Brooklyn)—evacuated during or after Sandy due to the failure of multiple electrical and mechanical systems including emergency power systems. In the immediate aftermath of Sandy, hospital bed capacity was down eight percent citywide. (See sidebar: *Coney Island Hospital during Sandy*)

Meanwhile, 10 hospitals remained open despite power outages and/or limited flooding in basement areas. In the week after the storm, Beth Israel in Manhattan—powered only by back-up generators due to the area-wide power outage—



saw a 13 percent increase in ED use. To meet patient demand, the hospital suspended elective procedures and surgeries. Other hospitals used workarounds in response to communication and information technology (IT) failures. For example, runners on each floor conveyed doctors' orders, paper charts replaced electronic records, and two-way radios were used to communicate with other providers. To handle the influx of patient evacuees, some receiving hospitals turned lobbies into inpatient wards and gave emergency permission for OB/GYNs displaced from other hospitals to deliver babies in their facilities.

Some hospitals narrowly escaped flood damage. For example, Metropolitan Hospital in upper Manhattan just missed having its critical electrical systems flooded, and on Staten Island University Hospital's North Campus, floodwaters came within inches of the hospital entrance.

New York City hospitals incurred an estimated \$1 billion in costs associated with emergency response measures taken during and immediately after Sandy, including the costs of staff overtime, patient evacuations, and emergency repairs of equipment. To return to normal operations, as of the writing of this report, it is projected that damaged hospitals will spend at least another \$1 billion on repairs and mitigation. In addition, permanent revenue loss for hospitals citywide is estimated to have been nearly \$70 million per week in the immediate aftermath of the storm. Hospitals that were closed due to serious damage experienced revenue losses over many months.

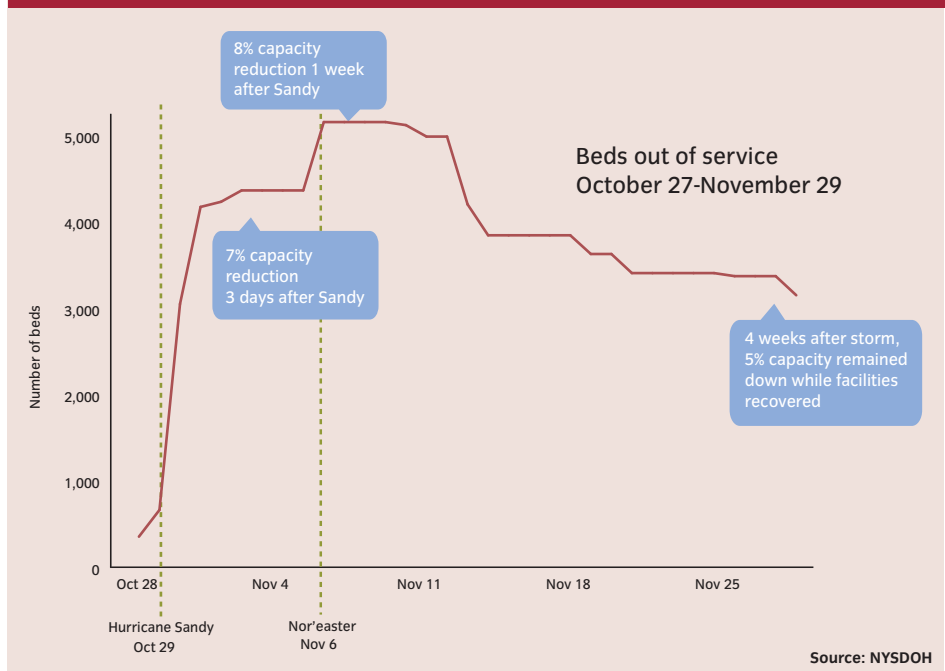
Sandy's impact on residential providers was also significant. Sixty-one nursing homes and adult care facilities were in areas impacted by power outages and/or flooding. Half of these providers continued to operate—some because they sustained minimal or no damage, others because they had effective emergency plans. But within a week of the storm, 26 facilities had to shut down, and another five partially evacuated, reducing citywide residential capacity by 4,600 beds and leading to the evacuation of 4,500 residents who had to be transported to other facilities or Special Medical Needs Shelters, which were staffed by personnel from the New York City Health and Hospitals Corporation (HHC) and Disaster Medical Assistance Teams (DMAT). These closures impacted hospitals as well, preventing them from discharging patients to nursing homes, as they normally would have done. Instead, hospital beds that could have been available for new patients remained occupied by existing patients who had nowhere else to recover after treatment. (See chart: *Citywide Bed Capacity Reductions in Nursing Homes and Adult Care Facilities*)



Over 700 patients were evacuated from Bellevue Hospital in Manhattan the day after Sandy.

Credit: HHC

### Citywide Bed Capacity Reductions in Nursing Homes and Adult Care Facilities



Source: NYSDOH

Power loss was the primary cause of post-Sandy evacuations from nursing homes and adult care facilities, and many providers experienced both utility outages and damage to building electrical equipment. Even providers with generators had difficulties if those generators were located in parts of buildings that flooded or if providers had failed to secure fuel in advance. Without power, other critical systems—lights, heating, elevators, kitchens, and medical equipment—could not function.

Although two nursing homes and one adult care facility evacuated patients in advance of the storm, 28 others evacuated under emergency conditions. These stressful emergency scenarios added significantly to patient risk (though, fortunately, there was no loss of life during any Sandy-related evacuations in the city). Some evacuees were trans-

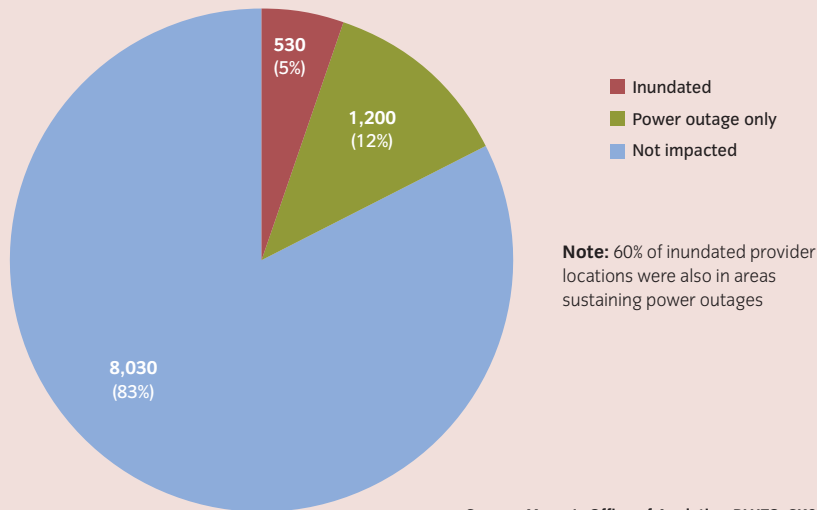
ported without medical records or proper identification, making it difficult for receiving providers to administer appropriate care or notify evacuees' families and caretakers.

Among other residential providers, the majority with fewer than 10 beds, approximately 5 percent of facilities were located in inundated areas, and another 10 percent were in areas impacted by power outages. These disruptions caused some facilities to evacuate patients while others remained safely sheltered in place. Overall, however, these evacuations did not significantly impact the broader healthcare system because many evacuees were safely transferred to other providers.

Community-based providers in over 500 buildings across the city (5 percent of total community-based provider buildings) were

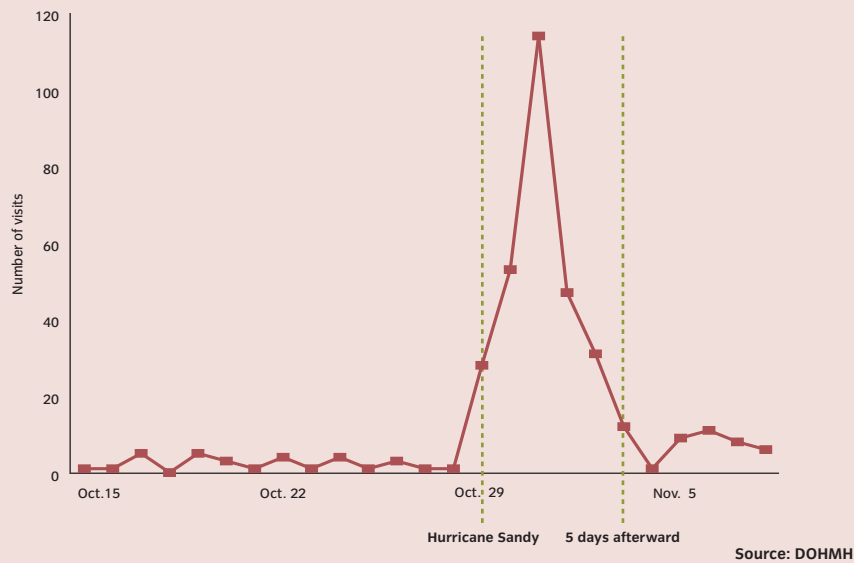
## Impact of Sandy on Buildings Housing Community-Based Providers

### Provider locations impacted by Sandy



Source: Mayor's Office of Analytics, PLUTO, SK&A

## Citywide Emergency Department Visits Needing Dialysis



located in inundated areas, including 300 buildings with doctors' offices, 100 retail pharmacies, and at least 70 outpatient and ambulatory care centers. Flooding in facilities in low-rise buildings or on the lower levels of taller buildings resulted in damage that often took weeks or even months to repair. Providers on higher floors could not reopen until damaged electrical systems, boilers, elevators, and other building systems were repaired. (See chart: *Impact of Sandy on Buildings Housing Community-Based Providers*)

An additional 12 percent of community-based providers' buildings were in areas that experienced power outages only. Since most community-based providers occupy buildings without generators, these providers typically remained closed until utilities were restored.

The impact of community-based provider closures was felt most in the areas hardest hit by the storm. In South Queens, for example, 60 percent of provider buildings were in inundated areas, while in Southern Manhattan, 95 percent of providers experienced power outages. Elsewhere in the city, community-based care was only affected if doctors and staff could not travel to their offices. Most providers opened as soon as transportation was restored.

New Yorkers whose providers' facilities closed often were left without a way to see or communicate with their providers. For many without immediate medical concerns, the temporary closures may have had limited impact. However, others with pressing healthcare needs—dialysis patients or those on methadone, for

instance—had to seek alternative care immediately, often from hospital emergency departments or mobile medical vans staffed by doctors and nurses from community clinics and other healthcare workers. The longer providers remained closed, the greater the numbers of individuals who had to look elsewhere for care. (See chart: *Citywide Emergency Department Visits Needing Dialysis*)

Home-based care was impacted primarily by disruptions in the transportation system. The public transportation shutdown, travel restrictions on single-occupancy cars, and gasoline shortages all made it difficult for nurses and aides to reach the homes of patients scattered across the five boroughs. If and when providers finally did reach their destinations, elevators that were out of service—due to power outages or flood damage—often made it challenging for staff to reach patients on upper floors in high-rise buildings. The power, water, and heat outages within patients' homes were also problematic, increasing the likelihood that existing medical conditions would worsen or new ones would develop.

## What Could Happen in the Future

Now and over the next 40 years, the primary climate risks facing the healthcare system are expected to be storm surge and heat waves.

### Major Risks

Newly released Preliminary Work Maps (PWMs) from the Federal Emergency Management Agency (FEMA) place at least 300 more buildings housing healthcare providers in the 100-year floodplain than were in the floodplain in the 1983 Flood Insurance Rate Maps (FIRMs). Based on high-end projections for sea level rise from the New York City Panel on Climate Change (NCCC), another 200 facilities will be in the 100-year floodplain by the 2020s, and a total of 1,000 healthcare facilities will be in the 100 year floodplain by the 2050s. If the vulnerabilities of healthcare providers to flooding are not addressed, 10 percent of New York City's healthcare buildings will be at risk of damage and closure in the event of a major flood event under this scenario.

Among the vulnerable healthcare facilities are hospitals with 10 facilities—representing 16 percent of hospital beds citywide—in the 100-year floodplain, as indicated by the PWMs, and one more is in the 500-year floodplain. This one facility is expected to be added to the 100-year floodplain by the 2020s, with two more likely to be added by the 2050s. By mid-century, hospitals in the 100-year floodplain are expected to include three psychiatric hospitals and four regional trauma centers. (See map: *Hospitals in the Floodplain*)

# Risk Assessment: Impact of Climate Change on the Healthcare System

Major Risk Moderate Risk Minor Risk

Hazard	Scale of Impact			Comments
	Today	2020s	2050s	
<b>Gradual</b>				
Sea level rise	Minor Risk	Minor Risk	Minor Risk	Minimal Impact
Increased precipitation	Minor Risk	Minor Risk	Minor Risk	Minimal Impact
Higher average temperature	Minor Risk	Minor Risk	Minor Risk	Minimal Impact
<b>Extreme Events</b>				
Storm surge	Moderate Risk	Moderate Risk	Major Risk	Risk to facilities will increase as sea level rises
Heavy downpour	Minor Risk	Minor Risk	Minor Risk	Minimal Impact
Heat wave	Minor Risk	Moderate Risk	Moderate Risk	Increased patient demand can likely be handled by normal operations INDIRECT: Power outages could lead to evacuation because HVAC systems are required for operation, yet many are not connected to backup power
High winds	Minor Risk	Minor Risk	Minor Risk	Minimal Impact

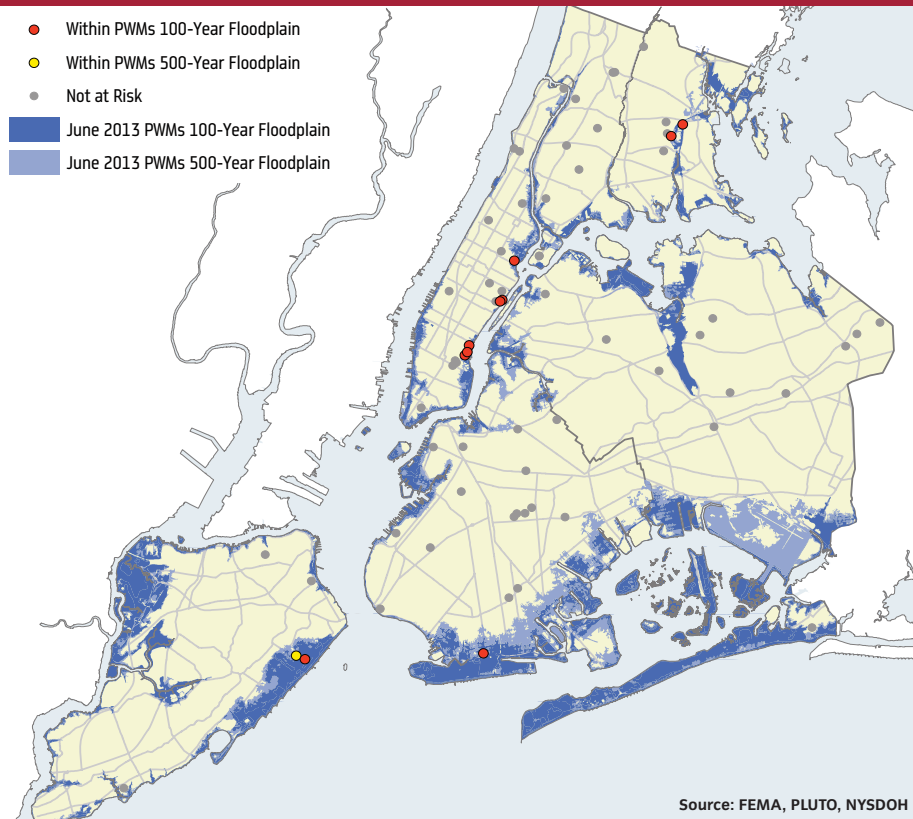
Meanwhile, 37 nursing homes and adult care facilities, representing 14 percent of citywide bed capacity, are in the 100-year floodplain, as indicated by the PWMs, with seven more likely to be in the floodplain by the 2020s. By the 2050s, 33 nursing homes and 25 adult care facilities are likely to be in the 100-year floodplain, many of these (approximately 60 percent) in Southern Brooklyn and South Queens. Among other residential care facilities, approximately 70 are in the floodplain, (7 percent of citywide bed capacity), with another 50 (an additional 5 percent of citywide bed capacity) likely to be added by the 2050s. (See map: *Nursing Homes and Adult Care Facilities at Risk in Southern Brooklyn and South Queens*)

Among community-based providers, approximately 5 percent of buildings with providers are in the 100-year floodplain, as indicated by the PWMs. There are approximately 550 buildings with community clinics, doctors' offices, pharmacies, and other outpatient and ambulatory care centers in the 100-year floodplain and nearly 400 more buildings are expected to be in the floodplain by the 2050s. (See chart: *Projected Growth in Flood Risk of Buildings Housing Community-Based Providers*)

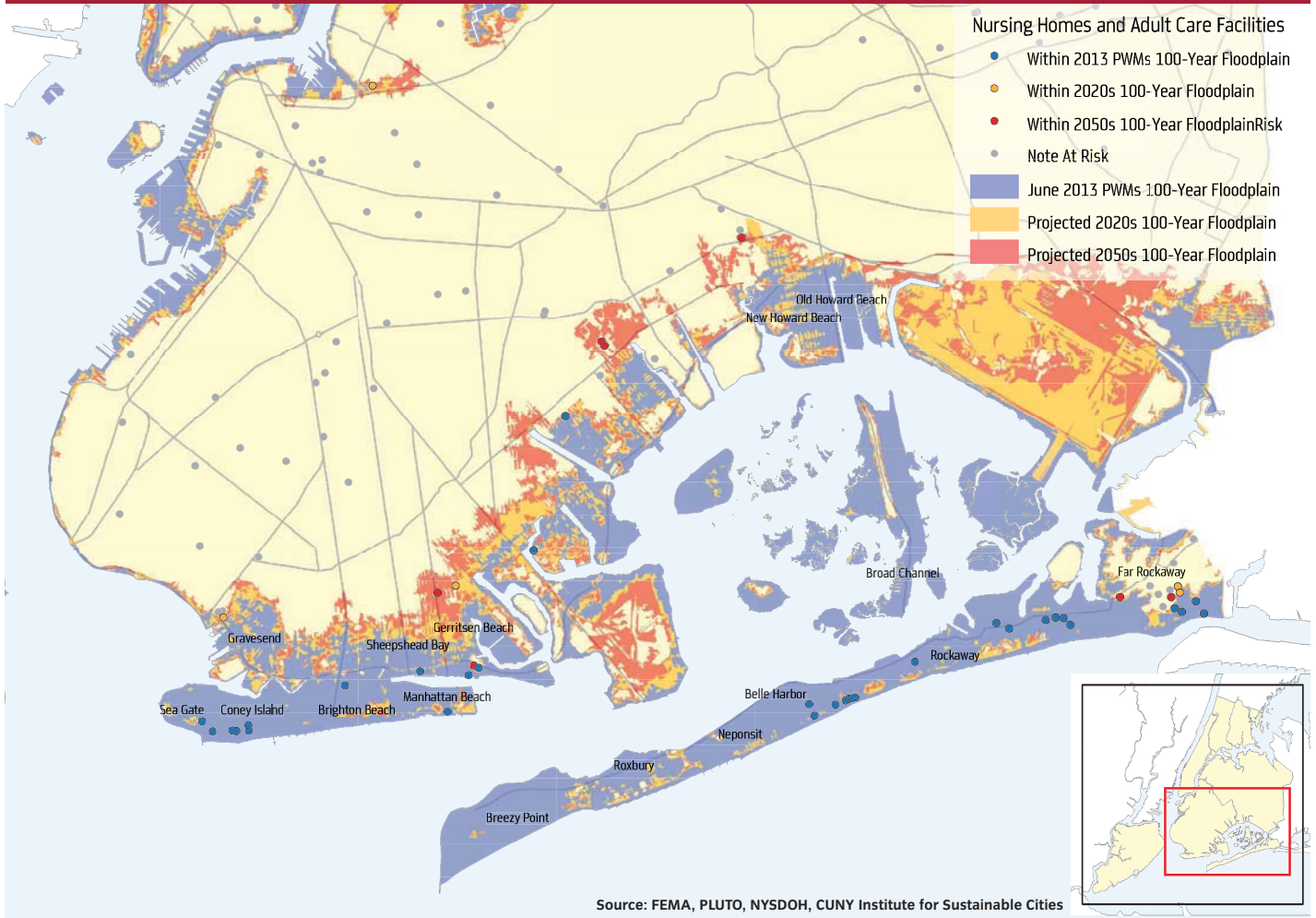
### Other Risks

In addition to storm surge, heat waves pose a serious health risk to New Yorkers. They can cause

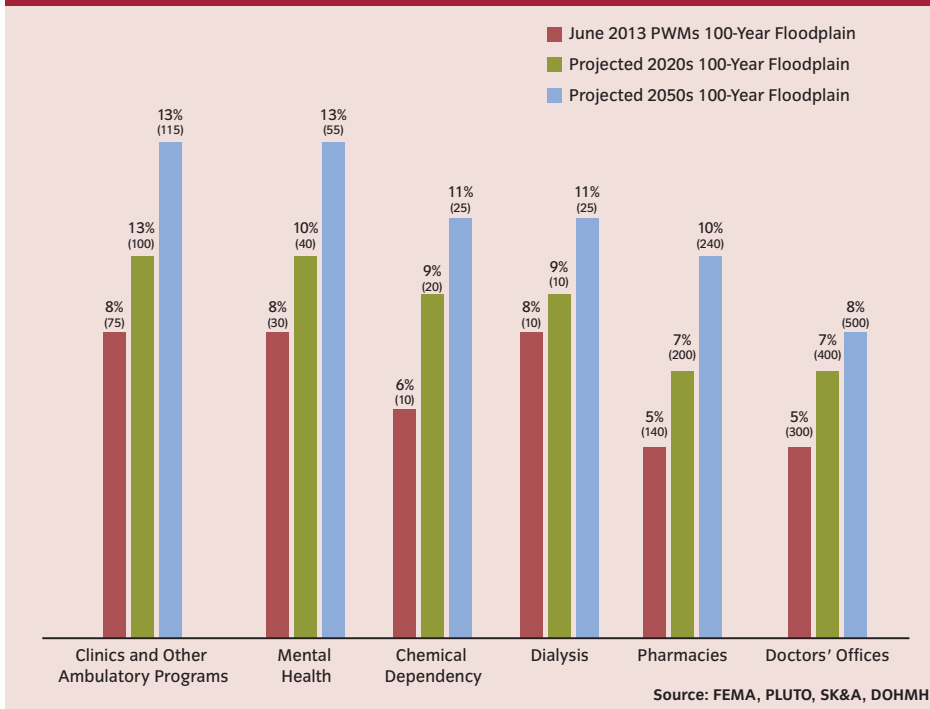
### Hospitals in the Floodplain



## Nursing Homes and Adult Care Facilities in Southern Brooklyn and South Queens



## Projected Growth in Flood Risk of Buildings Housing Community-Based Providers



deaths by exacerbating chronic conditions and inducing heat-related medical conditions, such as heat stroke. Heat waves are particularly life-threatening to elderly and medically fragile individuals who do not have air conditioning in their homes. Even New Yorkers who do have air conditioning will be impacted if heat waves lead to widespread power outages. In addition, power outages from heat waves cause disruptions in the healthcare system citywide. Community-based providers would likely have to shut down until power is restored. Hospitals, nursing homes, and adult care facilities would not need necessarily to evacuate immediately, provided they had backup generators to maintain adequate cooling capacity. However, today the vast majority of these facilities do not have backup power for cooling of their inpatient units.

Sudden downpours and wind are unlikely to have a significant impact on healthcare providers, particularly as facilities with the most vulnerable patients (for example, hospitals) are required to have greater structural resiliency than regular commercial buildings. However, specific facilities may be at risk depending on their site drainage capacity for heavy rains and their façade, window, and rooftop conditions.

This chapter contains a series of initiatives that are designed to mitigate the impacts of climate change on New York’s healthcare system. In many cases, these initiatives are both ready to proceed and have identified funding sources assigned to cover their costs. With respect to these initiatives, the City intends to proceed with them as quickly as practicable, upon the receipt of identified funding.

Meanwhile, in the case of certain other initiatives described in this chapter, though these initiatives may be ready to proceed, they still do not have specific sources of funding assigned to them. In Chapter 19 (*Funding*), the City describes additional funding sources, which, if secured, would be sufficient to fund the full first phase of projects and programs described in this document over a 10-year period. The City will work aggressively on securing this funding and any necessary third-party approvals required in connection therewith (i.e., from the Federal or State governments). However, until such time as these sources are secured, the City will proceed only with those initiatives for which it has adequate funding.

To preserve the health and well-being of all New Yorkers, the City’s healthcare system must maintain sufficient capacity to meet patients’ needs during disasters and be prepared to resume normal services as quickly as possible. To this end, the City will require flood-prone hospitals, nursing homes, and adult care facilities to provide redundancies for critical systems and prevent physical damage to equipment. These facilities account for almost 90 percent of all inpatient and residential bed capacity at risk of flooding. If successfully mitigated, they can stay open and ensure that system capacity is not heavily strained during disasters. The remaining residential bed capacity at risk of flooding is spread across many smaller providers citywide. The vulnerability of these providers to climate risks is typically best addressed through emergency planning and other operational solutions, especially because physical protection of these facilities may be too difficult and not cost-effective given building and physical constraints.

Since community-based providers are located citywide, most will not be affected by flooding from extreme weather events. However, those impacted will be highly concentrated in hard-hit communities. The City will, therefore, work with clinics and pharmacies to implement targeted mitigation in areas where services may be most needed after a disaster. To further reduce barriers to the restoration of community-based care, the City will also call upon outpatient providers to consider technology-based mitigation strategies that are appropriate to their scale and allow for faster recovery.



In the aftermath of Sandy, temporary boilers were used at NYU Langone Medical Center.

Credit: FEMA

Furthermore, measures to increase the resiliency of citywide power, transportation, and water systems will ensure that community-based and home-based providers can recover the resources that they depend on most as quickly as possible. (See Chapter 6, *Utilities*; Chapter 10, *Transportation*; and Chapter 12, *Water and Wastewater*)

## Strategy: Ensure critical providers’ operability through redundancy and the prevention of physical damage

Hospitals, nursing homes, and adult care facilities rely on extensive equipment and utility services to diagnose, treat, and care for patients. Basic utilities (such as power and water supply); building equipment (heating, ventilation, air conditioning, and elevator systems); medical equipment (diagnostic labs, X-ray machines, and medical gas tanks); and other services (such as kitchens and laundry rooms) are all integral to normal patient care. Much of this equipment is located in the facilities’ lower levels, which are at risk of flooding during extreme weather events. Fortunately, providers have operational plans and workarounds for many of these systems in case of disruptions.

However, some systems—power, water, heating, and air conditioning—require both operational planning and physical hardening to be made more resilient. These systems are the foundation of a facility’s medical infrastructure and are essential for the operation of all other services and equipment, including emergency operations. Without these critical systems, providers cannot ensure safe patient care and may be forced to evacuate. Furthermore,

severe damage to these systems can result in long-term closures as repairs can often take several months.

Therefore, the City will amend its Construction Codes to require new and existing healthcare providers to take actions that ensure critical building systems are physically protected from the impacts of extreme weather, and—to address outages—are supplied with backup systems. The City also will provide financial assistance to support the mitigation projects of providers who have limited funding sources. These new resiliency measures will minimize the risk of evacuating patients and keep important healthcare facilities open for the benefit of all New Yorkers.

### Initiative 1 Improve the design and construction of new hospitals

New hospitals that are constructed in the floodplain could experience critical system failures due to storm surge and may be at risk of evacuating patients. To improve the resiliency of any new hospital that is built in the 500-year floodplain, the City will, therefore, amend its Construction Codes to require a higher level of protection and critical systems redundancy.

For example, new hospital buildings will be required to meet construction code standards for flood-resistant construction to the 500-year flood elevation, which is a higher than the 100-year flood elevation to which protection is required today. Protecting utilities and mechanical equipment to this higher flood level will ensure that new hospitals—which are expected to serve the city for many decades—will be protected even as climate change increases flood risk.



Credit: FEMA

Submarine doors can be used to protect building equipment in lower floors.

In addition, the City will institute new resiliency requirements related to electronic data and communications technologies, which play an increasingly central role in patient care. New hospitals in the 500-year floodplain will be required to increase their IT and telecommunications resiliency by installing two independent points-of-entry for telecom and communication to reduce the risk of outages from a single supplier.

Backup options are crucial to ensure that critical systems can function and long-term closures can be avoided. New hospitals will, therefore, also be required to be built with pre-wired electrical connections for external emergency power generators as well as for temporary boiler and chiller connections if the primary equipment is below the 500-year flood elevation. In addition, new hospitals in the 500-year floodplain will be required to ensure that air conditioning services to their inpatient care areas are available when utility power is disrupted (for example, by placing chiller systems on emergency power). Having an air conditioning solution that is not dependent solely on primary utility power will help avert evacuations. These measures will ensure that providers do not incur high costs later for damages, repairs, or retrofits. The Office of Long-Term Planning and Sustainability (OLTPS) will include the proposed amendments to the New York City Construction Codes in its broader proposal to the New York City Council in the latter half of 2013.

### Initiative 2 Require the retrofitting of existing hospitals in the 500-year floodplain

Many existing hospital buildings in the floodplain remain vulnerable to the impact of storm surge. To improve the resiliency of these buildings, the City will require existing hospital buildings in today's 500-year floodplain to meet, by 2030, a subset of the amended New York City Construction Codes standards through building retrofits.

This mandate will apply to the eleven hospitals that are, as indicated by the PWMs, in the floodplain. They will be mandated to protect their electrical equipment, emergency power systems, and domestic water pumps to the 500-year flood elevation by elevating the equipment, hardening equipment in place (for example, through the use of submarine doors), or dry flood-proofing basements and lower floors. They will also be required to ensure that emergency power systems—generators and fuel pumps—are accessible to building staff at all times, so that emergency power can be maintained continuously, even during flood conditions.

As with new hospitals, existing hospitals will also be required to install by 2030: Backup air conditioning service for inpatient care areas in case of utility outages (for example, chillers on emergency power); pre-connections for temporary boilers and chillers if primary equipment is not elevated; and pre-connections for external generators as a backup power source in case the hospital must run on emergency power for extended periods. These redundancies will provide an additional level of protection for hospitals' most critical services, and thus, will help avert evacuation in the event that primary equipment is breached or permanently damaged.

Many providers have already met several of these requirements. For example, many hospital generators are elevated today. In addition, providers generally acknowledge that power, emergency power, and water are necessary for them to remain operational, and investments in flood mitigation are needed to minimize future evacuation risk. Accordingly, many providers already have made plans to address these risks. To avoid placing an undue financial burden on providers, hospitals will not be mandated to retroactively protect other critical systems and services (such as emergency departments, elevators, lab equipment, telecommunications, IT, and medical equipment) for which other workarounds can be implemented. Never the less, protection for these systems still will be encouraged as a best practice especially since they could be essential for some facilities to remain in operation, depending on their layout and unique risks.

OLTPS will include these retrofit requirements in its broader proposal to the New York City Council in 2013. The City will enforce compliance with this mandate by 2030 (recognizing compliance to be voluntary for hospitals owned by the State or Federal government). As part of this process, by the end of 2020, hospitals will be required to submit an interim report certifying that they have complied with the requirements or to submit an affidavit describing a plan to achieve such compliance by 2030. Hospitals added to the floodplain in future versions

of flood maps will have 15 years from the release of such new maps to implement retrofits.

### Initiative 3 Support the Health and Hospitals Corporation's (HHC) effort to protect public hospital emergency departments from flooding

Emergency departments (EDs) are critical access points for patients in need of hospital services. Three public hospitals' EDs are at risk of flooding due to storm surge. Subject to available funding, the City will aim to ensure these EDs are protected and available to care for New Yorkers. Bellevue Hospital (Manhattan), Metropolitan Hospital (Manhattan), and Coney Island Hospital (Brooklyn) are operated by the New York City HHC, which serves all New Yorkers, regardless of their ability to pay. With EDs located below the 500-year flood elevation, direct flood damage would cause the EDs to be closed for months, as equipment, walls, and floors would need to be replaced. Extended closures would require patients to travel longer distances to receive care, and other providers to accommodate additional volume.

Bellevue Hospital has the only designated regional trauma center below 68th Street in Manhattan. The City will pursue a coastal protection pilot project, subject to available funding, which includes measures to address the flood risk to Bellevue's ED. Mitigation options under consideration include floodwalls and ramps. The City will also support HHC's on-going efforts to work with the State and Federal governments to identify mitigation solutions and funding sources that allow its other EDs to be protected from flooding. Current options being explored include elevating Coney Island Hospital's ED and other critical building systems above the 500-year flood elevation and installing temporary or permanent floodwalls around Metropolitan Hospital's ED and campus (see Chapter 3, *Coastal Protection*).

### Initiative 4 Improve the design and construction of new nursing homes and adult care facilities

New nursing homes and adult care facilities are at risk of power service failures due to storm surge, which could result in patient evacuations. To address this risk, the City will amend its Construction Codes to require that new facilities be constructed with additional resiliency measures for their emergency power systems, which are essential to allow staff and patients to shelter in place safely during a disaster. Power in these residential facilities is needed not only for standard operational requirements—such as lighting, elevators, use of medical equipment, and communications—but also

for essential emergency operations such as pumping floodwater out of basements if flood protection fails.

New nursing homes are already required to have emergency generators, but because generators can fail when used for an extended period of time, facilities will now be required to have in place an electrical pre-connection for an external stand-by generator. The ability to switch electrical systems over quickly to a stand-by generator can reduce significantly the likelihood of emergency evacuations during or after a disaster.

Meanwhile with respect to adult care facilities, they are not currently required by the State or City to have any emergency power systems. Their residents are more ambulatory and less fragile than nursing home patients but, nevertheless, require care and living assistance that is dependent on working electricity. For this reason, the City will require new facilities to install either an emergency generator that is adequately protected or pre-connection to an external stand-by generator. OLTPS will propose these requirements for new nursing homes and adult care facilities to the City Council in the latter half of 2013.

### **Initiative 5**

#### **Require the retrofitting of existing nursing homes in the 100-year floodplain**

Among all the critical systems that nursing homes rely on for normal operations, power and water are the most essential during emergency conditions because they are required for so many other services such as heating, air conditioning, sanitation, and elevator services.

The City will therefore require existing nursing homes in the 100-year floodplain which, as indicated by the PWMs, includes 18 facilities (11 percent of the citywide bed capacity), to meet standards by 2030 for the protection of electrical equipment, emergency power systems, and domestic water pumps (if applicable) retroactively pursuant to changes in the City's Construction Code. These systems will be protected to the 100-year flood elevation, in accordance with specifications already in the New York City Construction Codes.

OLTPS will propose these requirements to the City Council in the latter half of 2013. The City will enforce compliance with this mandate. As part of this process, by the end of 2020, nursing homes will be required to submit an interim report certifying that they have complied with the retrofit requirements or to submit an affidavit describing a plan to achieve such compliance by 2030.

Because it may be difficult for some nursing homes to secure the financial capital needed



The Shorefront Center in Southern Brooklyn was constructed nearly 30 feet above ground.

Credit: MJHS

## **Shorefront Center During Sandy**

Built in 1994, the Shorefront Center for Rehabilitation and Nursing Care, in Southern Brooklyn, was designed to comply with building code requirements for flood-resistant construction due to its proximity to the ocean. Having been built to exceed the 500-year flood elevation by three feet, the entire facility is elevated nearly 30 feet above ground, with parking spaces below. All of the building's systems and equipment are also elevated and thus protected from floodwaters. The emergency power supply is furnished with enough capacity to run medical equipment, elevators, and heating, ventilation, and air conditioning (HVAC) systems to ensure the facility can continue to operate during power outages. Furthermore, the elevated first floor houses only the lobby and other support services. Community and administrative space is located on the second floor, while residents' and patients' rooms start on the third.

During Sandy, the building functioned as planned. At the peak of the storm, floodwaters filled the parking area and reached the lobby door, but did not enter the building. Emergency power generators remained safe and supplied backup power for four days while area-wide power was out. The nursing home's emergency plans for food and medical supplies allowed staff and patients to shelter in place despite limited transportation for incoming supplies. Shorefront was not only able to provide continuous care to its residents during and after Sandy, but it also assisted people from the local community who sought food and shelter.

for retrofit projects, a financial assistance program will be launched by the City, subject to available funding (see Initiative 7). Nursing homes that are added to the floodplain with the release of future flood maps will be required to comply within 15 years of such new flood maps going into effect.

### **Initiative 6**

#### **Require the retrofitting of existing adult care facilities in the 100-year floodplain**

Over 25 percent of citywide adult care facility bed capacity is in the 100-year floodplain (within 19 facilities) and is at risk of power outages due to storm surge. Many of these facilities have their

electrical equipment in lower levels where it is vulnerable to flooding. Furthermore, these facilities are also at risk of power outages during heatwaves. In either case, power outages would increase the risk of emergency evacuations. The City will, therefore, require existing adult care facilities located in the 100-year floodplain to elevate or protect their electrical equipment to the 100-year flood elevation, in accordance with the specifications applicable to new buildings in the New York City Construction Codes. In addition, these providers will be required to install an emergency generator that is adequately protected in their facilities. Alternatively, they may install an electrical pre-connection to an external generator,



At Shore View Nursing Home in Brighton Beach, an emergency generator was moved from the basement and elevated on a raised platform.

Credit: Shore View Nursing Home

provided they have an operational plan in place that allows them to access an external generator quickly during an emergency (through, for example, regular contracts with suppliers).

OLTPS will propose these requirements to the City Council in the latter half of 2013. The City will enforce compliance with this mandate. As part of this process, by end of 2020, adult care facilities will be required to submit an interim report certifying that they have complied with the retrofit requirements or an affidavit describing a plan to achieve such compliance by 2030. As with nursing homes, adult care facilities will be eligible for financial support, subject to available funding, to comply with the mandate (see Initiative 7). Moving forward, facilities that are added to the floodplain with the release of future flood maps will be required to comply within 15 years of the new flood maps going into effect.

### **Initiative 7** Support nursing homes and adult care facilities with mitigation grants and loans

The primary obstacle for most nursing homes and adult care facilities in implementing mitigation measures is financing the investment.

Subject to available funding, the City, through DOHMH and the New York City Economic Development Corporation (NYCEDC), will, therefore, administer competitive grants and subsidized loans to assist providers with the upfront costs of certain mandated retrofit projects.

Most nursing homes and adult care facilities receive the majority of their revenue from publicly funded programs such as Medicaid, Supplemental Security Income, or Safety Net Assistance. Typically, reimbursement rates from these programs are not sufficient to enable nursing homes and adult care facilities to invest in costly mitigation projects that do not impact day-to-day care directly. If any capital investments

are made, some nursing homes may receive Medicaid reimbursements for a portion of their mitigation costs; while other providers may not be reimbursed.

To qualify for the program, nursing homes and adult care facilities will be required to demonstrate financial need, emergency preparedness planning, and an operational commitment to remain safely open during disasters or reopen quickly thereafter. Eligible mitigation will include retrofits to meet amended building codes (see Initiatives 5 and 6) and wet flood-proofing of walls and floors below the 100-year flood elevation to limit damage from mold. The goal is for NYCEDC and DOHMH to launch the program, capped at \$50 million citywide, when the proposed building code amendments for nursing homes and adult care facilities go into effect.

### **Initiative 8** Increase the air conditioning capacity of nursing homes and adult care facilities

Nursing homes and adult care facilities today typically do not have enough emergency power capacity to run their air conditioning systems. Thus, some providers could be forced to evacuate during power outages that occur in hot

summer months. To reduce this risk, the City will seek a sales tax waiver for 100 nursing homes and adult care facilities citywide to install emergency power solutions for their air conditioning systems. This benefit, which will be capped at \$3 million citywide, will only be available to those facilities eligible for such benefits under state law. Eligibility criteria for this program will be announced over the next year and will, among other things, include demonstrated financial need.

## **Strategy: Reduce barriers to care during and after emergencies**

Additional initiatives, spearheaded by the City in collaboration with healthcare associations and providers, will ensure that community-based providers in the healthcare system can provide limited but critical services under emergency conditions and restore normal services as quickly as possible after a disaster. The City's goal is to improve the resiliency of the community-based provider network so that even in the hours and days immediately after a disaster, when other local businesses are still recovering, healthcare providers can offer essential services to New Yorkers with the greatest need for care.

### **Initiative 9** Harden primary care and mental health clinics

In communities that are at risk of extensive flooding, the accessibility of primary care and mental health services may be compromised for weeks after a disaster due to extended facility closures. Ensuring that local clinics can reopen quickly to provide primary care, mental health counseling, and other medical services in high-need communities is important for the health and safety of residents and will address the concentrated impact of storm surge.

Subject to available funding, the City, through DOHMH and a fiscal intermediary, will therefore



At Shore View Nursing Home in Brighton Beach, a cement wall protects vents for boilers and chillers from over 5 feet of storm surge.

Credit: Shore View Nursing Home





Credit: FEMA

**Patient health records were damaged by floodwaters.**

disburse grants and interest-free loans to five to six providers that serve large outpatient populations in communities where medical services may be reduced significantly because of extreme weather events. These capital investments will enable faster recovery of services—for example, via installation of emergency power systems, protection of other critical building systems, and wet floodproofing of facilities. The goal is to launch an application process during the next year. The selection process will prioritize clinics that offer a broad scope of medical services, and demonstrate adequate emergency operations plans.

### **Initiative 10** **Improve pharmacies' power resiliency**

Pharmacies dispense life-saving drugs. However, without power, pharmacists cannot access the necessary patient records or insurance information to dispense these drugs. For retail pharmacies that do not sustain structural building damage, generators allow providers to restore the most critical building services they need to reopen. With an emergency power supply, pharmacies can access patient records, receive calls from doctors about new prescriptions or refills, and communicate with insurers and payers for billing purposes. To reopen with emergency power, pharmacies also will need to have robust emergency operations plans ensuring staff transportation and the delivery of supplies to the facility. For New Yorkers who depend on regular prescriptions, quick restoration of pharmacy services is critical.

DOHMH will, therefore, work with other agencies, including Office of Long-Term Planning and Sustainability, the Office of Emergency Management, the Department of Transportation, the Department of Buildings, the Department of Environmental Protection, and pharmacies to assist pharmacies to reopen quickly after a disaster. DOHMH will explore issues such as installing pre-connections for external

generators, identifying a central emergency point of contact, permitting, and emergency operations planning. By the end of 2013, DOHMH will launch an emergency preparedness website for pharmacies.

### **Initiative 11** **Encourage telecommunications resiliency**

In the aftermath of a disaster, it is important that New Yorkers be able to speak to their doctors for guidance on needed medical care. While in-person visits are ideal for diagnosing and treating health concerns, a phone consultation can be extremely valuable in addressing many patients' needs after a disaster.

For example, a telephone conversation allows a trusted doctor who is familiar with a patient's medical history and specific health conditions to help with post-disaster anxiety, answer health-related questions, perform initial triage of medical concerns, refill prescriptions, or direct patients to alternative providers and medical resources. Telecommunications resiliency is especially important for mental health providers who may need to support patients during the extremely stressful period after a disaster.

To this end, DOHMH is developing a best practice guide and outreach plan to help community-based providers understand the importance of telecommunications resiliency as well as the options they might consider and questions to ask when evaluating solutions. Resiliency solutions could include using backup phone systems (such as a remote answering service that would not be affected by local weather hazards), Voice over Internet Protocol (VoIP) technology that allows office phone lines to be used off-site, and pre-disaster planning to inform patients of available emergency phone numbers. DOHMH

will continue to develop the informational materials through the remainder of 2013.

### **Initiative 12** **Encourage electronic health record-keeping**

Doctors rely on patients' medical records to provide and track care, but these important records may be compromised or destroyed due to flooding. Damage to paper records results in the loss of valuable patient information, which may impact care. In addition, the specialized disposal of this sensitive material once damaged can result in high waste removal costs.

Electronic Health Records can help prevent the permanent loss of data and allow for quick restoration of services after a disaster. However, even EHR systems need to be implemented with operational resiliency in mind. For example, providers might want to ensure that they can still access patient information even if they cannot occupy their offices. In addition, providers must ensure that computers and servers are not located on floors where they may be flooded. Their vendors' servers must also be protected from flood risk.

DOHMH's Primary Care Information Project (PCIP) sponsors numerous initiatives to help primary care and mental health providers city-wide with EHR technical assistance for their practices. Moving forward, PCIP programs will highlight the ways in which EHR can be used to prevent permanent loss of data and quickly restore services after a disaster. PCIP will target providers, in the floodplain, that can benefit significantly from transitioning to EHR, with specific guidance on how EHR should be implemented for maximum effectiveness in flood hazard mitigation.



**Running on generator power, a temporary pharmacy in a double-wide trailer served customers in Sheepshead Bay, Southern Brooklyn.**

Credit: DuaneReade

## A SURVEY OF HOSPITALS TO DETERMINE THE PREVALENCE AND CHARACTERISTICS OF HEALTHCARE COALITIONS FOR EMERGENCY PREPAREDNESS AND RESPONSE

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Kunal J. Rambhia, Richard E. Waldhorn, Frederick Selck, Ambereen Kurwa Mehta,  
Crystal Franco, and Eric S. Toner

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Previous reports have identified the development of healthcare coalitions as the foundation for disaster response across the United States. This survey of acute care hospitals characterizes the current status of participation by US hospitals in healthcare coalitions for emergency preparedness planning and response. The survey results show the nearly universal nature of a coalition approach to disaster response. The results suggest a need for wide stakeholder involvement but also for flexibility in structure and organization. Based on the survey results, the authors make recommendations to guide the further development of healthcare coalitions and to improve local and national response to disasters.

**I**N 2009, A REPORT SPONSORED BY THE US Department of Health and Human Services (HHS) on the first 5 years of the Hospital Preparedness Program (HPP) noted that hospitals had begun planning a coordinated response to mass casualty events that could overwhelm a single hospital and require the resources of several hospitals, public health agencies, emergency management personnel, emergency medical services (EMS), and others.<sup>1</sup> Every state and municipality participating in the HPP described some form of healthcare coalition, but there was significant variability in the structure, maturity, capability, and degree of linkage of healthcare coalitions with the local, state, and regional jurisdictional emergency response systems.

A subsequent report on the challenge of healthcare preparedness for catastrophic health events concluded that every US hospital should participate in a healthcare coalition that prepares for and responds collaboratively to common medical disasters and catastrophic health events.<sup>2</sup> Links should be established between neighboring healthcare coalitions to enable regional exchange of healthcare

information and assets during a catastrophic health event.<sup>2</sup> The HPP, administered by the Office of the Assistant Secretary for Preparedness and Response (ASPR), has placed increasing emphasis on building required partnerships and coalitions during the FY2010 and FY2011 budget periods. The FY2011 ASPR HPP guidance says that this work should build on developing broader-reaching healthcare system partnerships/coalitions that enhance community resilience.<sup>3</sup> This concept is presented in “Comprehensive Coalition Strategies for Optimization of Healthcare,” which is promoted through the FY2009 Pandemic Influenza Healthcare Preparedness Improvements for States Funding Opportunity Announcement,<sup>4</sup> and the new handbook *Medical Surge Capacity and Capability: The Healthcare Coalition in Emergency Response and Recovery*.<sup>5</sup> The ASPR HPP guidance also points to the “Provisional Criteria for the Assessment of Progress toward Healthcare Preparedness” report, which outlines key functional characteristics and metrics for assessment of progress in the development of healthcare coalitions.<sup>6</sup> FY2012 ASPR

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Kunal S. Rambhia, MS, is a Senior Analyst; Richard E. Waldhorn, MD, and Frederick Selck, MA, are Contributing Scholars; Crystal Franco, MPH, is an Associate; Eric S. Toner, MD, is a Senior Associate; all at the Center for Biosecurity of UPMC, Baltimore, Maryland. Ambereen Kurwa Mehta, MD, MPH, is at Georgetown University Medical School, Washington, DC.

guidance further emphasizes development of healthcare coalitions and suggests structural and functional characteristics.<sup>7</sup>

A first step in promoting the development of healthcare coalitions was a competitive grant process, the Health Facilities and Emergency Care Partnership Grant Program, which funded 16 successful applications for coalition development programs. Evaluation of this program included descriptions of several new healthcare coalitions and further progress in previously established programs.<sup>8</sup>

Although these reports and the ASPR HPP guidance recognize and encourage the development of healthcare coalitions, their methodology does not allow for any conclusions about the “epidemiology” of healthcare coalitions. These coalitions were becoming more common and important in healthcare emergency preparedness. But how many such coalitions exist, how much US hospitals participate in healthcare coalitions, and how effectively these coalitions are integrated with jurisdictional emergency preparedness systems throughout the country could not be determined from these anecdotal reports and case studies. State HPP coordinators who were interviewed may have over- or underreported hospitals’ participation in coalitions. Reporting of impressive results from well-established coalitions that were successful in a competitive grant process may not be representative of hospitals throughout the country. An important step toward the goal of development of healthcare coalitions in all communities and jurisdictions is an analysis of where the country is now in hospital participation in healthcare coalitions.

This survey is an effort to characterize the status of participation by US hospitals in healthcare coalitions for emergency preparedness planning and response.

## METHODS

We surveyed 4,632 acute care hospitals in the US (non-federal, non-Veterans Affairs hospitals) regarding their participation in collaborative healthcare coalitions for coordination of emergency preparedness and response. We developed the survey questions, which were based on previous research into healthcare coalitions and healthcare system preparedness for mass casualty events.<sup>1</sup> Before the survey was disseminated, it was tested by 3 experts in emergency preparedness healthcare coalitions to ensure that it was easy to understand, that the questions were meaningful, and that all important topics were covered. A list of survey questions can be found at [www.liebertonline.com/bsp](http://www.liebertonline.com/bsp).

The survey was e-mailed directly to the president, chief executive officer, or designated executive at acute care hospitals, who were asked to forward the survey to appropriate hospital personnel in charge of disaster preparedness. E-mail addresses were obtained from a database provided for 1-time use by the American Hospital Association (AHA). The first e-mail invitation to participate in the

survey was sent in early August 2011, and the survey remained open for about 1 month.

A support e-mail account was provided to answer questions about the survey. The survey was also advertised by leaders of the National Hospital Preparedness Program, who e-mailed grantees and stakeholders to encourage hospital participation in the survey. We also announced the survey on a conference call with AHA members.

The survey was designed and data were collected using SurveyMonkey. The data were analyzed using STATA version 11.2. The survey data were tested to measure whether the respondents were representative of the hospitals in the AHA database based on 4 characteristics: urbanicity, bed size, geographic distribution, and teaching hospital status.

The data analysis was carried out in 3 parts: summary statistics, chi-squared analyses, and a conditional scoring test. The chi-squared tests primarily examined responses to the questions of whether hospitals reported that coalitions participated in joint response to mass casualty events and whether coalition members contribute money or in-kind resources to the coalition. The conditional scoring test examined 14 hospital coalition characteristics based on when the survey respondents indicated their coalition began.

## RESULTS

### *A Representative Sample*

The survey generated 477 responses from a survey population of 4,632 acute care facilities, a 10.3% response rate. The demographics of the responding hospitals are described in Table 1.

To measure geographic distribution, we grouped the HHS regions into 5 groups and measured the survey respondents against the AHA database.<sup>9</sup> The regions were divided as follows:

- Northeast—Regions 1-3
- Southeast—Region 4
- South—Region 6
- Midwest—Regions 5, 7, 8
- Pacific—Regions 9, 10

Table 1 displays each group with 95% confidence intervals. Hospitals in the Midwest group are slightly overrepresented, while hospitals in the Southeast are slightly underrepresented. These mild deviations in geographic distribution are to be expected in a survey that was conducted using a convenience sample. Survey respondents included hospitals from 49 of 50 states.

Compared with the AHA dataset, the survey respondents were statistically representative with regard to urban or rural location, bed size, and teaching hospital status. Percentage of urban hospitals and teaching hospitals and

Table 1. Characteristics of Survey Respondents and AHA Database with 95% Confidence Intervals

<i>Criteria for Representative Sample</i>	<i>Survey Respondents</i>	<i>AHA Database</i>
Median bed size	92 beds (75.2-108.8)	96 beds (90.9-101.1)
Urban hospitals	54.7% (50.2-59.2%)	60.1% (58.7-61.5%)
Teaching hospitals	25.5% (21.6-29.4%)	23.3% (22.2-24.4%)
Regional distribution		
Regions 1-3	21.3% (17.6-25.0%)	17.4% (16.4-18.5%)
Region 4	14.0% (10.9-17.1%)	19.8% (18.7-20.9%)
Regions 5,7,8	41.3% (36.9-45.8%)	33.3% (31.9-34.5%)
Region 6	12.7% (9.75-15.7%)	15.9% (14.9-16.9%)
Regions 9,10	10.7% (7.88-13.4%)	13.6% (12.7-14.6%)

median bed size are shown in Table 1 for both the AHA dataset and the survey respondents. Table 1 shows that the survey respondents for all 3 categories are within the 95% confidence intervals of the AHA data. Urban hospitals may be slightly underrepresented, but not outside the 95% confidence intervals.

According to the most recent data from ASPR, 5,341 hospitals in the 50 states and 4 metropolitan areas participate in the HPP.<sup>10</sup> The California Hospital Association estimates that these hospitals represent over 85% of the more than 6,300 hospitals in the US.<sup>11</sup> About 75% of survey respondents indicated they participate in the HPP. Although this measure was not tested for statistical significance, it is clear that hospitals participating in HPP were not overrepresented. Because HPP guidance supports the development of coalitions, that HPP hospitals are not overrepresented indicates that the data are not skewed toward coalition participation.

### *Coalition Participation*

Nearly all (94.51%) the hospitals that responded to the survey said that they participated in a discrete entity, partnership, organization, coalition, planning group, consortium, or other agreement with other hospitals and community partners for emergency preparedness and response. Nearly 90% of respondents said that more than 75% of their local hospitals participated in their healthcare coalition. Although many coalitions were founded before 2002, more than 60% began after 2002, when federal funds became available to most hospitals to improve their ability to respond to public health emergencies and bioterrorism.

We recognized that several hospitals representing the same coalition would probably respond to the survey. The survey provided the option of entering the name of the healthcare coalition that the hospital participates in. In examining these responses, we identified 314 unique coalitions out of 416 that entered a coalition name, so there were some coalitions represented more than once. Although 7 coalitions were represented 4 or more times, the most hospitals representing the same coalition was 7. This occurred only once. This indicates that a broad range of coalitions was represented in the survey.

### *Structure and Function of Coalitions*

Additional survey results, presented in Table 2, show the diverse structure, leadership, and funding of healthcare coalitions for emergency preparedness and response. Notably, in 88% of respondents, more than 75% of hospitals

Table 2. Summary Statistics

<i>Survey Question</i>	<i>Percent</i>
Does your hospital participate in a coalition for emergency planning and response? ( <i>n</i> =474)	
Yes	94.51
No	5.49
Is participation voluntary? ( <i>n</i> =440)	
Participation is voluntary	26.36
Participation is required	73.64
What percent of acute care hospitals in the community participate? ( <i>n</i> =440)	
More than 75%	88.64
Between 25% and 75%	9.55
Less than 25%	1.82
When was the coalition started? ( <i>n</i> =440)	
Before 2002	32.27
Between 2002 and 2007	60.68
After 2007	7.05
Stakeholder participation ( <i>n</i> =440)	
Hospitals only	12.95
Includes other stakeholders	87.05
Organizing entity of coalition ( <i>n</i> =378)	
Hospital or group of hospitals	48.41
Public health agency or EMA	51.59
Structure of coalition ( <i>n</i> =435)	
Formal linkage	72.41
Informal linkage	19.54
Don't know	8.05
HPP participation ( <i>n</i> =433)	
Yes	75.29
No	24.71
Distribution of HPP funds ( <i>n</i> =321)	
Directly to hospital	22.74
To coalition for distribution to hospitals or common purchasing	40.50
To both	24.91
I don't know	11.84

in a community participated in coalitions and most coalitions began after HPP funding was initiated in 2002. Although most coalitions included a formal linkage, the leading organization was split between a hospital or group of hospitals and a public health or emergency management agency. More than 75% of hospitals said they participate in the HPP, and among those, grant money was distributed in a variety of ways.

**Stakeholder Involvement in Coalitions**

Of the 477 survey respondents, 383 (80%) said they participated in a healthcare coalition with a diverse group of stakeholders, and 12% said that the coalitions in which they participated included only hospitals. Of those 383 that described a diverse group of stakeholders, public health agencies, EMS providers, and emergency management agencies participated at a high rate: about 90% for each (Table 3, Figure 1). Most hospitals reported state or regional hospital associations and first responder organizations also participated in their coalitions. About half the hospitals in this group reported that long-term health providers and mental health providers participated in their coalition. The overall rate of stakeholder participation is high and is in accordance with federal grant guidance and accreditation requirements (such as the Joint Commission’s Emergency Management Standards).

**Coalition Activities**

Survey respondents were asked to describe activities performed by their coalitions (Table 4, Figure 2). Response rates were highest for participation in planning activities, conducting joint training and drills, and sharing bed availability and surge capability. Overall, respondents said

Table 3. Percent of Hospitals that Indicated Various Stakeholder Participation in Coalitions

<i>Stakeholder (n = 383)</i>	<i>Stakeholders’ Participation (%)</i>
Public health agencies	92.43
EMS providers, private or municipal	88.51
Emergency management agencies	87.47
State or regional hospital associations	69.97
First responder organizations	65.27
Mental health providers	48.30
Long-term care providers	47.52
Coroner or medical examiner	42.30
Private ambulance providers	32.90
Home health agency	28.98
Federally qualified health centers	21.67
Primary care providers	19.06
Physicians’ practices	16.45
State medical societies	9.66

that most coalitions engaged in most of the activities listed in the survey. The one exception was member contribution of money or in-kind resources to support the coalition, to which only 23.7% of hospitals responded positively. These activities are divided into those that are primarily conducted before a disaster (preparedness) and activities primarily conducted during a disaster (response).

**Preparedness Only Versus Preparedness and Response**

There were differences between coalitions that participated in joint response to mass casualty events and those that did not participate in response activities (ie, were largely preparedness-only entities). None of the responding hospitals said that their coalitions were response-only entities. Table 5 shows a comparison of the characteristics reported between coalitions that did or did not jointly respond to mass casualty events and whether there were statistically significant differences. Of note, coalitions were more likely to be involved in a joint response if the local emergency management agency and EMS providers were part of the coalition. They were also more likely to be involved in a disaster response if they contributed resources to the coalition and participated in the local emergency operations center (EOC).

However, whether the leading organization of the coalition was a hospital or public health/emergency management agency (EMA) and whether hospitals were required to participate in coalitions were not associated with whether the coalition had a role in response. Likewise, participation in the HPP and the method of distributing HPP funds was not associated with whether joint response was a characteristic of a coalition.

**Member Contributions**

Similarly, there were differences between coalitions in which members contributed money or in-kind resources to support the coalition and those that did not. Table 6 details these differences as determined by a chi-square analysis. Public health agency participation in the coalition correlated with hospital contribution of funds, as did participation in the local EOC. However, state or regional hospital association, EMS, and EMA involvement was not associated with contribution of funds or resources. The lead organization of the coalition, HPP participation, and required hospital participation in coalitions were not significantly associated with member support of coalitions. But members were more likely to contribute funds or resources to the coalition if HPP funds were sent to the coalition directly for distribution to hospitals. Furthermore, there was an association between joint purchasing or other cost incurring activities such as management of alternative care facilities and members contributing to the coalition. This was also true for sharing data on patient load and available assets.

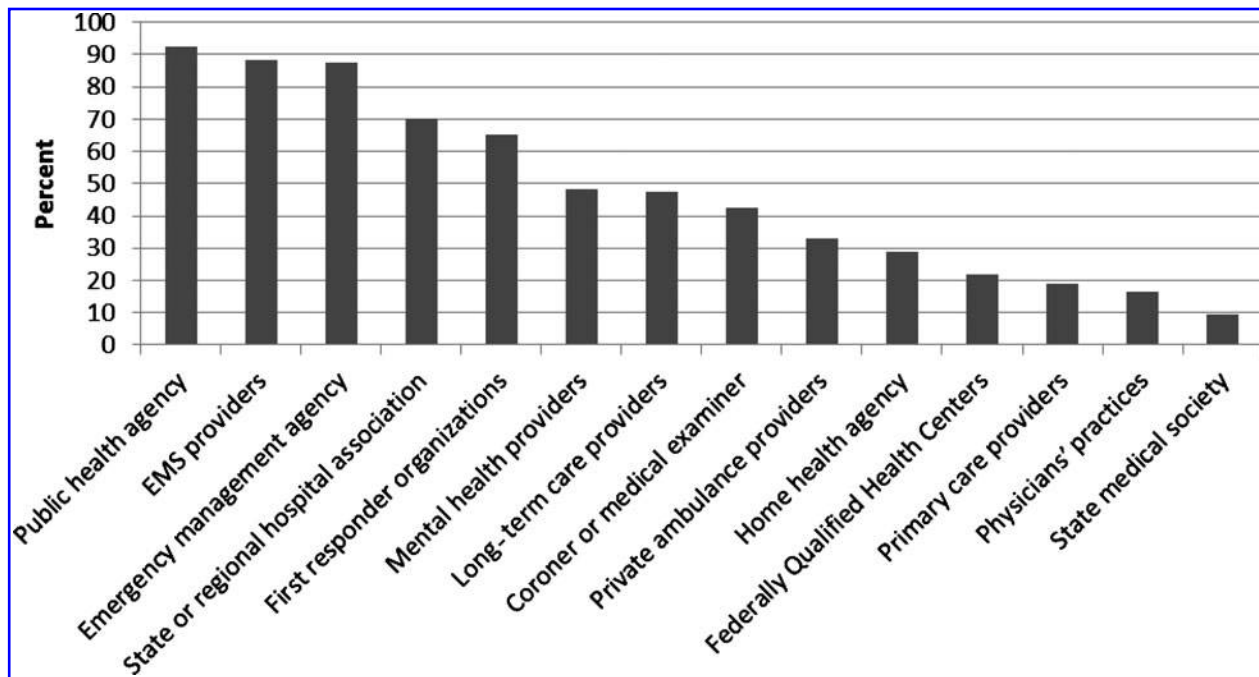


Figure 1. Stakeholder Involvement in Coalitions

Table 4. Percent of Hospitals that Participate in Coalitions that Perform These Activities

Activity	Percent (n = 426)
<b>Preparedness</b>	
Planning activities	97.18
Joint training exercises and drills	92.49
Formally links hospitals, jurisdictional response, and public health agencies	80.52
Joint purchasing of equipment and supplies, or regional stockpiles	79.58
Joint threat assessment/hazard vulnerability analysis	75.59
Members contribute money or in-kind resources to support coalition	23.71
<b>Response</b>	
Shares bed availability and surge capability during planning and response	93.90
Joint response to mass casualty events	82.86
Convenes regular coalition meetings	82.16
Local EOC participation	78.40
Serves as information clearinghouse with systems for tracking patient load and available assets	69.01
Coordinates alternative care facilities	59.62
Coordinates use of volunteers in healthcare setting in emergency response	54.93

Note: The researchers divided these activities into “preparedness” and “response” categories after completion of the survey during the data analysis. The complete survey tool is available online at: [www.liebertonline.com/bsp](http://www.liebertonline.com/bsp)

### Age of Coalition

Coalitions also had different qualities based on when they began; we hypothesized that coalitions that have existed for longer are more likely to be more advanced, include more stakeholders, and perform more activities than newer coalitions. As part of the survey, we asked respondents what year their coalition started. In the survey, 3 time periods were given for the question, “When was this entity started?”: before 2002, between 2002 and 2007, and after 2007.

Figure 3 and Table 7 examine 14 characteristics of coalitions taken from the survey. Each of the 3 periods was scored based on positive responses to each of the 14 questions. A positive response was assigned a value of 1, a negative response 0, and the mean numbers of positive responses to the 14 questions per survey respondent in each group were then compared to determine significance. These 14 characteristics were used in the scoring analysis:

1. Joint planning activities
2. Participation in HPP
3. Public health participation
4. Emergency medical services participation
5. Joint response to mass casualty events
6. Alternative care facilities coordination
7. Mental health provider participation
8. Contribution of money or in-kind resources to support coalition
9. Private ambulance provider participation
10. Distribution of HPP funds through coalition
11. Formal linkage through MOU, MOA, or contract

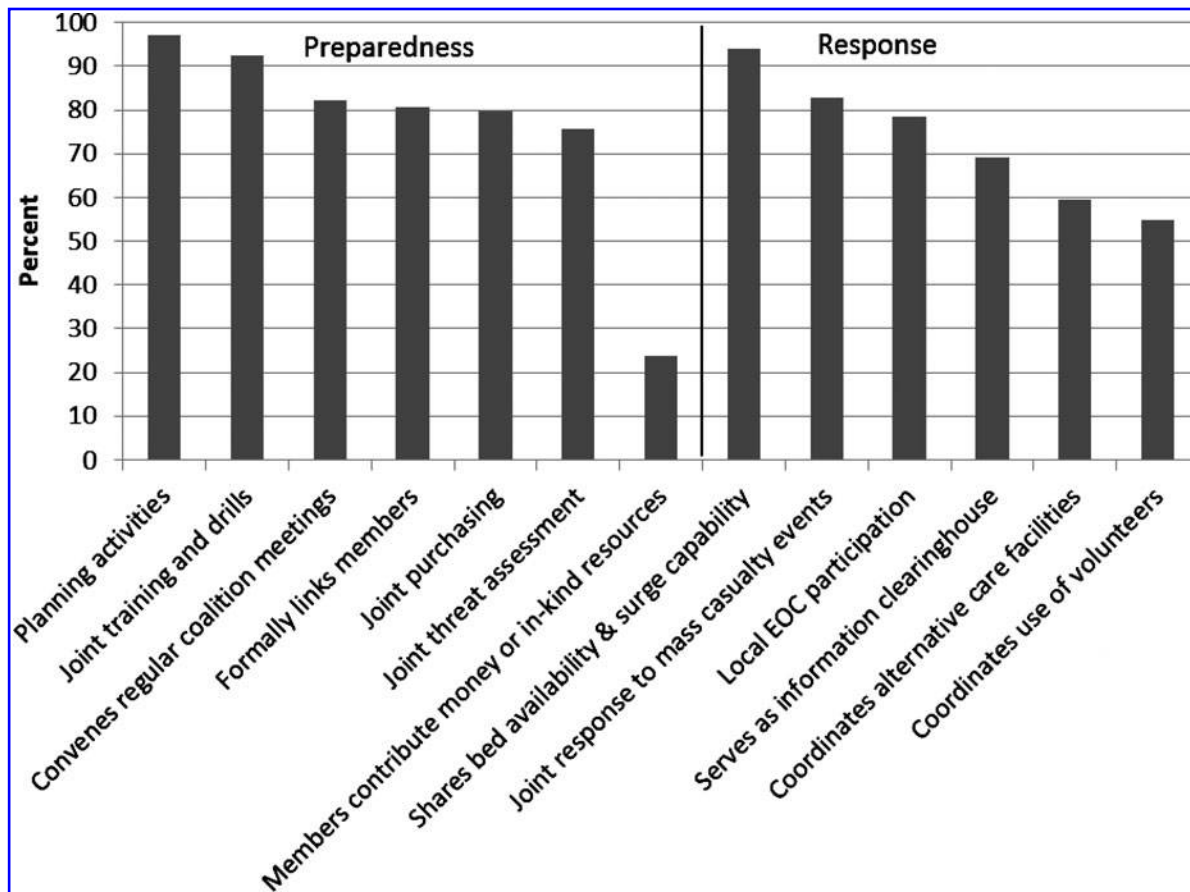


Figure 2. Coalition Activities

- 12. Joint purchasing of equipment, supplies, stockpiles
- 13. Participation in local emergency operations center (EOC)
- 14. Sharing of bed availability

As expected, coalitions that began before 2002 had, on average, more of the 14 characteristics than those coalitions that began later. When the before-2002 group was compared with the other 2 groups, there was statistically significant difference. Figure 3 shows the total coalition activity score in the 3 age ranges. Table 7 shows trends for all 14 characteristics for coalitions that began in 2007 and earlier and after 2007, with statistically significant trends indicated by asterisks.

**Limitations**

This survey is based on self-reporting, and there is no means to verify the reports. The low response rate of about 10% is also a limitation in interpreting these data broadly across all hospitals in the country. The results of this survey are subject to some bias. Although the sample seems representative by the measures we examined, it may not be a true representation of the spectrum of US hospitals by other measures. High-performing hospitals (ie, those that par-

ticipate in coalitions) may be overrepresented in the survey respondents. The survey was administered to hospitals, and not directly to healthcare coalitions, which may also introduce bias in addition to multiple hospitals representing a single coalition. Furthermore, the survey could be subject to recall bias of the respondents.

**DISCUSSION**

This survey of a representative sample of US hospitals revealed that most hospitals identify themselves as participants in healthcare coalitions for emergency preparedness and response. Organized healthcare coalitions have existed for many years and were started by groups of private hospitals,<sup>12</sup> state or local public health agencies, or hospital associations or were built on preexisting emergency response infrastructures, such as Metropolitan Medical Response System (MMRS), or trauma systems.<sup>6</sup> This survey shows that the adoption of this approach to the organization and performance of emergency preparedness and response by US hospitals is nearly universal in this sample and is a fairly recent development. Other surveys have shown similar results by analyzing the extent to which hospitals achieve certain emergency preparedness and

Table 5. Chi-square Tests: Characteristics of Coalitions Described as Involved in Preparedness and Response Compared to Those Involved in Preparedness Only

<i>Characteristics more likely associated with coalitions involved in response</i>	P Value
Participates in local emergency operations center	<0.001
Members contribute money or in-kind resources to support the coalition	<0.001
Coalition and its partners jointly purchase equipment or supplies and/or create regional stockpiles	<0.001
Coalitions coordinate alternative care facilities	<0.001
Coalitions serve as an information clearinghouse with systems for tracking patient load and available assets	<0.001
EMS providers, private or municipal representation in coalition	0.003
Emergency management agency representation in coalition	0.056
<i>Characteristics with no significant difference between groups</i>	
Public health agency representation in coalition	0.108
Method of HPP fund distribution	0.231
State or regional hospital association representation in coalition	0.253
Hospitals participate in national Hospital Preparedness Program	0.767
Lead organization of coalition	0.807
Voluntary participation in coalition	0.955

Table 6. Chi-square Tests: Characteristics of Coalitions Described as Members Contributing Money or Resources to Support the Coalition Compared to Those in Which Members Do Not

<i>Characteristics more likely associated with coalitions in which members contribute money or in-kind resources</i>	P Value
Coalition and its partners jointly purchase equipment or supplies and/or create regional stockpiles	0.001
Coalitions serve as an information clearinghouse with systems for tracking patient load and available assets	<0.001
Coalitions coordinate alternative care facilities	0.003
Method of HPP fund distribution	0.011
Public health agency representation in coalition	0.029
Participates in local emergency operations center	0.031
<i>Characteristics with no significant difference between groups</i>	
Voluntary participation in coalition	0.358
EMS providers, private or municipal representation in coalition	0.434
State or regional hospital association representation in coalition	0.536
Hospitals participate in national Hospital Preparedness Program	0.617
Emergency management agency representation in coalition	0.944
Lead organization of coalition	0.950

Figure 3. Characteristic Score by Coalition Age

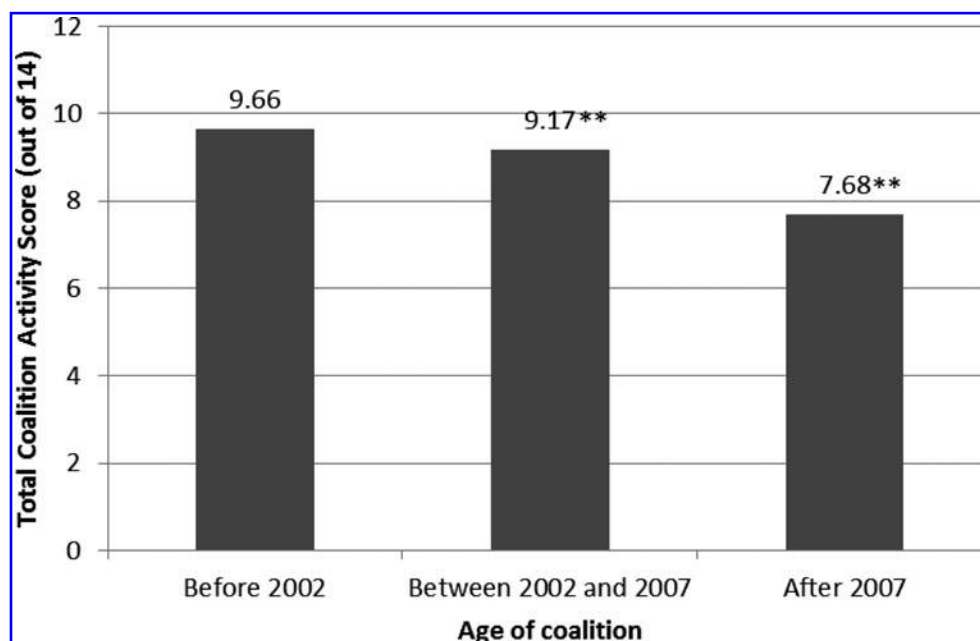




Table 7. Scores of Coalition Characteristic by Coalition Age

<i>Characteristic</i>	<i>Year Started</i>	
	<i>2007 and Earlier</i>	<i>After 2007</i>
Joint planning	0.97	1.00**
HPP participation	0.76	0.61*
Public health participation	0.83	0.58**
EMS participation	0.79	0.58**
Joint coalition response to disasters	0.85	0.58**
Coordinates alternative care facilities	0.61	0.39**
Mental health participation	0.44	0.26**
Contributes money/resources	0.24	0.16
Private ambulance provider participation	0.30	0.19
HPP funds to coalition	0.31	0.23
Formally linked	0.82	0.68
Joint purchasing	0.80	0.71
Participation in local EOC	0.78	0.77
Shares bed availability	0.94	0.94

\*Indicates a *p*-value of less than 10%.

\*\*Indicates a *p*-value of less than 5%.

response functions.<sup>13</sup> In a previous report on the first 5 years of the HPP program, background interviews of officials in 63 states and municipalities included frequent anecdotal reports of the significance of the development of healthcare coalitions.<sup>6</sup> Several new and established healthcare coalitions received competitive partnership grants, and their progress and development have been described.<sup>8</sup>

Because of the methodology of these previous reports, the question left unanswered was whether the importance and prevalence of healthcare coalitions as organizing entities for hospital preparedness and response was over- or underestimated in anecdotal reports. In the current study, 94% of surveyed hospitals identified themselves as healthcare coalition participants, suggesting that these entities are the dominant structures for hospital emergency preparedness and response.

The timing of the start of the healthcare coalitions suggests that HPP funding and guidance significantly affected their growth and development: 60% of coalitions developed after 2002 when HPP funding and guidance became available, and some have developed recently, since 2007, when guidance from the HPP began to emphasize the importance of this type of collaborative organization.<sup>3</sup> The lower coalition activity score for coalitions formed after 2007 suggests that seeking and gaining diverse stakeholder buy-in and participation takes a significant amount of time, as does engaging in response activities and preparedness activities.

The current study provides further details about healthcare coalitions. Respondents noted that more than 75% of hospitals in the surrounding local or regional community participated in the coalitions. Participation also included other stakeholders, such as public health agencies, emergency management agencies, and coalition members

that were linked by a formal agreement. This suggests that this is a true coalition and not just a hospital response to grant guidance or accreditation agency requirements. Roughly equal percentages of coalitions were described as being organized by a group of hospitals or a public health agency, which suggests that either structure can be successful from the perspective of participating hospitals. Similarly, a variety of HPP funding distribution methods were described, including direct funding of hospitals, of coalitions, or both, which did not seem to affect the range of functional capabilities of coalitions.

The identification of the breadth of stakeholder participation was also informative. As noted, public health and emergency management agencies, such as EMS and other first responder organizations, and state or regional hospital associations were most frequently mentioned; however, at least 25% of the respondents mentioned home health agencies, long-term care providers, mental health providers, and medical examiners' offices as partners in healthcare coalitions. This inclusion of essential stakeholders in community-wide planning and response also supports the conclusion that these coalitions are more than hospital-based entities.

The coalition functions most frequently reported demonstrate comprehensive efforts toward the development of surge capacity and capability. Although planning and training activities were most commonly reported, 75% of hospitals noted that the coalitions in which they participate were involved in joint response to mass casualty events through formal links to other hospitals and the jurisdictional response agencies, sharing of bed availability and surge capability during response, and participation with the local EOC.

About half the hospitals reported that coalitions coordinated the use of alternative care facilities or volunteers in the healthcare setting during an emergency response. The survey questionnaire was not designed to explore the use of volunteers, either in hospitals or alternative care facilities, in more detail. Further investigation is necessary to understand the way programs such as the Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP), the Medical Reserve Corps (MRC), and the National Disaster Medical System (NDMS) are coordinated with hospitals and healthcare coalitions at the local, state, and regional levels.<sup>14</sup>

There were some differences in the characteristics of coalitions that participated in an emergency response compared to those that participated only in preparedness. EMS and EMA were more frequently included in those coalitions that become involved in a response, and these coalitions played a role in the local EOC. Although only 23% of hospitals noted that members contributed money or in-kind resources, coalitions in which those hospitals participated were more likely to be involved in a disaster response, suggesting that member investment may be important for supporting response activity. Resource investment may also play a role in healthcare coalition sustainability and the commitment of members to the

mission of the organization, but these possibilities were not investigated in the current report.

## RECOMMENDATIONS

The findings of this survey suggest several implications for program guidance, performance measures, and funding strategies to promote further development of healthcare coalitions.

- The survey showed that nearly all hospitals are involved in preparedness activities but fewer are involved in response activities. Federal and state guidance to hospitals and public health agencies should emphasize building response functions of healthcare coalitions.
- The survey results indicated a correlation between EMS and EMA participation in a coalition and coalition participation in a local EOC with a coalition coordinating joint response to disasters. Guidance should promote the inclusion of EMS and EMA as stakeholders in coalitions, if they are not already included, and suggest participation in the local EOC.
- The survey showed lower participation of certain stakeholders in the coalition. Inclusion of ambulatory facilities, long-term care providers, coroners, medical examiners, federally qualified health centers (FQHCs), primary care practices, physicians' practices, home health agencies, and mental health providers in healthcare coalitions should be encouraged.
- The survey indicated that the variability in organization structures and mechanisms for distribution of hospital preparedness funds did not seem to affect hospital participation in coalitions. Therefore, flexibility in these areas should be maintained to allow for differences in historical strengths and weaknesses of potential lead agencies or entities.
- The survey showed that in only a few coalitions did members provide financial support or in-kind resources to the coalition. Sustainability planning should be a part of healthcare coalition work and strategy, as it will require funds to maintain current progress. Further studies are needed to determine the impact of financial or in-kind resource contributions by member institutions on the long-term sustainability and effectiveness of healthcare coalitions.

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Address correspondence to:  
*Kunal J. Rambhia, MS*  
*Senior Analyst*  
*Center for Biosecurity of UPMC*  
*621 East Pratt St., Ste. 210*  
*Baltimore, MD 21202*

*E-mail: krambhia@upmc-biosecurity.org*



# The Next Challenge in Healthcare Preparedness: Catastrophic Health Events

Preparedness Report | January 2010



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## Project Team: Center for Biosecurity of UPMC

**Eric Toner, MD, Principal Investigator**

Senior Associate

**Richard E. Waldhorn, MD, Co-principal Investigator**

Distinguished Scholar

**Crystal Franco, MPH, Project Manager**

Senior Analyst

**Ann Norwood, MD, COL, USA, MC (Ret.)**

Senior Associate

**Brooke Courtney, JD, MPH**

Associate

**Kunal Rambhia**

Analyst

**Matthew Watson**

Analyst

**Thomas V. Inglesby, MD**

Director and Chief Executive Officer

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**Project Contacts:** Eric Toner, MD, and Richard Waldhorn, MD

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# Executive Summary

## The Next Challenge in Healthcare Preparedness: Catastrophic Health Events

In 2007, the Office of the Assistant Secretary for Preparedness and Response (ASPR) in the U.S. Department of Health and Human Services (HHS) contracted with the Center for Biosecurity of UPMC (the Center) to conduct a 2-year, comprehensive assessment of the HHS Hospital Preparedness Program (HPP), from the time of its establishment in 2002 through mid-2007, and to develop recommendations for improving and evaluating future hospital preparedness efforts. This document, *The Next Challenge in Healthcare Preparedness: Catastrophic Health Events (Preparedness Report)*, is the third major deliverable of this project.

Prior to completing this *Preparedness Report*, the Center submitted to HHS its *Evaluation Report* (delivered March 2009). A key finding of the *Evaluation Report* was that, while much progress has been made in healthcare preparedness for common medical disasters, the U.S. healthcare system is ill-prepared for catastrophic health events (CHE), and there is as yet no clear strategy that will enable an effective response to such an event. For this report, the definition of “catastrophic health event” is that put forth in Homeland Security Presidential Directive 21 (HSPD-21): an event that could result in tens or hundreds of thousands of sick or injured individuals who would require access to healthcare resources.

This *Preparedness Report* proposes the following key elements of a national strategy for healthcare preparedness and response:

- Definition and vision of a U.S. healthcare system prepared to handle the response to a spectrum of mass casualty events that vary in size and severity from common medical disasters (eg, a bus crash or tornado), to catastrophic health events (eg, a nuclear detonation) that would seriously injure or sicken tens of thousands of people or more.
- Recommendations and actions that will lead to a healthcare system capable of responding to the full spectrum of mass casualty events, including CHEs.



## Methodology

The methodology used for this *Preparedness Report* included a thorough review of the published U.S. and international literature on healthcare disaster preparedness, healthcare response to disasters, and complex systems theory literature; a review of HPP program guidance from 2008 and 2009; and other federal guidance, plans, and documents with particular emphasis on CHEs. Three CHE scenarios based on federal planning assumptions also were considered in the development of this report.

A preliminary presentation of the analysis and recommendations of this report was made at the second Issue Analysis Meeting on February 24, 2009. Input and peer review from that meeting's participants — state and local disaster coordinators and key disaster healthcare leaders in government and academia — have also been incorporated into this document. See *Appendix D: Second Issue Analysis Group Meeting Participants* (page 54).

## Major Challenges to Catastrophic Health Event Response

The Center's analysis of the current system for a national response to CHEs revealed several major challenges:

- Many hospitals and other healthcare organizations do not yet participate in fully functional healthcare coalitions, which are necessary to CHE response.
- Most existing coalitions do not yet have the ability to share information, resources, and decision making with neighboring coalitions during a CHE.
- There are inadequate systems to perform the necessary triage, immediate treatment, and transport of patients outside of the immediate area stricken by a CHE.
- Existing plans and resources for patient transport are grossly inadequate for moving the expected numbers of patients.
- There is not enough guidance on the crisis standards of care that will be necessary throughout all stages of a CHE.
- There is no plan that sufficiently outlines healthcare roles, responsibilities, and actions during the response to a CHE.

## Definition and Vision of a Healthcare System Prepared for Events of All Sizes

**Definition:** A well-prepared healthcare system is able to effectively manage the healthcare consequences of common medical disasters and is able to respond quickly and with agility to harness all useful public and private national resources to cope with a CHE.

**Vision:** During a disaster, a well-prepared healthcare system will be able to function under a variety of adverse circumstances that may include: an immediate surge of patients in need of acute care, a prolonged surge of patients, a contaminated or contagious environment, loss of infrastructure that necessitates triage and treatment outside of healthcare institutions, poor situational awareness, and disruption of incident management chains of command.

## Recommendations

Described below are recommendations and specific actions that the federal government can take to achieve progress toward preparing the U.S. healthcare system for responding effectively to mass casualty events of all sizes (see Table 1). These recommendations are derived from the results of research and evaluation conducted by the Center in developing the *Descriptive Framework*, the *Evaluation Report*, the *HFPP and ECP Partnership Evaluation*; from conducting Issue Analysis Meetings; and from the Center's independent analysis.

**Table 1: Overview of Recommendations for Improving U.S. Healthcare Response to Mass Casualty Events of All Sizes**

RECOMMENDATIONS	ACTIONS
<p><b>Every U.S. hospital should participate in a healthcare coalition that prepares and responds collaboratively to common medical disasters and CHEs.</b></p>	<ul style="list-style-type: none"> <li>• A Presidential Decision Directive on healthcare preparedness for CHEs should be issued (as a follow-up to Homeland Security Presidential Directive-21*) to outline a vision of preparedness that builds on progress to date and is consistent with the National Health Security Strategy (NHSS).**</li> <li>• HPP, U.S. Centers for Disease Control and Prevention (CDC), and U.S. Department of Homeland Security (DHS) federal grant programs should require organization of grantee preparedness and response activities through healthcare coalitions linked to emergency management and public health authorities. Program guidance should outline the critical functions that coalitions must be able to perform.†</li> <li>• The HPP should promulgate more detailed guidance on the organization and response roles of healthcare coalitions, including surge capacity goals.</li> <li>• HPP guidance should specify surge goals to be achieved by healthcare coalitions.</li> <li>• Centers for Medicare and Medicaid Services (CMS) should provide all healthcare entities with financial incentives to participate in healthcare coalitions.</li> <li>• HPP should establish goals and metrics to assess the progress of the development of healthcare coalitions in every community.</li> </ul>
<p><b>Links should be established between neighboring healthcare coalitions to enable regional exchange of healthcare information and assets during a CHE.</b></p>	<ul style="list-style-type: none"> <li>• HPP, CDC, and DHS program guidance should specifically require collaboration with neighboring jurisdictions and coalitions across state lines, including sharing of plans and joint exercises.</li> <li>• HHS should develop guidelines and requirements for communications, situational awareness, and health information technology (HIT).</li> </ul>
<p><b>Out-of-hospital triage sites should be established and healthcare responders should be trained in CHE triage.</b></p>	<ul style="list-style-type: none"> <li>• Future HPP guidance should include requirements for out-of-hospital triage site designation, and ensure provision of specialized training in CHE triage for National Disaster Medical System (NDMS) teams and identified first responders.</li> </ul>

RECOMMENDATIONS	ACTIONS
<p><b>A patient transportation system that harnesses alternative, private sector resources should be created.</b></p>	<ul style="list-style-type: none"> <li>• Federal initiatives already in place to provide a national network of emergency medical transport capacity should address the enhancement of local emergency medical transportation following CHEs.</li> <li>• NDMS, DHS, and United States Transportation Command (USTRANSCOM) should jointly review and revise aeromedical evacuation strategies.</li> <li>• Federal and state governments should develop and disseminate guidance and best practices for transportation planning efforts.</li> <li>• HHS and DHS should jointly commission a detailed study of crisis standards of care related to patient transportation.</li> </ul>
<p><b>Development of crisis standards of care should be expanded, and their consistent implementation within and across states should be promoted.</b></p>	<ul style="list-style-type: none"> <li>• HHS should continue to provide leadership on the issue of crisis standards of care, to include providing a clearinghouse of information to facilitate state and local planning efforts.</li> <li>• Future HPP guidance should specify crisis standards of care planning, as well as intrastate and interstate consistency in crisis standards, as priorities for grantees.</li> </ul>
<p><b>A national framework for healthcare response to CHEs should be developed to guide states, jurisdictions, and local entities in developing ConOps for medical and public health activities.</b></p>	<ul style="list-style-type: none"> <li>• DHS and its federal partners should expedite the development of federal Concept of Operations (ConOps) for CHEs.</li> <li>• HHS should create a work group of federal planners and stakeholders to sketch a national ConOps for medical and public health activities (Emergency Support Function [ESF-8]) following a CHE, using a Tier 1 Urban Area Security Initiative (UASI) region.</li> </ul>

\* The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/xabout/laws/gc\\_1219263961449.shtm#1](http://www.dhs.gov/xabout/laws/gc_1219263961449.shtm#1). Accessed November 12, 2009.

\*\* U.S. Department of Homeland Security. Federal Emergency Management Agency. *Comprehensive Preparedness Guide 101*. March 2009. 2009. <http://www.fema.gov/about/divisions/cpg.shtm>. Accessed January 22, 2010.

† Healthcare coalition critical functions are described in the HHS Tier 2 *MSCC Handbook*, the Center for Biosecurity *Evaluation Report*, and the Center for Biosecurity *Provisional Assessment Criteria* (see *Appendix B* of this *Preparedness Report*, page 36).

## Conclusions

While the recommendations made in this report are feasible, many of them will take time to accomplish. Concrete progress toward the goal of CHE preparedness can be achieved through the series of actions outlined in this report, but will require sustained effort at the federal, state, and community levels for a number of years, and funding sufficient to make it possible.



# The Next Challenge in Healthcare

## Preparedness: Catastrophic Health Events

### Project Overview

In 2007, the Office of the Assistant Secretary for Preparedness and Response (ASPR) in the U.S. Department of Health and Human Services (HHS) contracted with the Center for Biosecurity of UPMC (the Center) to conduct a 2-year, comprehensive assessment of the HHS Hospital Preparedness Program (HPP), from the time of its establishment in 2002 through mid-2007, and to develop recommendations for improving and evaluating future hospital preparedness efforts. This document, *The Next Challenge in Healthcare Preparedness: Catastrophic Health Events (Preparedness Report)*, is the third major deliverable of this project. It builds upon the findings and recommendations of the earlier reports of this project, including the *Descriptive Framework for Healthcare Preparedness for Mass Casualty Events (Descriptive Framework)*<sup>1</sup> and *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward (Evaluation Report)*.<sup>2</sup>

#### **Key project activities and deliverables under this contract have included the following:**

- Development of the Center for Biosecurity of UPMC *Descriptive Framework for Healthcare Preparedness for Mass Casualty Events (Descriptive Framework)*, a conceptual model of local and regional healthcare system preparedness for mass casualty events that outlines the essential elements of hospital disaster preparedness (delivered February 2008.)
- Assessment of both the accomplishments of the HPP<sup>3</sup> from 2002 through 2007 and the impact of the program on hospital and community preparedness. The assessment was based on the

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1 Center for Biosecurity of UPMC. *Descriptive Framework for Healthcare Preparedness for Mass Casualty Events*. Prepared for the U.S. Department of Health and Human Services under Contract No. HHSO100200700038C. 2008.

2 Center for Biosecurity of UPMC. *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward*. Prepared for the U.S. Department of Health and Human Services under Contract No. HHSO100200700038C. 2009. <http://www.upmc-biosecurity.org/website/resources/publications/2009/pdf/2009-04-16-hppreport.pdf>.

3 The program's name has changed over time. Initially, it was referred to as the "National Bioterrorism Hospital Preparedness Program" (NBHPP), but it was renamed "Hospital Preparedness Program" (HPP). Recently, the name changed to the "National Healthcare Preparedness Program" (NHPP). Throughout this report, we refer to the program as "HPP." The HPP was originally administered by HHS's Health Resources and Services Administration (HRSA), but was moved to HHS's Office of the Assistant Secretary for Preparedness and Response (ASPR), where it now resides, pursuant to the December 2006 Pandemic and All-Hazards Preparedness Act (PAHPA).

*Descriptive Framework* and the contributions of members of a Virtual Working Group (Working Group) of local, state, and regional hospital preparedness experts. Both the assessment and the accompanying June 2008 and February 2009 Issue Analysis Meetings, comprising subgroups of the Working Group, culminated in *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward (Evaluation Report)*, which was delivered March 2009.

- Development of *Provisional Assessment Criteria* for evaluating progress in preparedness within the HPP program and determining the feasibility of adopting its elements as a tool for routine HPP reporting and assessment; these criteria are based on the *Descriptive Framework* and *Evaluation Report* (delivered August 2009). An excerpt from the *Assessment Criteria* is included in *Appendix B: Assessment Criteria for the Future* (page 36).
- Evaluation of the effectiveness, efficiency, and impact of the 11 demonstration grant projects in the competitive Healthcare Facilities Partnership Program (HFPP), the 5 demonstration projects in the Emergency Care Partnership Program (ECP), and development of policy recommendations for the ECP moving forward, delivered December 2009.

## Purpose of the Preparedness Report

A key finding of the March 2009 *Evaluation Report* was that, while much progress has been made in healthcare preparedness for common medical disasters, the U.S. healthcare system is ill-prepared to respond to catastrophic health events (CHE), and there is as yet no clear strategy that will enable an effective response to such an event.

This *Preparedness Report*, therefore, proposes key elements of a national strategy for healthcare preparedness and response to mass casualty events of all sizes. Those elements include the following:

- Major challenges to healthcare preparedness for CHEs
- Vision and definition of a successful response system for the future
- Recommendations for improving U.S. healthcare response to mass casualty events of all sizes
- Assessment criteria for measuring progress toward healthcare preparedness and response capability goals (see *Appendix B: Assessment Criteria for the Future*, page 36)

**Defining “Catastrophic Health Event”:** As defined by Homeland Security Presidential Directive 21 (HSPD-21), a CHE is “any natural or manmade incident, including terrorism, that results in a number of ill or injured persons sufficient to overwhelm the capabilities of immediate local and regional emergency response and health care systems.”<sup>4</sup> This magnitude of healthcare need would quickly exceed the capability of any locality or region. HSPD-21 directs the federal government to develop a strategy for addressing these kinds of events:

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<sup>4</sup> The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/about/laws/gc\\_1219263961449.shtm#1](http://www.dhs.gov/about/laws/gc_1219263961449.shtm#1). Accessed November 12, 2009.

*A catastrophic health event, such as a terrorist attack with a weapon of mass destruction (WMD), a naturally-occurring pandemic, or a calamitous meteorological or geological event, could cause tens or hundreds of thousands of casualties or more, weaken our economy, damage public morale and confidence, and threaten our national security. It is therefore critical that we establish a strategic vision that will enable a level of public health and medical preparedness sufficient to address a range of possible disasters.*<sup>5</sup>

Preparing the healthcare system for such events is challenging due to both the country's lack of experience with this scale of disaster and the level of coordination that CHE response would demand. Preparedness for CHEs will require new approaches that are in concord with ongoing successful efforts to prepare for common medical disasters and capable of addressing events of much greater consequence—those that could have national and homeland security significance.

## Methodology

The findings and recommendations of this *Preparedness Report* are based upon the Center's *Descriptive Framework*, findings and analysis described in the *Evaluation Report*, an updated review of the healthcare preparedness and disaster response, and input from hospital and public health preparedness experts from the Virtual Working Group.

***Descriptive Framework:*** The *Descriptive Framework* is a conceptual model of local and regional hospital and healthcare system preparedness for mass casualty events that outlines the essential elements of hospital disaster preparedness. It is based on the Center's comprehensive review and analysis of hospital disaster preparedness documents, which included reports, evaluations, handbooks, and studies that were produced before and after the 2002 establishment of the HPP.

***Evaluation Report:*** The *Evaluation Report* included a review of progress in healthcare preparedness in the HPP from 2002 to 2007 and preliminary recommendations for the future of the program. To select preparedness topics from the *Descriptive Framework* that would structure the *Evaluation Report* research, the project team completed: (1) a comprehensive review of the literature on and history of U.S. hospital preparedness, FY2002-2008 HPP guidance, and self-reported data from HPP grantees; (2) in-depth conversations with the Working Group, HHS staff and leadership, and experts in healthcare preparedness from every U.S. state, the District of Columbia, the nation's 3 largest municipalities (Chicago, Los Angeles, and New York), Puerto Rico, and the U.S. Virgin Islands; and (3) in-person discussions with Working Group participants during 2 Issue Analysis Meetings convened by the Center in June 2008 and February 2009.

**Literature review:** A thorough literature review was conducted using PubMed to identify all studies published in U.S. and international journals from 1995 through 2009 that examined the following topics: disaster preparedness in healthcare systems, healthcare response to disasters, and complex systems theory. The research team also conducted a thorough internet search using the Google search engine to supplement the PubMed search.

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5 The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/about/laws/gc\\_1219263961449.shtm#1](http://www.dhs.gov/about/laws/gc_1219263961449.shtm#1). Accessed November 12, 2009.



The team reviewed HPP program guidance from 2008 and 2009, as well as other federal guidance, plans, and documents relevant to healthcare response to mass casualty events, with particular emphasis on CHEs. See: *Appendix C: Existing Systems for CHE Response* (page 44).

**Virtual Working Group:** The Working Group phase of the evaluation involved 91 in-depth telephone or in-person conversations with 133 individuals who had firsthand experience with hospital preparedness efforts (including but not limited to HPP experience); participants represented all U.S. states, the District of Columbia, the nation’s 3 largest municipalities (Chicago, Los Angeles, and New York), Puerto Rico, and the U.S. Virgin Islands. The project team identified and recruited Working Group participants by contacting grant coordinators and HPP leaders from each of the 62 jurisdictions participating in the HPP (see Figure 1).

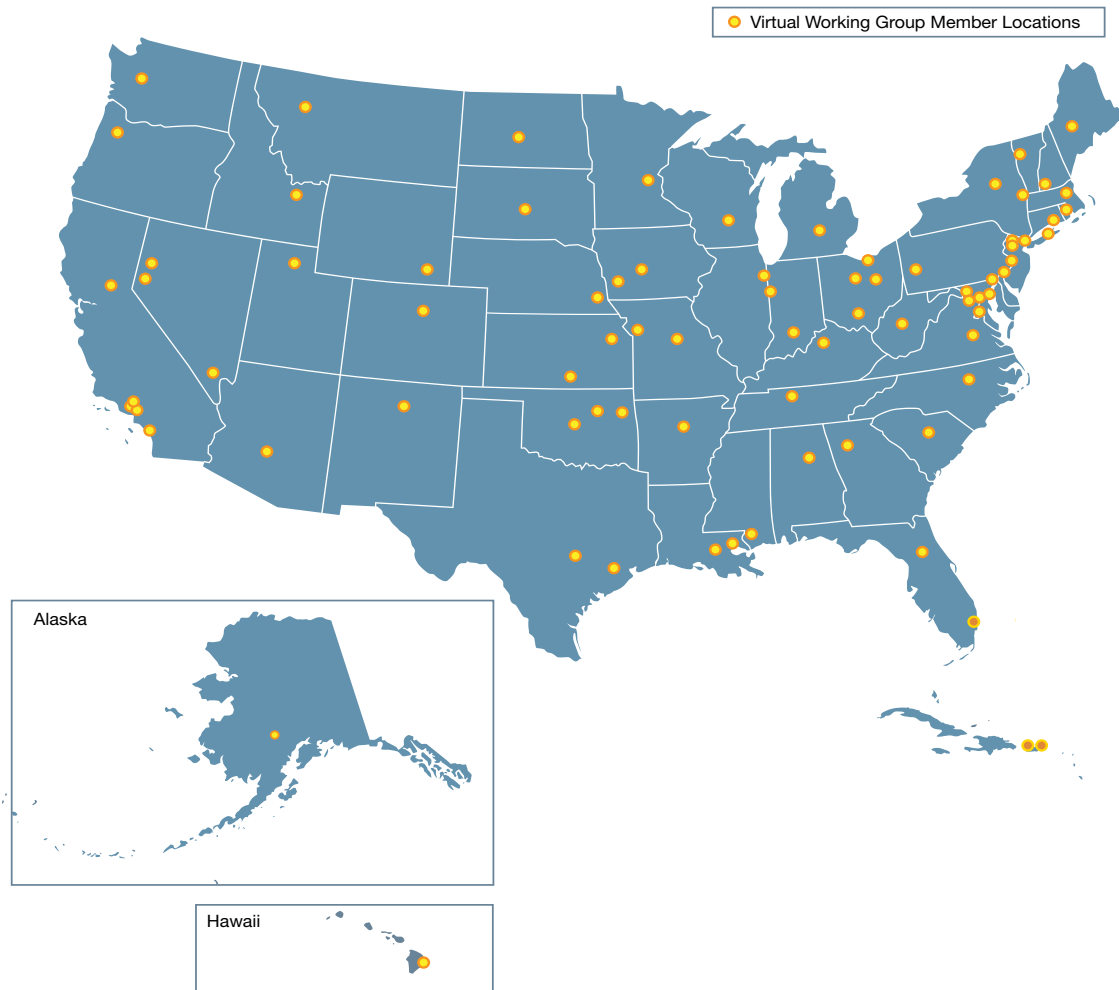
**Participants:** Virtual working group participants included HPP grant coordinators; state hospital preparedness coordinators; disaster coordinators from academic medical centers, public hospitals, nonprofit community hospitals, for-profit hospitals, small independent hospitals, and hospitals belonging to multi-hospital organizations; emergency medical services (EMS) representatives; healthcare preparedness experts; leaders in healthcare and public health; and leaders of key government preparedness and evaluation efforts. In all, 9 healthcare sectors were represented by 91 participants; numbers of participants from each sector are noted below:

- Department of Health—Municipality: 6
- Department of Health—State: 31
- Department of Health—Territory: 2
- EMS: 3
- Hospital: 28
- Hospital Association: 4
- Hospital Region: 4
- Hospital System: 6
- National Preparedness Leaders: 7

Hospital representatives were selected from various types and sizes of institutions in an attempt to assess progress toward preparedness in the range of hospital systems, from rural to urban.

**Issue Analysis Meeting:** The Center invited 28 individuals to participate in its second Issue Analysis Meeting (Issue Analysis Meeting: National Strategy for Healthcare Preparedness and Response for Catastrophic Health Events), which focused on healthcare preparedness topics in more detail, through a structured, in-person group discussion. Participants included local, state, and federal public health and government officials, representatives from hospitals and health systems, representatives from academia, and other subject matter experts (see *Appendix D: Second Issue Analysis Group Meeting Participants*, page 54, for a list of participants). The meeting was held on February 24, 2009, at the Center for Biosecurity of UPMC in Baltimore, Maryland. Each of the 28 participants was provided with a draft of the *Evaluation Report* and other background materials to review in advance. During the meeting, the group was presented with 2 scenarios, derived from the DHS National Planning Scenarios (NPS), and similar to Scenarios #1 and #2 included in this report (see pages 13 and 14) The meeting was facilitated by Center leaders and senior members of the Center’s HPP project team on a not-for-attribution basis and was recorded for reference purposes only.

Figure 1. Map of Working Group Participants for HPP Evaluation



To confirm the validity of the findings and to promote further exploration, the meeting discussions were organized around the following 5 topic areas derived from the Working Group conversations:

- Need for a national (not federal) concept of operations (ConOps) plan for healthcare response to CHEs down to the local level.
- Promotion of fully functioning healthcare coalitions in every community.
- Creation of a patient transport system that harnesses private sector resources.
- Establishment of close operational relationships among neighboring healthcare coalitions for mutual aid to supplement state and federal incident command systems.
- Provision of incentives for all healthcare entities to participate in healthcare coalitions for disaster response.

Discussions addressing each of the meeting topics ranged from approximately 30 to 60 minutes. Feedback from the second Issue Analysis Meeting was received and incorporated into the *Preparedness Report*. While the views in this report were substantially shaped by those expressed by members of the 133 Virtual Working Group members and the 27 individuals who participated in the second Issue Analysis Meeting, the *Preparedness Report* represents the opinions of the Center for Biosecurity of UPMC and does not necessarily represent the opinions or consensus of the meeting participants.

**Definitions:** The term “mass casualty event” has been used to describe many kinds of disasters that range widely in scale and number of casualties. This report will use the same definition of “mass casualty event” that was used in the earlier *Descriptive Framework*: “any event that requires the coordinated response of at least several hospitals within a community to provide adequate medical care for those affected.”

The definition of “catastrophic health event” used in HSPD-21<sup>6</sup> is used in this report: “Any natural or manmade incident, including terrorism, that results in a number of ill or injured persons sufficient to overwhelm the capabilities of immediate local and regional emergency response and health care systems.”<sup>7</sup>

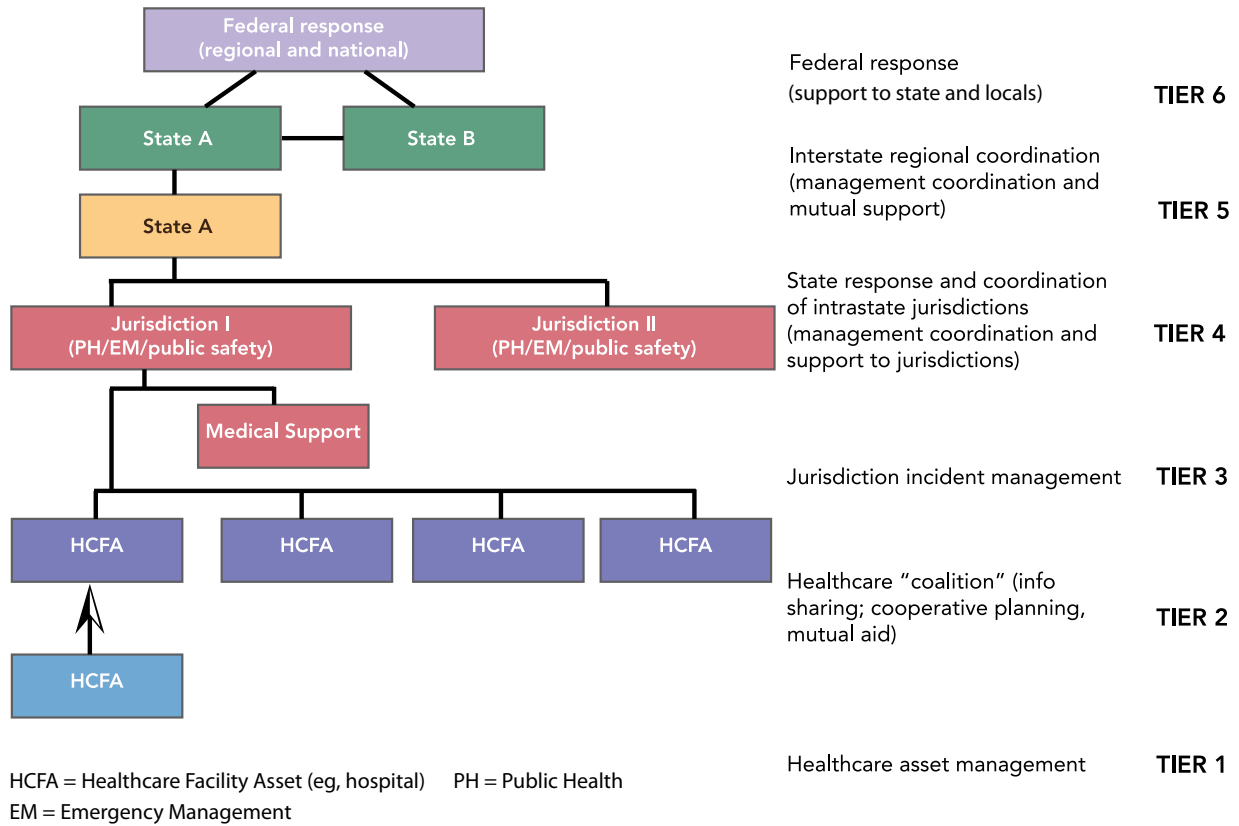
Healthcare coalitions were identified in the *Evaluation Report* as essential to effective regional response to commonly occurring mass casualty events and as an important part of the foundation of a national strategy for response to CHEs. Healthcare coalitions have been defined in a variety of ways, reflecting the current great diversity in their composition, organization, governance, and scope of activities. In this report “healthcare coalition” is defined as a formal collaboration among hospitals, public health, and emergency management authorities (EMA) that may include other nonhospital healthcare entities. The geographic size and relationship between a coalition and city, county, or state jurisdictional boundaries vary and reflect local conditions. Fully functional and mature healthcare coalitions have a role in both preparedness and response. This project expands the definition of healthcare coalitions to correspond to the first 3 Medical Surge Capacity and Capability (MSCC) Framework tiers (see Figure 2) to emphasize the concept outlined in the MSCC that the coalition must integrate with the broader jurisdiction emergency management agencies.

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6 *Homeland Security Presidential Directive 21* establishes a National Strategy for Public Health and Medical Preparedness, and was set forth by President Bush in October 2007. For more information see *Appendix C* of this *Preparedness Report* page 44.

7 The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/about/laws/gc\\_1219263961449.shtml#1](http://www.dhs.gov/about/laws/gc_1219263961449.shtml#1). Accessed November 12, 2009.

Figure 2. Adapted from HHS Medical Surge Capacity and Capability (MSCC) Framework<sup>8</sup>



<sup>8</sup> U.S. Department of Health and Human Services. *Medical Surge Capacity and Capability: The Healthcare Coalition in Emergency Response and Recovery*. Prepared for HHS Under Contract # HHSP23320064154EB. May 2009.



# Why the U.S. Healthcare System Must Prepare for Catastrophic Health Events

Since the inception of modern medicine, the U.S. has been fortunate to have had no experience with CHEs. The 9/11 attacks and Hurricane Katrina (2005), as terribly consequential as they both were, did not result in tens of thousands of patients in need of access to emergency medical care. However, other regions of the globe have not been so fortunate, as was the case in the devastating earthquakes in Haiti (2010) and China (2008) and the tsunami in Southeast Asia (2005), all of which are examples of CHEs.<sup>9</sup>

There are a number of terrorist and natural hazard scenarios articulated in the NPS that have the potential to be catastrophic in nature, and for which the U.S. must plan and prepare.<sup>10</sup> Given the potential consequences, CHE preparedness is a matter of national security.

Building the capability to respond effectively to a CHE will take a great deal of effort and coordination of private and public institutions and resources. From previous discussions with local and state level disaster preparedness coordinators, it is clear that, while the country has made progress toward responding to common medical disasters, less progress has been made in thinking through and preparing for CHE response. Therefore, the next step in national disaster preparedness must be to develop plans to respond effectively to CHEs.

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9 Haiti: On January 12, 2010, an earthquake of a magnitude 7.0 struck Haiti. As this report is being prepared, details about the earthquake are still emerging. However, with casualty estimates ranging from 100,000 to 200,000 and as yet undetermined numbers of injured victims, there is no question about the scale of this disaster or that it fits the definition of a CHE. • China: On May 12, 2008, a large earthquake in the Sichuan Province of China killed more than 69,000 people, injured more than 370,000, and left almost 5 million people homeless. • Southeast Asia: The 2005 Indian Ocean Tsunami left nearly 200,000 people dead across 11 countries, injured more than 100,000, and displaced or left homeless several million.

10 U.S. Department of Homeland Security (DHS). *National Preparedness Guidelines*. September 2007. [http://www.dhs.gov/xlibrary/assets/National\\_Preparedness\\_Guidelines.pdf](http://www.dhs.gov/xlibrary/assets/National_Preparedness_Guidelines.pdf). These scenarios include a biological attack, a nuclear detonation, and a large scale earthquake.



# Examples of Catastrophic Health Events

The U.S. could confront a range of CHEs that would be attended by distinct challenges, even as they shared key commonalities. CHEs could be geographically widespread, like an influenza pandemic, or could be more localized, like a large hurricane or a nuclear detonation. A CHE may cause obvious and extensive physical destruction, or it may cause destruction that is not immediately obvious. By definition, all CHEs have the potential to produce tens or hundreds of thousands or more live casualties that would overwhelm the healthcare system.

The following 3 scenarios illustrate the size and scale of exemplar CHEs, estimate the healthcare system resources that would be required and available for response, and posit the major challenges to effective healthcare response. The first 2 scenarios<sup>11</sup> are based on the NPS released by the Homeland Security Council and DHS, but include additional information about healthcare capacity. The third scenario uses HHS planning assumptions for a severe influenza pandemic<sup>12</sup> and applies these assumptions to CDC's FluSurge<sup>13</sup> modeling program to derive additional information about healthcare capacity for the event.

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11 The White House Homeland Security Council. *National Planning Scenarios: Executive Summaries—Created for Use in National, Federal, State, and Local Homeland Security Preparedness Activities*. April 2005. Page 2-1. <http://cees.tamui.edu/covertheborder/TOOLS/NationalPlanningSen.pdf>. Accessed November 25, 2009.

12 U.S. Department of Health and Human Services. *HHS Pandemic Influenza Plan. November 2005, Planning Assumptions*. <http://www.hhs.gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf>. Accessed September 26, 2009.

13 *CDC FluSurge 2.0*. Atlanta, GA: U.S. Centers for Disease Control and Prevention. <http://www.cdc.gov/flu/tools/flusurge/>. Accessed September 26, 2009.





## Scenario 1: Nuclear Detonation

### Detonation of 10-Kiloton Improvised Nuclear Device (from National Planning Scenario #1)

- **Location:** Washington, DC/National Capital Region (NCR).
- **Physical damage:** Extensive building collapse; 250 major fires within ¼-mile radius; loss of electrical power, most electronics, and communication within ¾ miles. In outer ring, shattered glass and auto crashes that could cause thousands of injuries.
- **Fallout:** Extends into Virginia, Maryland, and possibly beyond.
- **Casualties:** 9,000 instantaneous deaths; 19,000 injured from blast, burns, trauma, and radiation (6,000 die in <24 hours; 13,000 acutely injured victims survive).
- **Injuries and illness:** An additional 120,000 victims exposed to significant fallout, with acute radiation syndrome (ARS) over 1 to 14 days; most will need hospital care; many could survive if care is received.

### Hospital Capacity (Center for Biosecurity estimate)

- **Within 20-mile radius:** 4 of 49 hospitals are destroyed or nonfunctional;\* the estimated surge capacity of 45 other hospitals in the area is 3,500 beds.\*\*
- **Within 100-mile radius:** Approximately 14,000 surge beds and 2,000 intensive care unit (ICU) beds could be available within 24 hours.†

### Challenges

- **Search and rescue operations:** In such a difficult and dangerous environment, many victims will die before they can reach a hospital.
- **Transportation for responders, public, and patients:** Infrastructure will be severely damaged, and there will be debris throughout the city.
- **Identification, screening, and transport of ARS patients:** No method currently exists for rapidly categorizing patients based on dose of radiation and risk.
- **Communications:** Most modes of communication will be disrupted.
- **Hospital surge:** All hospital beds from Philadelphia to Norfolk will be needed for the acutely injured; fallout patients will require surge capacity of the entire U.S. healthcare system.‡

\*Determined by overlaying NPS map with location of hospitals on Google maps.

\*\*Based on Center's estimate of 30% surge capacity available within 24 hours from 13,000 total beds (after subtracting the number of damaged hospitals assuming 20% surge available immediately and additional 10% available within 24 hours).

†Based on Center's estimate of 30% surge capacity available within 24 hours of 46,000 total beds within 100 miles.

‡Sheltering in a building following a nuclear event could provide significant protection from radiation. DHS is currently working on guidelines and recommendations for sheltering in place and other protective actions. IOM. *Assessing Medical Preparedness to Respond to a Terrorist Nuclear Event: Workshop Report*. Washington, DC. The National Academies Press. 2009. Pages 18, 19, 48, 49.



CDC/Laura Rose/Janice Haney Carr

## Scenario 2: Biological Attack

Attack with Aerosolized *B. anthracis* (from National Planning Scenario #2)

- **Location:** Large city, such as Washington, DC/National Capital Region (NCR).
- **Potentially exposed:** 330,000 individuals; release not recognized until first patients become sick\*.
- **Cases:** 13,000 cases of inhalational anthrax, most requiring critical care.
- **Median incubation period:** 10 days.
- **Hospital beds needed:** 13,000 critical care beds.

Hospital Capacity (Center for Biosecurity estimate\*\*)

- **Within 20-mile radius:** 49 hospitals; 13,000 beds in total.
- **Estimated surge capacity:** 3,300 regular beds available within 24 hours;† 585 ICU beds available within 24 hours.‡

### Challenges

- **Hospital triage:** Thousands or tens of thousands of noncritical individuals will seek medical care at hospitals.
- **Surge capacity:** There will be a critical lack of regional hospital and ICU surge capacity—only 5% of critical care surge and 30% of hospital bed needs can be met regionally.
- **Limited time to implement response:** Patient surge will greatly exceed capacity within 1 to 2 days of recognition of outbreak.
- **Diagnostics:** No rapid diagnostic tests for anthrax currently exist.
- **Needs vs. resources:** Need for mass dispensing of limited countermeasures to public and responders.

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\*NPS assumes that the release would not be detected by the BioWatch system.

\*\*Personal communication, ASPR.

†Based on the Center's estimate of 30% surge capacity available within 24 hours.

‡Based on the Center's estimate of 15% of hospital beds being ICU beds.



## Scenario 3: Severe Influenza Pandemic

1918-like Severe Influenza Pandemic (from HHS Planning Assumptions\*)

- **Location:** Entire U.S.
- **Symptomatic cases:** 90 million
- **Outpatient visits:** 45 million
- **Hospitalizations:** 9.9 million

Healthcare Resources Required: Peak Bed Occupancy & Ventilator Utilization by Flu Patients (FluSurge\*\*)

- **Hospital beds:** 1,130,284 (151% of existing hospital beds nationally)
- **ICU beds:** 327,475 ICU beds (364% of existing ICU beds nationally)
- **Ventilator utilization:** 163,737 (205% of existing ventilators nationally)

### Challenges

- **Scope:** All hospitals and all communities will be affected more or less concurrently. Sharing of resources and distribution of patient load is not likely to be possible.
- **Scale:** All medical care capacity will be overwhelmed, especially emergency departments and ICUs.
- **Limited resources:** There will not be enough ventilators for all who need them and, mass dispensing of limited countermeasures to the public will be very difficult.
- **Resource allocation:** Optimal allocation of scarce medical resources and coordinated implementation of crisis standards of care will be very important.

\*U.S. Department of Health and Human Services. *Pandemic Influenza Plan. November 2005, Planning Assumptions*. <http://www.hhs.gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf>. Accessed September 26, 2009.

\*\*CDC, FluSurge 2.0. <http://www.cdc.gov/flu/tools/flusurge/>. Accessed September 26, 2009. Input HHS planning assumptions for a severe pandemic along with population data and healthcare resource data for entire U.S. using a 15% attack rate during an 8 week outbreak.



## Major Challenges to Catastrophic Health Event Response

Catastrophic health events are in many ways fundamentally different from common medical disasters. Casualties will be orders of magnitude higher in a CHE, infrastructure may be destroyed, and incident command may be significantly hampered. The first hours and days following a CHE will be chaotic, with limited healthcare situational awareness or communications capabilities; incident commanders will be overwhelmed; and communication will likely be difficult. In all likelihood, in this kind of event there will be no single entity or individual with the situational awareness, information sources, or communication capacity to effectively direct the use of all available medical resources or the distribution of patients. However, in many scenarios, this period of time will be the most critical for CHE healthcare response. Actions taken during this period are likely to determine how many people ultimately will live or die, whether there will be a functioning healthcare system, and the public's perception of the response.

Many hospitals and other healthcare organizations do not yet participate in fully functional healthcare coalitions, which are necessary to CHE response.

The *Descriptive Framework* identified community-based collaboration among institutions and agencies in the healthcare sector as essential to preparedness for mass casualty events. The *Medical Surge*

*Capacity and Capability (MSCC) Handbook*,<sup>14</sup> the Joint Commission standards,<sup>15</sup> and HPP guidance<sup>16</sup> all emphasize the importance of such cooperation. Without a mechanism for coordinating the efforts of many response organizations, it will be impossible for healthcare institutions to respond optimally to large mass casualty events. As detailed in the earlier *Evaluation Report*, the healthcare coalitions that have emerged across the country are in various stages of development. Their diverse structures, membership, and missions reflect the needs of different communities, the highly fragmented and competitive U.S. healthcare landscape, and the limited coalition guidance provided thus far by federal partners and healthcare regulators. Coalitions continue to emerge and develop around the country, yet much of the U.S. healthcare system today still is not represented in a healthcare coalition, and many existing coalitions are not yet fully developed and functional in both preparedness and response. There remains a need to fund and guide the development of coalitions around the country, using a common, yet flexible, set of functional criteria (See *Appendix B – Provisional Assessment Criteria*, page 36).

### Most existing healthcare coalitions do not yet have the ability to share information, resources, and decision making with neighboring coalitions during a CHE.

A CHE, as defined by HSPD-21, would produce a number of casualties sufficient to overwhelm, fairly quickly, the resources of not just an individual hospital, but an entire healthcare coalition, and even multiple contiguous coalitions. In order to respond to an event of this magnitude, mechanisms must be in place to obtain situational awareness of the healthcare response (eg, number of patients, type of patient care, available beds, available staff, transportation assets, etc.), and to make coordinated decisions about allocation of scarce resources (ie, staff, equipment, and materials), standards of care, and alternate care arrangements.

Currently, there are no mechanisms in place to achieve the situational awareness needed for national coordination of public and private healthcare resources, to track and manage resources, or to facilitate the difficult healthcare decision making that will be necessary in response to a CHE. While many healthcare coalitions now have communications plans, equipment, and procedures that better enable situational awareness among partners within a coalition, the ability to develop an accurate understanding of the larger scope and pace of an emergency throughout a state, region, or the nation, and the ability to execute an appropriate and adequate CHE response remains an enormous challenge. Horizontal communication and collaboration among neighboring healthcare coalitions, including connections across state borders, have not yet been formed in most locations. Such horizontal communication efforts should complement the vertical connections currently being established among healthcare coalitions and state, multistate-regional, and federal officials.<sup>17</sup>

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14 U.S. Department of Health and Human Services. *Medical Surge Capacity and Capability Handbook*, 2nd ed. <http://www.hhs.gov/disasters/discussion/planners/mscc/index.html>. September 2007.

15 The Joint Commission. *History Tracking Report: 2009 to 2008 Requirements*. Accreditation Program: Hospital. Chapter: Emergency Management. 2008. [http://www.jointcommission.org/NR/rdonlyres/D5607767-744C-462D-9527-B9B0E464C524/0/HAP\\_EM\\_09\\_to\\_08.pdf](http://www.jointcommission.org/NR/rdonlyres/D5607767-744C-462D-9527-B9B0E464C524/0/HAP_EM_09_to_08.pdf). Accessed January 7, 2010

16 U.S. Department of Health and Human Services. Hospital Preparedness Program (HPP). Office of the Assistant Secretary for Preparedness and Response. Notice. 73 FR 28471 (May 16, 2008).

17 One exception to this is the FEMA's Region 4 Unified Planning Coalition (UPC), an interstate public health and medical preparedness and response organization devoted to planning and the development of partnerships.

In a CHE, healthcare coalitions will have to take a lead role in coordinating the allocation of scarce resources and implementing crisis standards of care in a fair, uniform, and ethical manner based on situational awareness and resource assessment. Healthcare coalitions have begun to plan individually for these scenarios, yet the situational awareness, communications, and coordination mechanisms needed to implement them have not yet been developed. If they are to succeed in CHE response, coalitions will have to coordinate and share information with neighboring coalitions, in addition to local, state, tribal, regional, and federal officials.

### There are inadequate systems to perform the necessary patient triage, treatment, and transport out of the immediate area stricken by a CHE.

The hospitals closest to a CHE or within the stricken area, which likely operate at or near full capacity on a normal day, will be very quickly overwhelmed if they are still operational. By definition, any CHE will produce an overwhelming number of sick or injured patients, along with patients who are suffering from stress-related health problems after the event. The primary concerns of hospitals still in operation must be protecting the health of already hospitalized patients and the triage and rapid temporary stabilization of incoming patients. It will be essential that patients are transferred quickly to other, less-affected hospitals; in most instances, this will require transfer to another city or jurisdiction. To lessen the burden on the hospitals as much as possible, initial triage of all patients and treatment of those with non-life threatening conditions should take place somewhere other than the hospital. HHS has developed a functional response system, Radiation Triage, Treatment and Transport (RTR) that features Assembly Centers (for non-critically injured and general evacuees) and Medical Care sites.<sup>18</sup> The RTR system has been incorporated into practical guidance for local responders rendering life-saving assistance in the wake of a nuclear detonation.<sup>19</sup> The RTR is a reasonable approach and a good beginning; however, even if the RTR system were to be implemented successfully, the number of people in need of care would likely far exceed the capacity of nearby hospitals.

### Existing plans and resources for patient transport are grossly inadequate for moving the expected numbers of patients during a CHE.

Patient transport will be very difficult during the response to a CHE. According to each of the NPS, crucial lifesaving medical care will be needed in the initial hours and days following a CHE, long before many federal and state resources will arrive on scene.<sup>20</sup> Furthermore, in many CHE scenarios, the total number of deployable state and federal resources is not sufficient to accommodate the number of anticipated patients.<sup>21</sup> Based on the NPS and the healthcare capacity in most major U.S. cities, hospital surge capacity within a 100- to 200-mile radius of a CHE will be exceeded quickly in most cases;

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18 Hrdina CM, Coleman CN, Bogucki S, Bader JL, Hayhurst RE, Forsha JD, Marcozzi D, Yeskey K, Knebel AR. The "RTR" medical response system for nuclear and radiological mass-casualty incidents: A functional TRIage-TRAnsport-TReatment medical response model. *Prehospital Disast Med.* 2009;24(3):167–178.

19 Homeland Security Council Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats. *Planning Guidance for Response to a Nuclear Detonation. First Edition.* January 16, 2009

20 Franco C, et al. The National Disaster Medical System: past, present, and suggestions for the future. *Biosecur Bioterr.* 2007;5 (4).

21 Ibid.

response to some scenarios will necessitate integration of the surge capacity of the entire country. This need for healthcare surge will require rapid and efficient transport of patients to facilities in outlying areas, and will necessitate employment of alternative modes of transportation, such as private vehicles, buses, helicopters, water craft, and other nontraditional means.

### There is not enough guidance on the crisis standards of care that will be necessary throughout all stages of a CHE.

The preceding CHE challenges—provision of triage in alternate care sites and rapid transport of patients out of the stricken area—involve changing the ways in which healthcare operations normally are carried out. Consideration of crisis standards of care, therefore, is integral to all parts of CHE response. Often, this planning is the responsibility of state or local health departments, individual hospitals, and/or healthcare coalitions, and is complicated by the range of public and private sector stakeholders involved, challenging medical and legal issues, limited guidance, and the need for consistency in plan development and implementation. HHS and state and local planners have developed some useful guidance documents for moving this issue forward at the state, local, and hospital levels.<sup>22</sup> However, even allowing for differences among communities, there is significant variability in crisis standards of care planning among state and local jurisdictions, as well as among individual hospitals and healthcare coalitions. This variability includes, for example, differences in the stages of plan development, the content of plans, and the approaches to managing scarce resources. Moreover, research has shown that many states are having difficulty in planning for crisis standards of care and have requested additional assistance and guidance from HHS.<sup>23,24</sup> The recent guidance on crisis standards of care from the Institute of Medicine (IOM) does define the challenges and begins to provide national level guidance for crisis standards. The IOM document recognizes regional variability and promotes consistency and transparency while also identifying remaining critical gaps in planning.<sup>25</sup>

### There is no plan that sufficiently outlines healthcare roles, responsibilities, and actions during the response to a CHE.

At present, federal concept plans (CONPLANS) and operations plans (OPLANS) for a CHE are still under development, and the National Health Security Strategy has just been released.<sup>26</sup> A number of federal

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22 See, for example: Institute of Medicine, Committee on *Guidance for Establishing Standards of Care for Use in Disaster Situations. Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations: A Letter Report*. September 2009 • U.S. Agency for Healthcare Research and Quality. *Altered Standards of Care in Mass Casualty Events*. AHRQ Publication No. 05-0043. 2005 • U.S. Agency for Healthcare Research and Quality. *Mass Medical Care with Scarce Resources: A Community Planning Guide*. AHRQ Publication No. 07-0001. 2007 • Devereaux A, Christian MD, Dichter JR, et al. Summary of suggestions from the Task Force for Mass Critical Care Summit, January 26-27, 2007 *Chest*. 2008;133(5):1S-7S • New York State Department of Health and New York State Task Force on Life and the Law. *Allocation of Ventilators in an Influenza Pandemic: Planning Document*. March 15, 2007.

23 U.S. Government Accountability Office. *Emergency Preparedness: States Are Planning for Medical Surge, but Could Benefit from Shared Guidance for Allocating Scarce Resources* (GAO-08-668). June 2008.

24 Center for Biosecurity of UPMC. *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward*. Prepared for the U.S. Department of Health and Human Services under Contract No. HHSO100200700038C. 2009.

25 Institute of Medicine, Committee on *Guidance for Establishing Standards of Care for Use in Disaster Situations. Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations: A Letter Report*. September 2009.

26 U.S. Department of Health and Human Services. Assistant Secretary for Preparedness and Response. *National Health Security Strategy*. December 2009. <http://www.hhs.gov/aspr/opsp/nhss/index.html>. Accessed January 22, 2010.

documents and initiatives have been created to integrate and synchronize response and recovery plans among federal, regional, state, territorial, and local governments. The *Comprehensive Preparedness Guide 101*, published in March 2009,<sup>27</sup> serves as the foundation for state and local planning. *Appendix C: The Current System for a National Response to CHEs* (page 44), depicts existing CHE preparedness and response structure and assets at multiple levels of government. Federal planners envision that, over time, there will be a truly national all-hazard ConOps plan. Currently, however, the lack of such a plan remains an obstacle to effective planning for CHEs.<sup>28</sup>

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27 U.S. Department of Homeland Security. Federal Emergency Management Agency. *Comprehensive Preparedness Guide 101*. March 2009. <http://www.fema.gov/about/divisions/cpg.shtm>. Accessed January 22, 2010.

28 The federal government is currently reviewing preparedness plans and policies, so this information may change. October 2009. Personal communication, ASPR.





FEMA/Marvin Nauman

# Definition and Vision of a Healthcare System Prepared for Mass Casualty Events of All Sizes, Including Catastrophic Health Events

## Definition of Healthcare Preparedness

A well prepared healthcare system is one that is able to respond quickly and with agility to mass casualty events of all sizes and sources, including those that cross jurisdictional boundaries, so as to minimize loss of life, suffering, and serious adverse effects on society. Such a system would include every healthcare institution and every community in the country. In the midst of an event as large as a CHE, a prepared system would be able to provide care for the sick and injured, protect the well, and maintain essential healthcare services for the general population. The system would be able to harness all useful national public and private resources to cope with a CHE.

## Vision of Success

**Healthcare coalitions for preparedness and response:** In a well prepared healthcare system, every healthcare institution will be integrated into a community-based healthcare coalition that joins public health agencies, EMAs, Emergency Medical Services (EMS), and private non-healthcare partners. Healthcare coalitions would serve both preparedness and response functions in their communities and would be linked together through interpersonal and electronic connections to create regional coalition networks.

**Horizontal and vertical communications:** Healthcare coalitions would have the ability to communicate both horizontally, with other coalitions, and vertically, with state, multistate regional, and federal authorities.

**Resource sharing:** A healthcare coalition would have agreements among its members and with neighboring coalitions to share equipment and staff in an emergency, and agreements and procedures to guide the use of crisis standards of care, alternate care facilities, and patient evacuation and transportation.

**Utilization of public and private assets:** The communications, coordination, and resource sharing within and among coalitions and with state, regional, and federal authorities would make available the use of substantial public and private healthcare assets during a disaster.

**Flexible response to adverse circumstances:** The healthcare system would be able to function under a variety of adverse circumstances that may include the following: an immediate and/or prolonged surge of patients in need of acute care; a contaminated or contagious environment; a loss of infrastructure and/or the need to triage and treat outside of a hospital or other healthcare institution; inadequate situational awareness; and a disruption of incident management chains of command.

With healthcare partners and coalitions connected both horizontally and vertically, individual parts of the healthcare system would be able to function autonomously if cut off from outside support and direction.

**Resilience:** Furthermore, the healthcare system as a whole would be able to adapt if parts became disabled, and after a disaster, the system would be able to recover quickly and resume provision of essential healthcare services to the population.

## Recommendations for Improving U.S. Healthcare Response to Mass Casualty Events of All Sizes

Described below are recommendations and specific actions that the federal government can take to achieve progress toward preparing the U.S. healthcare system for responding effectively to mass casualty events of all sizes (see Table 1, below). These recommendations are derived from the results of research and evaluation conducted by the Center in developing the *Descriptive Framework*, the *Evaluation Report*, the *HFPP and ECP Partnership Evaluation*; from conducting Issue Analysis Meetings; and from the Center's independent analysis.

**Table 1: Overview of Recommendations for Improving U.S. Healthcare Response to Mass Casualty Events of All Sizes**

RECOMMENDATIONS	ACTIONS
<p><b>Every U.S. hospital should participate in a healthcare coalition that prepares and responds collaboratively to common medical disasters and CHEs.</b></p>	<ul style="list-style-type: none"> <li>• A Presidential Decision Directive on healthcare preparedness for CHEs should be issued (as a follow-up to Homeland Security Presidential Directive-21*) to outline a vision of preparedness that builds on progress to date and is consistent with the National Health Security Strategy (NHSS).**</li> <li>• HPP, U.S. Centers for Disease Control and Prevention (CDC), and U.S. Department of Homeland Security (DHS) federal grant programs should require organization of grantee preparedness and response activities through healthcare coalitions linked to emergency management and public health authorities. Program guidance should outline the critical functions that coalitions must be able to perform.†</li> <li>• The HPP should promulgate more detailed guidance on the organization and response roles of healthcare coalitions, including surge capacity goals.</li> <li>• HPP guidance should specify surge goals to be achieved by healthcare coalitions.</li> <li>• Centers for Medicare and Medicaid Services (CMS) should provide all healthcare entities with financial incentives to participate in healthcare coalitions.</li> <li>• HPP should establish goals and metrics to assess the progress of the development of healthcare coalitions in every community.</li> </ul>
<p><b>Links should be established between neighboring healthcare coalitions to enable regional exchange of healthcare information and assets during a CHE.</b></p>	<ul style="list-style-type: none"> <li>• HPP, CDC, and DHS program guidance should specifically require collaboration with neighboring jurisdictions and coalitions across state lines, including sharing of plans and joint exercises.</li> <li>• HHS should develop guidelines and requirements for communications, situational awareness, and health information technology (HIT).</li> </ul>
<p><b>Out-of-hospital triage sites should be established and healthcare responders should be trained in CHE triage.</b></p>	<ul style="list-style-type: none"> <li>• Future HPP guidance should include requirements for out-of-hospital triage site designation, and ensure provision of specialized training in CHE triage for National Disaster Medical System (NDMS) teams and identified first responders.</li> </ul>

RECOMMENDATIONS	ACTIONS
<p><b>A patient transportation system that harnesses alternative, private sector resources should be created.</b></p>	<ul style="list-style-type: none"> <li>• Federal initiatives already in place to provide a national network of emergency medical transport capacity should address the enhancement of local emergency medical transportation following CHEs.</li> <li>• NDMS, DHS, and United States Transportation Command (USTRANSCOM) should jointly review and revise aeromedical evacuation strategies.</li> <li>• Federal and state governments should develop and disseminate guidance and best practices for transportation planning efforts.</li> <li>• HHS and DHS should jointly commission a detailed study of crisis standards of care related to patient transportation.</li> </ul>
<p><b>Development of crisis standards of care should be expanded, and their consistent implementation within and across states should be promoted.</b></p>	<ul style="list-style-type: none"> <li>• HHS should continue to provide leadership on the issue of crisis standards of care, to include providing a clearinghouse of information to facilitate state and local planning efforts.</li> <li>• Future HPP guidance should specify crisis standards of care planning, as well as intrastate and interstate consistency in crisis standards, as priorities for grantees.</li> </ul>
<p><b>A national framework for healthcare response to CHEs should be developed to guide states, jurisdictions, and local entities in developing ConOps for medical and public health activities.</b></p>	<ul style="list-style-type: none"> <li>• DHS and its federal partners should expedite the development of federal Concept of Operations (ConOps) for CHEs.</li> <li>• HHS should create a work group of federal planners and stakeholders to sketch a national ConOps for medical and public health activities (Emergency Support Function [ESF-8]) following a CHE, using a Tier 1 Urban Area Security Initiative (UASI) region.</li> </ul>

\* The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/xabout/laws/gc\\_1219263961449.shtm#1](http://www.dhs.gov/xabout/laws/gc_1219263961449.shtm#1). Accessed November 12, 2009.

\*\* U.S. Department of Homeland Security. Federal Emergency Management Agency. *Comprehensive Preparedness Guide 101*. March 2009. 2009. <http://www.fema.gov/about/divisions/cpg.shtm>. Accessed January 22, 2010.

† Healthcare coalition critical functions are described in the HHS Tier 2 *MSCC Handbook*, the Center for Biosecurity *Evaluation Report*, and the Center for Biosecurity *Provisional Assessment Criteria* (see *Appendix B* of this *Preparedness Report*, page 36).



## Recommendations

Every U.S. hospital should participate in a healthcare coalition that prepares and responds collaboratively to common medical disasters and CHEs.

**Building a national system of fully functional healthcare coalitions that are capable of effectively responding to CHEs will require the action and support of the federal government and its preparedness programs.** To enable a more robust national disaster health and medical system that is capable of responding to both common medical disasters and CHEs, healthcare coalitions first must be established in communities throughout the U.S. All healthcare coalitions should have as active participants the hospitals in a given community, along with other healthcare entities (such as specialty hospitals, long-term care facilities, dialysis centers, free standing clinics, and surgical centers), other private non-healthcare partners, and public health, EMS, and EMAs. Coalitions should have a governance structure and formal agreements that define relationships among partners, and all fully functional healthcare coalitions should have a role in coordinating both preparedness and response.

- **The federal government should provide states with guidance on the basic functions of healthcare coalitions:**
  - A Presidential Decision Directive on healthcare preparedness for CHEs should be issued (as a follow-up to HSPD-21) to outline a vision of preparedness that builds on progress to date and is consistent with the National Health Security Strategy.<sup>29</sup>
  - HPP, CDC, and DHS federal grant programs should require organization of grantee preparedness and response activities through healthcare coalitions linked to emergency management and

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<sup>29</sup> U.S. Department of Health and Human Services. *National Health Security Strategy of the United States of America*. December 2009. <http://www.hhs.gov/aspr/osp/nhss/nhss0912.pdf>. Accessed January 13, 2010.

public health authorities. Program guidance should outline the critical functions that coalitions must be able to perform.<sup>30</sup>

- The HPP should promulgate more detailed guidance on the organization and response roles of healthcare coalitions, including surge capacity goals. Guidance must accommodate the necessary variety of effective governance structures and approaches.

**Healthcare coalitions need specific surge capacity goals.** The surge capacity of individual hospitals varies considerably: some operate at more than 100% occupancy much of the time, while others operate well under their capacity. Some hospitals have the ability to increase their numbers of beds, staff, and equipment, while others cannot. And each hospital has its own strengths and weaknesses. Across a community, however, these differences tend to even out. Furthermore, community-wide coalitions can recruit extra capacity from their participants, such as urgent care centers, nursing homes, and surgical centers. For these reasons, surge capacity and capability should be assessed and planned for at the coalition level.

There is no scientific way to determine the right amount of surge capacity for a given community; however, many emergency planners have identified the need for a specific number as a planning target. The best example of this is from Israel, which requires all of its hospitals to have 20% immediate surge capacity for inpatient beds; this number is also used by emergency preparedness scholars to provide a realistic estimate of what hospitals can achieve with short notice.<sup>31</sup> It is likely that capacity above an initial 20% surge could be achieved by most hospitals, given additional time to discharge patients and cancel non-urgent admission and procedures.

Emergency department surge capacity is not the same as inpatient surge capacity. Patient volumes in emergency departments (EDs) typically vary considerably from day to day. For example, it is not unusual for patient volume to increase by as much as 50% to 100% in relationship to weather events or during influenza epidemics. Many ED emergency operation plans include patient overflow areas, and most ED patients could be managed adequately in other outpatient settings, such as physician offices, clinics, or urgent care centers.<sup>32</sup> Because of the considerable variability in hospital surge capacity, future surge goals should be set on a community-wide basis rather than specified for individual hospitals.

- **HPP guidance should specify surge goals to be achieved by healthcare coalitions.** For example, coalitions should have plans to provide (within 4 hours) outpatient assessment and care to twice the number of patients seen on an average day in the EDs of its member hospitals. Furthermore, coalitions should have plans to accommodate (within 4 hours) patients requiring inpatient care equal to 20% above normal capacity of their member hospitals. This number should increase to 30% after 24 hours.

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30 Healthcare coalition critical functions are described in the HHS Tier 2 *MSSC Handbook*, the Center for Biosecurity *Evaluation Report*, and the Center for Biosecurity *Provisional Assessment Criteria* (see *Appendix B* of this *Preparedness Report*, page 36).

31 Peleg K, Kellermann A. Enhancing hospital surge capacity for mass casualty events. *JAMA*. 2009;302(5):565-566.

32 According to the U.S. Centers for Disease Control and Prevention (CDC), in 2006, only 12.8% of hospital emergency department (ED) visits resulted in admissions to the hospital. Most are triaged to urgent or minor rather than emergent care. Reference: Pitts R, Niska R, Xu J, et al. National hospital ambulatory medical care survey: 2006 emergency department summary. *National Health Statistics Reports*. August 6, 2008. <http://www.cdc.gov/nchs/data/nhsr/nhsr007.pdf>. Accessed November 13, 2009.

**Healthcare entities need financial incentives to participate in healthcare coalitions.** An optimal healthcare coalition involves the participation of all healthcare entities within a community. Yet many of these non-hospital entities do not recognize the important role they could play in preparedness and response or the benefits they might derive from participation. Many hospitals complain that participation carries a cost and produces no revenue. Hospitals accredited by the Joint Commission are required to have some degree of collaboration with community partners in planning and exercises, but most other healthcare entities have no such requirement. The one incentive that nearly all healthcare entities have in common is Medicare reimbursement. Currently, Medicare has emergency preparedness requirements for participating facilities, but these requirements are less stringent than the Joint Commission's emergency management standards and HPP guidance. If Medicare's requirements were enhanced and aligned with Joint Commission standards and HPP guidance, nearly all facilities would have a strong incentive to abide by them.

- **CMS should provide all healthcare entities with financial incentives to participate in healthcare coalitions.** CMS should update emergency preparedness requirements for participating healthcare facilities and align them with HPP guidelines and the Joint Commission's emergency management standards; requirements should include participation in a healthcare coalition.

**Progress toward the development of healthcare coalitions in every community must be assessed using established goals, metrics, and systems for accountability.** Assessment of healthcare coalitions should be based on their ability to perform critical coalition functions, such as engaging in effective planning and governance; providing situational awareness during a disaster; maintaining and operating reliable and redundant communications; ensuring the availability of adequate staff, supplies, and equipment across the coalition; and providing sound healthcare decision making for affected populations when resources are scarce. Assessment criteria should reflect the diverse nature of the challenges and priorities of coalitions in urban, rural, dense population, low population, and large land mass areas. As noted in the earlier *Evaluation Report*, Working Group participants reported that the most useful metrics for preparedness were those based on assessment of a coalition's performance in actual events or realistic exercises.

- **HPP should establish goals and metrics to assess progress in the development of healthcare coalitions in every community.** HPP should promulgate functional criteria and metrics for healthcare coalitions and develop a mechanism to hold grantees accountable for achieving the criteria. See *Appendix B: Assessment Criteria for the Future* (page 36).

**Links must be established among neighboring healthcare coalitions to enable regional exchange of healthcare information and assets during a CHE.**

**Collaboration among healthcare coalitions is essential to CHE response that extends beyond local and state geographic boundaries.** Few of the currently functioning healthcare coalitions have links to other healthcare coalitions and EMAs beyond their own local and state boundaries. To provide mutual aid, with or without state support, neighboring healthcare coalitions must, through regular meetings and mutual aid agreements, develop redundant, multimodal, high and low tech communications systems, and shared emergency response plans. Neighboring coalitions must also perform joint CHE exercises to

test their ability to expand surge capacity with a web of coalitions by facilitating an outward cascade of patient movement—from a stricken area and an inward cascade of resources to a stricken area.

- **HPP, CDC, and DHS program guidance should specifically require collaboration with neighboring jurisdictions and coalitions across state lines.**

**Healthcare coalition communication and situational awareness capabilities must be enhanced.**

To meet the challenge of serving as a structure and mechanism for the development of situational awareness for the healthcare response to a CHE, healthcare coalitions need enhanced tools for achieving situational awareness. Digital connections among hospitals, public health, EMS, and EMA are necessary to facilitate bidirectional flow of essential information. Healthcare coalitions must also establish information and communication connections with neighboring coalitions across jurisdictional lines in order to develop situational awareness in a CHE. The current federal effort to promote healthcare information technology should address this requirement for emergency response information technology.

- **HHS should develop guidelines and requirements for communications, situational awareness, and HIT.** HHS should convene work groups of experts and stakeholders who can develop guidelines and/or requirements for healthcare coalition communication, situational awareness, and information technology.

Out-of-hospital triage sites should be established, and healthcare responders should be trained in CHE triage.

**In a CHE, a large number of triage sites will have to be established within a few hours to accommodate CHE patients and lessen the impact of overwhelming numbers of patients on hospital operations.** Those sites would have to be predesignated, with caches of basic supplies readily available. In most scenarios, some of the predetermined sites may be unusable due to damage, contamination, loss of essential infrastructure, or lack of access. Personnel to staff triage sites would have to be available very quickly, so they would have to be local. And, to be most effective, personnel will need special training in triage decision making in the context of a CHE. For these triage sites to be effective, personnel running the sites would have to assess patients, provide very limited medical aid, provide palliative and comfort care, and transport patients to hospitals, other healthcare facilities, or shelters, as warranted.

- **Future HPP guidance should include requirements for designating out-of-hospital triage sites and ensuring provision of specialized training in CHE triage for NDMS teams and identified first responders.** Personnel reinforcements will be needed very quickly in a CHE; this role could be filled by specially trained state and federal medical teams that could be on scene within a few hours, and could be a role for Disaster Medical Assistance Teams (DMAT).<sup>33</sup>

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<sup>33</sup> Disaster Medical Assistance Teams (DMAT) are one type of mobile medical response team as part of the National Disaster Medical System (NDMS). (See *Appendix C* of this *Preparedness Report*, page 44, for further information about NDMS and its current response role).



A patient transport system that harnesses alternative private sector resources should be created.

**Taking advantage of national surge capacity will require a new, distributed approach to patient transport.** While the hospital surge capacity of most healthcare jurisdictions is quite limited, and the surge capacity of even whole multistate regions may be insufficient for some CHEs, the collective healthcare surge capacity of the nation as a whole is substantial. There are approximately 5,000 acute care hospitals with 800,000 staffed beds in the U.S.<sup>34</sup> Conservatively assuming a surge capacity of 20% in 24 hours, there could be 160,000 beds available following a CHE.<sup>35</sup> This number could be increased further by factoring in beds from military, Department of Veterans Affairs (VA) and specialty hospitals, as well as long-term care facilities and other nontraditional healthcare facilities. Taking advantage of this nationwide surge capacity will require plans for patient transport on a scale not addressed in existing plans. It will require a new, distributed approach that combines the use of traditional medical transport methods (eg, ambulances), private sector nontraditional vehicles (eg, buses, planes, and trains), and state and federal transportation assets (eg, military aircraft). Through effective matching of patient needs to scarce medical resources, a preplanned and well executed emergency patient transport and tracking system could save lives in the critical hours following a CHE.

- **Federal initiatives already in place to provide a national network of emergency medical transport capacity should address the enhancement of local emergency medical transportation following CHEs.** Utilization of private and nontraditional vehicles should be incorporated.

**Aeromedical transportation strategies should be revised.** The NDMS has long planned to use military aircraft supplied by USTRANSCOM to move patients to other parts of the country for hospital care in a disaster.<sup>36</sup> The limiting factor of military airlift capacity is not the availability of planes—each U.S. Air Force cargo plane can be converted to aeromedical evacuation within a few hours—rather, it is small number of trained and available aeromedical personnel. This limitation presumes that the personnel on the aircraft meet training standards and that the medical care provided enroute will meet normal standards of care.

If the CHE is the result of an attack, it may not be possible to rely on military transport because planes may be needed for military operations. If that is the case, then the Civil Reserve Air Fleet (CRAF) is another viable option. The CRAF is a program under which USTRANSCOM maintains contracts with the airlines to keep some planes available on short notice for back up transportation capacity, including aeromedical evacuation. The potential capacity of the CRAF is extensive: there are nearly 1,400 aircraft in the program, of which approximately 50 are designated for aeromedical evacuation.<sup>37</sup> But the aeromedical portion of the CRAF was not designed to be a rapid response asset. The program was

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34 Fast facts on U.S. hospitals. American Hospital Association website. Updated April 13, 2009. <http://www.aha.org/aha/resource-center/Statistics-and-Studies/fast-facts.html>. Accessed September 25, 2009.

35 20% of 800,000=160,000.

36 United States Transportation Command website. Department of Defense. April 4, 2009. <http://www.transcom.mil/organization.cfm>. Accessed September 22, 2009.

37 Ibid.

designed to transport injured service members home from war, and current procedures require that the planes first undergo an interior reconfiguration to carry litters (ie, stretchers) before they are deployed. This would slow operations considerably.

- **NDMS, DHS, and USTRANSCOM should jointly review and revise aeromedical evacuation strategies.** Plans must accommodate the large number of patients requiring transport during a CHE, assuming that many patients will be ambulatory, and that crisis standards of care (see below) will be employed for the transportation process.

**Alternative ground transport also must be considered.** The capacity of many EMS to respond to large scale disasters is very limited.<sup>38</sup> Local ambulance capacity could be augmented through recruitment of private ambulance companies by local emergency management authorities. However, even with those resources in place, there would be a large gap between the number of ambulances available and the number required. Additional ambulances from neighboring jurisdictions and states could also be utilized, but even then, the number would not be sufficient to meet the needs of most CHE scenarios. Furthermore, ambulances may be needed by their own jurisdictions to transfer patients between healthcare facilities. Ambulances from remote parts of the country also could be recruited to aid in response, but they may take several days to reach an affected area.<sup>39</sup>

While improvised use of alternative vehicles is predictable, advanced planning and exercises would optimize success. A comprehensive review of options could be explored, advantages and disadvantages of various vehicles could be weighed, and potential problems anticipated and resolved. Normally, patient transport is highly regulated and requires licensed ambulances and trained emergency medical technicians. To permit advanced planning with the public and private sectors, there must be resolution of legal, regulatory, and ethical issues related to the allocation of scarce medical transportation resources and the use of non-medical vehicles to augment evacuation.

- **Federal and state governments should develop and disseminate guidance and best practices for patient transport planning efforts.** CHE response will be local, and patient transport plans must be customized to fit the needs of a jurisdiction or a state. There is a need, however, for sharing best practices to help guide planning and support development of a consistent national framework.

**Transport triage and disaster transport standards will be needed.** Standards for types of vehicles, triage, and levels of medical care provided during transport will have to be shifted to crisis standards in order to accommodate response needs following a CHE. Triage will have to account for both severity of illness or injury and a patient's ability to travel. For patient transport over relatively short distances (perhaps up to 100 miles), it is conceivable that alternative, nontraditional ground transportation could be used, such as school or transit buses. In addition, buses or other vehicles may be modified to support patient litters and thus would be able to transport non-ambulatory patients who are not critical.

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38 Institute of Medicine. *Emergency Medical Services at the Crossroads*. June 14, 2006. <http://www.iom.edu/Reports/2006/Emergency-Medical-Services-At-the-Crossroads.aspx>. Accessed September 26, 2009.

39 In 2007, FEMA contracted with a private ambulance company to augment federal and local transportation resources in response to mass casualty events. More information on this contract can be found in *Appendix C* of this *Preparedness Report*, page 44.

- **HHS and DHS should jointly commission a detailed study of crisis standards of care related to patient transportation.** Although work has been done on crisis standards of care in general, specific focus is needed on crisis standards for disaster transport.

Development of crisis standards of care should be expanded, and their consistent implementation within and across states should be promoted.

**Unintended consequences of shifting to crisis standards of care can be reduced through advanced planning.** By definition, a CHE would involve some period of time during which available healthcare needs would exceed available capacity and capabilities in some locations. The U.S. has just enough capacity in its healthcare system to manage normal patient volume. Even relatively small surges in the number of patients, such as occur during flu season, can significantly stress the system and change the way in which patient care is provided. Depending on the scenario, this imbalance between need and capacity could be profound, prolonged, and widespread, prompting changes in the way care is provided, whether planned for or not. If not planned for, a shift to crisis standards of care could lead to unnecessary injury or loss of life, actual or perceived inequities in care, and liability exposure for responders. These potentially devastating consequences could be reduced through advanced planning for both allocation of scarce medical resources and implementation of crisis standards of care in resource-limited settings. Such crisis standards of care would focus on doing what is best for the population as a whole, rather than focusing on the best interest of individuals (as care normally is provided in non-disaster situations). Developing crisis standards of care is difficult because guidance is limited, and many complex medical, legal, and ethical issues involving multiple public and private sector stakeholders must be addressed. Those stakeholders include hospitals, physicians, and public health department planners. Conceptions of acceptable standards of care may vary by community or region.

Crisis standards of care should be used only when all other avenues of resource allocation have been exhausted. When needed, in order to be most effective and limit perceptions of inequity, standards should be implemented in as coordinated a way as possible across communities and regions. Healthcare coalitions could play a pivotal role in achieving consistent development and implementation of approaches. The recent IOM guidance on crisis standards of care emphasizes and provides a platform for consistency.<sup>40</sup>

Standards of care are fundamentally a local and state issue, based largely on local practice and state law. However, many of the medical and ethical aspects are similar across the country, so national guidance is helpful for planners at the state and local levels, and it would foster and facilitate consistency in planning. Significant work has been conducted on this topic at national and state levels,<sup>41</sup> but additional and continued national guidance and improved access to information on existing standards of care are needed to continue to advance state and local planning efforts. For instance,

40 Institute of Medicine, Committee on Guidance for Establishing Standards of Care for Use in Disaster Situations. *Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations: A Letter Report*. September 2009.

41 See, eg, Institute of Medicine, Committee on Guidance for Establishing Standards of Care for Use in Disaster Situations. *Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations: A Letter Report*. September 2009 • U.S. Agency for Healthcare Research and Quality. *Altered Standards of Care in Mass Casualty Events*. AHRQ Publication No. 05-0043. 2005 • U.S. Agency for Healthcare Research and Quality. *Mass Medical Care with Scarce Resources: A Community Planning Guide*. AHRQ Publication No. 07-0001. 2007 • Devereaux A, Christian MD, Dichter JR, et al. Summary of suggestions from the Task Force for Mass Critical Care Summit, January 26-27, 2007. *Chest*. 2008;133(5):1S-7S.

guidance is needed for pediatric and geriatric populations, community engagement, consistent or national liability protections, triggers, exercises, involvement of community providers, and processes for returning to normalcy.<sup>42</sup> And a clearinghouse that includes state and local documents on standards of care would be helpful.

- **HHS should continue to provide leadership on crisis standards of care and should provide a clearinghouse of information to facilitate state and local planning efforts.** Future HPP guidance should specify crisis standards of care planning, as well as intrastate and interstate consistency in crisis standards, as planning priorities for grantees.

A national framework for healthcare response to CHEs should be developed to guide states, jurisdictions, and local entities in developing ConOps for medical and public health activities.

**To enable effective response to a CHE, plans must be established, disseminated, and exercised in advance.** Critical lifesaving activities would occur in the first few hours and days following most CHEs. Unfortunately, this would also be the time when situational awareness is most difficult to achieve and when most levels of government would be working around the clock to activate command and coordination structures and mobilize resources. Hence, communities are expected to be prepared to manage response on their own for hours to days. During this early phase of response to a CHE, the full spectrum of incident management as envisioned in the National Incident Management System (NIMS) and the National Response Framework (NRF) will be just getting established and will not be available immediately. Therefore, as has been demonstrated in Israel,<sup>43</sup> each party involved in the immediate response must know in advance his/her precise role, responsibility, and expected actions so that all participants know what to do and what to expect from others. Just as in a fire drill or a “code blue” in a hospital, the initial actions taken by each responder must be automatic and immediate. To enable such a response there must be in place, in advance, a plan or a series of integrated and coordinated plans that are known to all and have been well exercised. Plans must be integrated and coordinated throughout the wide geographic areas likely to be involved in a CHE. Such a ConOps plan must include information on individual roles at all levels, from federal officials to healthcare providers at the local hospitals.<sup>44</sup> Recognizing that each state, jurisdiction, and institution is different (eg, different laws, political structures, and customs), it is not possible to create a national template that will work perfectly for every location. Instead, the ConOps plan could be a framework that individual states, jurisdictions, and local entities would use to create their own customized plans.

- **DHS and its federal partners should expedite the development of federal Concept of Operations (ConOps) for CHEs.** Key stakeholders from state and local government and the private sector, and especially hospitals, should be involved early in the process in order to help shape a plan that meets their needs.

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42 Institute of Medicine, Committee on Guidance for Establishing Standards of Care for Use in Disaster Situations. *Guidance for Establishing Crisis Standards of Care for Use in Disaster Situations: A Letter Report*. September 2009.

43 Peleg K, Kellermann A. Enhancing hospital surge capacity for mass casualty events. *JAMA*. 2009;302(5):565-566

44 Ibid.

- **HHS should create a work group of federal planners and stakeholders to sketch a national ConOps for medical and public health activities (ESF-8) following a CHE, using a Tier 1 UASI region.** The plan would define roles, and clearly address responsibilities and actions for each type of entity (eg, hospitals, healthcare coalitions, EMS, public health, and state and federal government) involved in the medical response to a CHE, from the federal level down to the local hospital. The plan would supplement, not supplant, the tiered framework described in the MSCC and NRF. This “straw man” national ConOps and lessons learned during its development could help the rest of the nation be ready more quickly for a CHE.



## Conclusions

As demonstrated in the earlier report, *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward*, much progress has been made in healthcare preparedness in recent years, especially in the realm of building coalitions of hospitals and public health entities for disaster preparedness and emergency response. In many places, this progress has improved response to common medical disasters. However, the Center's research and analysis concludes that individual hospitals, cities, states, and the country as a whole remain unprepared for a catastrophic health event that results in thousands or tens of thousands of sick or injured persons.

Improved preparedness and response for CHEs is possible and should be built on the successful work already completed by hospitals, coalitions, and their local, state, tribal, and federal partners. Ensuring the development of functional healthcare coalitions throughout the country is an important first step because such coalitions will enable all communities to respond effectively to common medical disasters and will create the necessary infrastructure for CHE response. Once established, healthcare coalitions will have to be linked together, and much greater patient transport capability will have to be established. A more detailed national plan for those actions is needed to guide the actions of providers in each tier of response to a CHE. The creation of crisis standards of care and some legal reforms are needed as well to make a national CHE response system truly functional.

The recommendations made in this report are feasible, but many of them will take time to accomplish. We are confident that concrete progress toward the goal of CHE preparedness can be achieved through the series of actions outlined in this report, but that work will require sustained effort at the federal, state, tribal, and community levels for a number of years and funding sufficient to support those efforts.

## Appendix A. List of Acronyms

<b>AAR</b>	After Action Report
<b>AHRQ</b>	Agency for Healthcare Research and Quality
<b>AMR</b>	American Medical Response
<b>ARS</b>	Acute Radiation Syndrome
<b>ASPR</b>	Assistant Secretary for Preparedness and Response
<b>CBRNE</b>	Chemical, Biological, Radiological, Nuclear, and Explosive
<b>CMRFC</b>	CBRNE Consequence Management Response Force
<b>CDC</b>	Centers for Disease Control and Prevention
<b>CHE</b>	Catastrophic Health Event
<b>ConOps</b>	Concept of Operations
<b>CMS</b>	Centers for Medicare and Medicaid Services
<b>CRAF</b>	Civil Reserve Air Fleet
<b>DHS</b>	Department of Homeland Security
<b>DMAT</b>	Disaster Medical Assistance Team
<b>DoD</b>	Department of Defense
<b>ECP</b>	Emergency Care Partnership Program
<b>EDs</b>	Emergency Departments
<b>EMA</b>	Emergency Management Agency
<b>EMAC</b>	Emergency Management Assistance Compact
<b>EMEDS</b>	Expeditionary Medical Support
<b>EMTALA</b>	Emergency Medical Treatment and Labor Act
<b>EOC</b>	Emergency Operations Center
<b>EOP</b>	Emergency Operations Plan
<b>ESAR-VHP</b>	Emergency System for Advance Registration of Volunteer Health Professionals
<b>ESF-8</b>	Emergency Support Function 8
<b>FEMA</b>	Federal Emergency Management Agency
<b>FMS</b>	Federal Medical Stations
<b>HFPP</b>	Healthcare Facilities Partnership Program
<b>HHS</b>	Department of Health and Human Services
<b>HIT</b>	Health Information Technology
<b>HPP</b>	Hospital Preparedness Program
<b>HRSA</b>	Healthcare Resources and Services Administration
<b>HSEEP</b>	Homeland Security Exercise and Evaluation Program
<b>HSGP</b>	Homeland Security Grant Program
<b>HSPD-21</b>	Homeland Security Presidential Directive 21
<b>HVA</b>	Hazard Vulnerability Analysis
<b>ICS</b>	Incident Command System
<b>ICU</b>	Intensive Care Unit
<b>IND</b>	Improvised Nuclear Device
<b>MMRS</b>	Metropolitan Medical Response System

## Appendix A. List of Acronyms

<b>MOU</b>	Memorandum of Understanding
<b>MRC</b>	Medical Reserve Corps
<b>MSCC</b>	Medical Surge Capacity and Capability Handbook
<b>NBHPP</b>	National Bioterrorism Hospital Preparedness Program (now referred to as the NHPP)
<b>NCR</b>	National Capital Region
<b>NDMS</b>	National Disaster Medical System
<b>NHPP</b>	National Healthcare Preparedness Program (formerly the HPP)
<b>NHSS</b>	National Health Security Strategy
<b>NORTHCOM</b>	United States Northern Command
<b>NPS</b>	National Planning Scenario
<b>NRF</b>	National Response Framework
<b>OPEO</b>	Office of Preparedness and Emergency Operations
<b>PAHPA</b>	Pandemic and All-Hazards Preparedness Act (Public Law No. 109-417)
<b>PAR</b>	Population at Risk
<b>PHEP</b>	Public Health Emergency Preparedness Program
<b>RTR</b>	Radiation Triage, Treatment, and Transport system
<b>SNS</b>	Strategic National Stockpile
<b>SPEARR</b>	Small Portable Expeditionary Aerospace Rapid Response
<b>TCL</b>	Target Capabilities List
<b>UASI</b>	Urban Area Security Initiative
<b>USTRANSCOM</b>	United States Transportation Command
<b>VA</b>	Department of Veterans Affairs
<b>VHA</b>	Veterans Health Administration
<b>VMI</b>	Vendor Managed Inventory
<b>WMD</b>	Weapons of Mass Destruction



# Appendix B. Assessment Criteria for the Future

## Provisional Criteria for the Assessment of Progress toward Healthcare Preparedness

### Rationale

**Widely used standards exist for individual healthcare facilities:** The provisional criteria for the assessment of progress toward healthcare preparedness presented in this document are derived from the preceding phases of this project and are designed to be consistent with the recommendations in the *Preparedness Report*. Our previous research and analyses have identified gaps in preparedness evaluation criteria available for both individual healthcare facilities and healthcare coalitions.

Specifically, as noted in the *Descriptive Framework*, we found that the 2008 Joint Commission Emergency Management Standards reflect preparedness capabilities for individual healthcare institutions well.<sup>45</sup> These standards are familiar to individual healthcare institutions, and share much in common with other well established assessment criteria such as the *Emergency Preparedness Checklist* from the CMS,<sup>46</sup> the *Target Capabilities List (TCL)* from DHS,<sup>47</sup> the *Comprehensive Emergency Management Program criteria* from the VHA,<sup>48</sup> and current HPP guidance. Work based on these standards has contributed to significant progress in healthcare preparedness; therefore, we recommend that the HPP utilize the Joint Commission Emergency Management Standards, along with these existing assessment criteria and metrics, as the basis for future assessment of preparedness in individual healthcare facilities.

**No assessment criteria exist for healthcare coalitions:** Some of the challenges associated with responding to mass casualty or CHEs are so great that an adequate response is possible only through healthcare coalitions that involve many community partners. Such challenges include, but are not limited to, transporting and distributing patients, sharing assets and resources, coordinating volunteers, operating alternate care facilities, and allocating scarce resources. Healthcare coalitions are needed to address mass casualty preparedness and response challenges that cannot be addressed by individual healthcare institutions on their own. Coalitions include, at a minimum, hospital, non-hospital healthcare providers, and public health departments, and they are closely tied to EMS and EMAs.

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45 The Joint Commission. *History Tracking Report: 2009 to 2008 Requirements*. Accreditation Program: Hospital. Chapter: Emergency Management. 2008. [http://www.jointcommission.org/NR/rdonlyres/D5607767-744C-462D-9527-B9B0E464C524/0/HAP\\_EM\\_09\\_to\\_08.pdf](http://www.jointcommission.org/NR/rdonlyres/D5607767-744C-462D-9527-B9B0E464C524/0/HAP_EM_09_to_08.pdf). Accessed July 1, 2009.

46 U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services. *Emergency Preparedness Checklist: Recommended Tool for Effective Health Care Facility Planning*. [http://www.cms.hhs.gov/SurveyCertEmergPrep/downloads/S&C\\_EPChecklist\\_Provider.pdf](http://www.cms.hhs.gov/SurveyCertEmergPrep/downloads/S&C_EPChecklist_Provider.pdf). Accessed September 10, 2009.

47 U.S. Department of Homeland Security. *Target Capabilities List, A Companion to the National Preparedness Guidelines*. September 2007.

48 U.S. Department of Veterans Affairs, Veterans Health Administration, Office of Public Health and Environmental Hazards, Emergency Management Strategic Health Care Group. *VHA Comprehensive Emergency Management Program Analysis Capabilities Description*. January 24, 2008.

Healthcare coalitions are playing an emerging role in disaster response and will be central to the national strategy for catastrophic health events discussed in the *Preparedness Report*. While it is now possible to assess progress in individual institutions, criteria to assess the successful contribution that coalitions make to preparedness have not yet been proposed; assessment is essential to measuring progress of healthcare preparedness within healthcare coalitions.

## Sources and Methods

These *Provisional Assessment Criteria for Healthcare Coalitions* were derived from the following earlier reports and deliverables:

- *Descriptive Framework*: An extensive review of the literature on medical preparedness and lessons learned from actual mass casualty events and exploration of the response needs that might result from potential future large scale disasters, such as those described in NPS, was used in the development of the *Descriptive Framework* on which the assessment criteria are based.
- From this review and the crosswalk analysis of commonality with other assessment criteria, *Assessment Criteria for Individual Healthcare Facilities and Early Healthcare Coalitions*, which were developed and tested in interviews and discussions with 133 subject matter experts from the 62 HPP states and municipalities who took part in the *Evaluation Report* Virtual Working Group.
- Review of the findings of the *Evaluation Report* and assessment criteria in an Issue Analysis Meeting in the fall of 2008, where the development and functional capability of healthcare coalitions was identified as the best marker of progress toward preparedness. This marked the starting point of the development of the assessment criteria.
- Draft *Assessment Criteria for Healthcare Coalitions/Partnerships* used in the evaluation of the HFPP and ECP Program site visits and follow-up interviews. This evaluation project provided an opportunity to test the assessment criteria and modify them after feedback from coalition leaders and participants.

After the literature review, and Working Group and Issue Analysis Group discussion and input, *Provisional Assessment Criteria* were developed. Further testing and validation of criteria will be required in future assessments of performance of healthcare coalitions in structured exercises and real events.

## Key Characteristics of Provisional Assessment Criteria for Healthcare Coalitions

**Assessment criteria for coalitions based on functional capabilities:** *The Provisional Assessment Criteria* are designed to measure the progress, maturity, and functional capabilities of healthcare coalitions. They primarily assess the ability to perform critical functions, such as engaging in effective planning and governance, providing situational awareness during a disaster, and maintaining and operating reliable and redundant communications. These criteria were chosen for the following reasons:

- They are relatively straightforward to assess.

- Our previous research indicates that these are good indicators of prepared coalitions.
- They are adaptable and so can accommodate the varied challenges and priorities of coalitions in urban and rural areas, across densely and sparsely populated areas, and among coalitions covering large geographical areas.

**Applicable for local, state, and federal levels:** This provisional criteria can be used by local, state, and federal authorities to assess the structure and functional capabilities of emerging coalitions, to assess the degree to which coalitions have advanced their collaboration for the development of community surge capacity goals, and to promote the development and continued maturation of healthcare coalitions.

## Future Performance Measures

**Performance measures that are consistent with these assessment criteria are needed:** Self-assessment surveys and structured after-action reports (AARs) of actual events or realistic exercises will be most important in helping coalitions assess their progress. Instruments should include the following:

- Vulnerability analysis of pre-existing hazards and documentation of gaps in capabilities within the coalition region.
- Documentation of how gaps were addressed during exercises or drills and the progress that was achieved in meeting those needs.
- Documentation of problems encountered during previous events or exercises and how they were addressed and corrected during subsequent events or exercises.
- Results of repetitive comprehensive testing of communications procedures and equipment.
- Self-assessment surveys that address the effectiveness of planning, governance, coordination, cooperation, and communication among partners within the coalition as well as among the coalition and local, state, and federal response agencies.

# Provisional Assessment Criteria for Healthcare Coalitions

## I. Planning, Process, Structure, and Organization

**Boundaries:** The geographic and jurisdictional boundaries of the healthcare coalition are clearly defined by the following:

- City
- County
- State
- Tribal
- Multiple jurisdictions
- Multistate region
- Alignment with public health, EMA, and EMS jurisdictional boundaries

**Membership:** All healthcare institutions/agencies in the geographic region of the healthcare coalition are represented:

- Hospitals
- Public Health Departments
- Tribal Health Departments
- Local EMA
- State EMA
- Local EMS
- State EMS
- Tribal EMS
- Cross-jurisdictional regional representation
- Non-hospital healthcare facilities (eg, nursing homes, dialysis centers, out-patient surgical centers)
- Private sector partners (eg, large retailers, direct service providers, manufacturers, transportation providers)

**Organization and authorities:** Member institutions are linked to each other, and the healthcare coalition is connected to state, tribal, and local authorities.

- The coalition is established through formal agreements (eg, a Memorandum of Understanding [MOU]).
- Mutual aid agreements exist between the healthcare coalition and outside organizations (private industry, adjoining regions, or adjoining states).
- The coalition is endorsed and supported during an emergency by the senior leadership of member institutions.
- The coalition has operational authority derived from or via local and/or state public health emergency authority.
- Connections exist with local/tribal/state authorities and other healthcare coalitions outside of jurisdictional boundaries:
  - The coalition, in collaboration with the public health agency, is linked to the EMA and incident command structure (ICS) through the ESF-8 function.
  - The coalition is linked to a multi-agency coordination group that includes at least public health, emergency management, and EMS.

- Linkages to multiple jurisdictions exist when coalition boundaries cross jurisdictional lines.
- Linkages exist directly to other healthcare coalitions.

**Hazard Vulnerability Analysis (HVA):** Threats to the community are jointly analyzed and prioritized. All coalition members use common hazard assumptions in developing individual HVAs and emergency operations plans (EOPs). At a minimum, the HVA includes the following:

- Local natural hazards
- NPS for catastrophic health events
- Disasters in which the community is cut off from outside support and/or the basic infrastructure is disrupted
- Large geographically remote events in which the community becomes a refuge for displaced or evacuated populations
- Planning for special needs populations.

**Emergency operations plans and training:** EOPs and training at individual institutions and throughout the healthcare coalition are consistent and fully integrated

- They are based on a shared HVA.
- There is a mechanism for collaborative planning.
- An inventory of relevant assets and resources was conducted among healthcare coalition entities.
- Joint training has been conducted for the workforces of individual institutions and agencies in the healthcare coalition.

**Exercises and dynamic improvement:** Healthcare coalition institutions and agencies jointly exercise EOPs.

- Joint exercises have been conducted based on coalition planning and training.
- Drills and full scale exercises are held in coordination with local and/or state or territory emergency management agencies.
- Unannounced drills are used for assessment.
- Evaluations and AARs are conducted following drills, exercises, and actual events; and the findings are incorporated into a corrective action plan.
- The Homeland Security Exercise and Evaluation Program (HSEEP) model for exercise evaluation is used.

## II. Situational Awareness and Communications

**Situational awareness:** Systems are in place that provide the healthcare coalition with situational awareness during a disaster.

- The healthcare coalition serves as an information clearinghouse for healthcare institution data (eg, patient load, bed availability, and inventory of assets).
- The coalition provides healthcare situational awareness information to the state and local ICS.
- The coalition provides healthcare institutions with information from the state and local ICS.
- The coalition provides expert medical advice to government authorities.
- Situational awareness systems are tested during incidents, exercises, and drills.

**Communications:** Reliable, redundant, and interoperable communication systems (plans and equipment) among member institutions and agencies are operational and linked to state and local emergency management and incident command.

- The communication plan uses a multi-agency coordination center or mechanism to exchange information, track resource requests and allocations, and interface with appropriate state and local emergency operations centers (EOCs) and key private sector response partners.
- Internet-based systems exist for tracking patients and assets, and they are linked to similar systems in other communities.
- Redundant non-Internet-based communications systems exist for the coalition.
- Redundant two-way communication links exist to the state and local ICS and other key agencies.

## III. Management of Staff, Supplies, and Equipment

**Surge capacity:** The healthcare coalition has planned for the development of surge capacity with defined procedures and authorities for matching patient load with available resources. Procedures are in place for recruiting, credentialing, training, and deploying volunteer healthcare workers.

- Plans exist for the use and function of Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP).
- Coordination exists with local Medical Reserve Corps (MRC) units.
- Plans exist for use of DMATs through NDMS.
- Joint purchasing agreements exist to ensure interoperable supplies and equipment.
- Standards exist for and training is conducted on interoperable equipment and communication systems.

## IV. Healthcare for Affected Populations

**Allocation of scarce resources:** The healthcare coalition has developed coordinated decision making processes for the allocation of scarce resources, including the following:

- Use of local, tribal, regional, and national bed capacity and the appropriate distribution of patients
- Distribution of scarce resources
- Use of situational awareness to guide crisis standards when appropriate
- Evacuation and institution of disaster transport standards of care
- Management of fatalities
- Identification and operation of alternate care sites and mobile medical assets in conjunction with state, local, and tribal authorities
- Management and distribution of care of concerned individuals seeking evaluation for potential effects of a disaster.

### Summary

Determining the capability and functionality of healthcare coalitions in communities across the country is essential for assessing progress toward national preparedness for catastrophic health events.

Assessment of healthcare coalitions is essential because a large mass casualty event will likely require the cooperation of multiple healthcare institutions, EMS, emergency management agencies, and public health agencies; response to a CHE will require regional collaboration and the response of multiple coalitions.

Assessment criteria for individual healthcare facilities in the *Descriptive Framework*, HPP guidance, and Joint Commission Emergency Management Standards have many similarities and should serve as the basis for ongoing evaluation. Several measurement tools to apply assessment criteria will be necessary, such as self-assessment surveys, structured AARs, site visits, and structured interviews (See Table 2). The assessment of progress toward healthcare preparedness requires evaluation of all tiers of the healthcare response structure, and no single set of criteria or metrics is appropriate for assessing capabilities and performance of all components in the tiers of the healthcare response system.

**Table 2: Tools Available to Assess Progress toward Preparedness for Hospitals, Healthcare Coalitions, and States**

Entity	Assessment Criteria	Measurement Tool	Reporting Mechanism
<b>Individual Healthcare Facilities</b>	<ul style="list-style-type: none"> <li>• <i>Descriptive Framework</i></li> <li>• HPP Guidance</li> <li>• Joint Commission Emergency Management Standards</li> </ul>	<ul style="list-style-type: none"> <li>• Self assessment surveys</li> <li>• Structured AARs of exercises</li> <li>• Agency for Healthcare Research and Quality (AHRQ) evidence based metrics</li> <li>• Joint Commission site visits</li> <li>• HPP (evaluation section or regional emergency coordinators) structured interviews</li> </ul>	<ul style="list-style-type: none"> <li>• Existing reports to state HPP coordinator</li> <li>• Proposed HPP structured interview reports</li> <li>• Joint Commission accreditation report</li> </ul>
<b>Healthcare Coalitions</b>	<ul style="list-style-type: none"> <li>• Joint Commission standards for planning and drills with multiple institutions</li> <li>• HFPP and ECP guidance</li> <li>• <i>Provisional Assessment Criteria</i></li> </ul>	<ul style="list-style-type: none"> <li>• Self-assessment surveys</li> <li>• Structured AARs of coalition wide exercises</li> <li>• Expanded HPP reports to include elements of <i>Provisional Assessment Criteria</i></li> </ul>	<ul style="list-style-type: none"> <li>• Existing reports to state HPP</li> <li>• Proposed HPP structured interview/site visit reports</li> <li>• Joint Commission accreditation report: community activity</li> </ul>
<b>States</b>	<ul style="list-style-type: none"> <li>• % of hospitals in states participating in HPP</li> <li>• % of hospitals in states participating in coalitions</li> <li>• % of hospital compliance with performance standards (summary of individual hospital reports)</li> </ul>	<ul style="list-style-type: none"> <li>• State report card</li> <li>• HPP state reporting requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Reports to national HPP</li> </ul>



# Appendix C. Existing Systems for CHE Response

## Existing Systems for National Response to a CHE

Over the past decade, many federal, state, tribal, territorial, and local government agencies have made substantial investments of money, time, and resources to improve the U.S. healthcare preparedness and response infrastructure. The following is a broad overview and discussion of the major response mechanisms likely to be employed in response to a CHE. It is provided as context for this report and to illustrate the extent and limits of the nation's capabilities. This review is not comprehensive in scope—its focus is specifically on structures or organizations that have a well defined role in the healthcare response to a CHE. Furthermore, while the contents of this review are current as of this report's publication date, the disaster response landscape is evolving continuously, so the response mechanisms described here may also change.

### I. Organization of the Federal CHE Response

**The National Incident Management System:** NIMS is the guiding all-hazards response management system for all levels of government.<sup>49</sup> This system provides a standard set of processes and terminology for organizing and managing response to an incident, regardless of size or geographic location. Responders trained in NIMS should know how to execute a local response and how to escalate that response up the chain of command to a sub-state regional, state, interstate, and federal response if necessary. All emergency management professionals and traditional first responders (ie, fire, police, and emergency medical services) are trained in NIMS, as are many representatives in public health agencies. NIMS has only recently been applied to the healthcare system, the culture of which has historically been less hierarchical than first responder agencies. This system is still a relatively new concept for the healthcare sector, which, for the most part, is made up of private organizations. Nonetheless, hospitals and other healthcare organizations now have employees trained in NIMS, and progress is being made, in large part due to the NIMS training requirement HPP grant guidance.

**National Response Framework:** NRF is an all-hazards framework that builds upon NIMS by describing federal roles and assets used during large incidents that require a federal response.<sup>50</sup> Under the NRF, ultimate authority rests within the White House. Operational and logistical actions will be coordinated by a lead federal agency that will be determined by the nature of the disaster. The NRF also illustrates the process for requesting federal assistance in a disaster and some basic high-level response actions that state and federal agencies should take in anticipation of and in response to a disaster. While the NRF does provide a high-level framework for response, it does not provide operational details for healthcare response to a disaster or CHE.

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49 U.S. Department of Homeland Security. *National Incident Management System*. December 2008. [http://www.fema.gov/pdf/emergency/nims/NIMS\\_core.pdf](http://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf). Accessed October 14, 2009.

50 U.S. Department of Homeland Security. *National Response Framework*. January 2008. <http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf>. Accessed October 14, 2009.

**Emergency Support Function:** (ESF)-8 is the component of the NRF that describes federal planning for the public health and medical response to a CHE.<sup>51</sup> Under ESF-8, the HHS is identified as the lead federal agency. Within HHS, ASPR is charged with the coordination of the response. In addition to HHS, 14 other federal agencies have a supporting role under ESF-8 and may contribute resources as the situation dictates. In the event of a CHE, the federal government, through HHS, is responsible for coordinating federal support to state and local authorities in the following core functional areas:

- Assessment of public health/medical needs
- Health surveillance
- Medical care personnel
- Health/medical/veterinary equipment and supplies
- Patient evacuation
- Patient care
- Safety and security of drugs, biologics, and medical devices
- Blood and blood products
- Potable water/wastewater and solid waste disposal
- Food safety and security
- All-hazard public health and medical consultation, technical assistance, and support
- Behavioral health care
- Agriculture safety and security
- Public health and medical information
- Vector control
- Mass fatality management, victim identification, and decontaminating remains
- Veterinary medical support
- Medical surge capacity and capability

**Medical Surge Capacity and Capability Framework:** HHS released the MSCC Framework in September 2007.<sup>52</sup> This management system pertains specifically to the healthcare response for mass casualty and catastrophic events. The MSCC is specifically designed to be integrated with NIMS, and is based on a framework of 6 coordination and response tiers, as illustrated in the figure below.

It should be noted that the resources of a lower tier do not have to be exhausted before a request for assistance can be made to a higher tier. Because of a CHE's extraordinarily destructive nature, the management of these events will likely necessitate a rapid escalation to Tier 6 of the MSCC structure. A recent update to the MSCC—the Tier 2 handbook—focuses specifically on healthcare coalitions.<sup>53</sup>

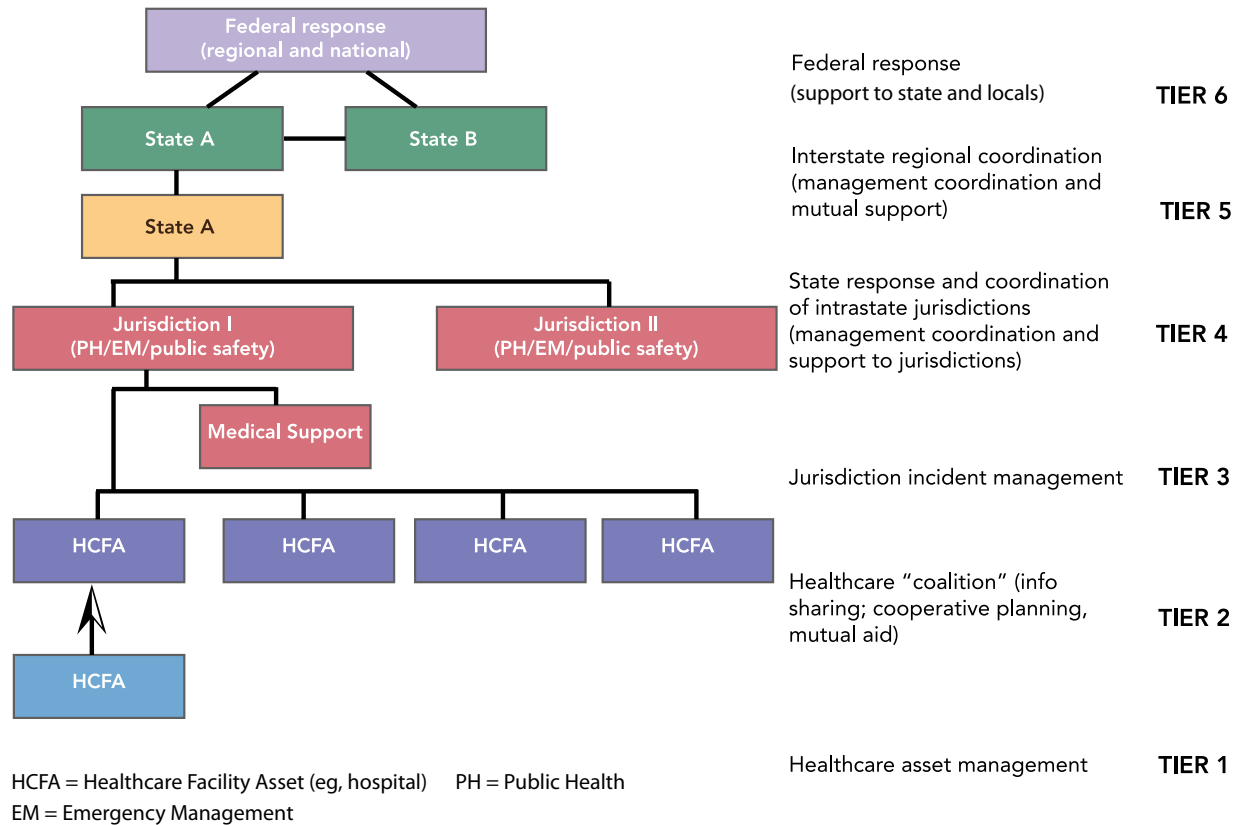
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51 U.S. Department of Homeland Security. *National Response Framework – Emergency Support Function 8*. January 2008. <http://www.fema.gov/pdf/emergency/nrf/nrf-esf-08.pdf>. Accessed October 14, 2009.

52 U.S. Department of Health and Human Services. *Medical Surge Capacity and Capability Handbook, 2nd ed.* September 2007. <http://www.hhs.gov/disasters/discussion/planners/mscc/>. Accessed September 14, 2009.

53 U.S. Department of Health and Human Services. *Medical Surge Capacity and Capability: The Healthcare Coalition in Emergency Response and Recovery*. Prepared for HHS Under Contract # HHSP23320064154EB. May 2009.

Figure 2. HHS Medical Surge Capacity and Capability (MSCC) Framework



**Homeland Security Presidential Directive (HSPD)-21:** In October 2007, the White House issued HSPD-21, which called for an enhanced medical and public health response capability that could protect the health and well being of American people to the greatest extent possible.<sup>54</sup> To this end, HSPD-21 focuses primarily on development of 4 response capabilities:

- Biosurveillance system capable of identifying the occurrence of a biological attack or naturally occurring disease outbreak.
- System for stockpiling and distributing medical countermeasure to provide large populations with vaccination, prophylaxis, or treatment “within 48 hours of the decision to do so.”
- “Disaster medical capability that can immediately re-orient and coordinate existing resources within all sectors to satisfy the needs of the population during a catastrophic health event.”
- Plan to promote building “resilient communities.”

54 The White House. *Homeland Security Presidential Directive 21: Public Health and Medical Preparedness*. October 18, 2007. [http://www.dhs.gov/about/laws/gc\\_1219263961449.shtm#1](http://www.dhs.gov/about/laws/gc_1219263961449.shtm#1). Accessed November 12, 2009.

## II. Federal Response Structures, Programs, and Resources

**National Disaster Medical System:** NDMS is a federal medical response system administered by ASPR. NDMS currently includes 3 major response components: (1) a mobile medical asset component comprising approximately 80 mobile medical response teams (including approximately 50 DMATs) that are deployed rapidly to provide personnel and equipment and supplies sufficient to sustain operations for 72 hours; (2) a patient evacuation component, utilizing military transport, led by the U.S. Department of Defense's (DoD) USTRANSCOM; and (3) a definitive care component, comprising private, VA, military, and public hospitals around the country that voluntarily contribute a virtual number of staffed beds to NDMS to accommodate patients evacuated from a disaster area.<sup>55</sup>

NDMS is a core component of the planned federal response to CHEs, but its assets are limited. DMAT and other NDMS deployable teams are staffed by working medical professionals. A majority of the DMATs are trained in general triage and disaster care and are supplemented by a few DMATs trained in specialties such as burn care and crush injuries. For the most part, DMATs are deployed to a disaster site with general disaster training and only enough equipment to last for 72 hours on their own. Therefore, NDMS teams have very limited capacity for providing inpatient-like care. However, these teams have proven to be important assets for performing triage and providing basic care to disaster victims if they arrive to the affected area in time. In a national disaster, NDMS teams are deployed for 2-week intervals, and their equipment and supplies can be supplemented by other federal medical assets, such as Federal Medical Stations (FMS) from the Strategic National Stockpile (SNS). An FMS is “a cache of medical supplies and equipment that can be used to set up a temporary non-acute medical care facility. Each FMS has beds, supplies, and medicine to treat 250 people for up to 3 days.”<sup>56</sup>

The vast majority of NDMS patient transport assets for a national disaster are provided through DoD's USTRANSCOM.<sup>57</sup> However, it takes time for these transportation assets to arrive at the scene of a domestic disaster—days to weeks depending on available resources and circumstances. Transport assets depend on the availability of military vehicles and personnel. Patients are transported mainly via military fixed wing aircraft that must be converted to accommodate acutely ill patients, and there are a limited number of military personnel who are trained to care for patients in flight. Because of these limitations, only small numbers of acutely ill patients can be transported by this method each day. NDMS also holds a contract with the CRAF to make commercial aircraft available to the government in an emergency.<sup>58</sup> However, this contract does not include provision of medical personnel, and converting commercial planes into planes configured for aero-medical transport, as contracted, may take days to weeks to accomplish. Reliance on the CRAF is further complicated by the findings of a recent U.S. Government Accountability Office (GAO) report, that noted, “although DOD depends on CRAF charter

55 National Disaster Medical System website. U.S. Department of Health and Human Services. <http://www.hhs.gov/aspr/oepo/ndms/index.html>. Accessed October 13, 2009.

56 U.S. Centers for Disease Control and Prevention. Division of Strategic National Stockpile. Federal Medical Station Profile. <http://www.texasjrac.org/documents/FMSfactsheetv3-1.pdf>. Accessed October 13, 2009.

57 Department of Defense. *Department of Defense Directive: National Disaster Medical System (NDMS)*. January 21, 2003. <http://www.dtic.mil/whs/directives/corres/pdf/601022p.pdf>. Accessed October 13, 2009.

58 U.S. Air Force. *Civil Reserve Air Fleet Factsheet*. July 2007. <http://www.af.mil/information/factsheets/factsheet.asp?id=173>. Accessed October 13, 2009.

passenger aircraft to move more than 90 percent of its peacetime needs, there has been nearly a 55 percent decline in this CRAF capacity since 2003.”<sup>59</sup>

**Stafford Act:** Managing a CHE will quickly overwhelm the resources of local, state, and regional authorities. As part of a broader request for federal assets, a governor’s office can make a request for federal aid through the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Stafford Act),<sup>60</sup> which provides the statutory authority for most federal disaster response activities. The Stafford Act authorizes the president to issue major disaster or emergency declarations in order to provide specific federal aid for response to incidents that overwhelm the capabilities of local and state governments. Under a major disaster declaration, the president may provide, without a cost ceiling, a wide range of aid. Aid may include the assistance of federal agencies, coordination of assistance, and/or distribution of supplies. An emergency declaration offers more limited assistance than a major disaster declaration (eg, a limit of \$5 million, unless the president determines otherwise and notifies Congress). A Stafford Act declaration may also be a necessary step in the authorization of certain types of federal medical responses, such as waiving sanctions for noncompliance with Emergency Medical Treatment and Active Labor Act (EMTALA).

**National Healthcare Preparedness Program:** Established by the HHS in 2002, the goal of the National Healthcare Preparedness Program (previously called and still referred to as the Hospital Preparedness Program [HPP]) is to enhance the ability of hospitals and healthcare systems to prepare for and respond to bioterrorist attacks and other public health emergencies, including an influenza pandemic and natural disasters. Current HPP priorities include strengthening hospital capabilities in the areas of interoperable communication systems, bed tracking, personnel management, and planning for fatality management and hospital evacuation. Past accomplishments have included developing and advancing bed and personnel surge capacity, decontamination capabilities, and isolation capacity; the purchase and stockpiling of pharmaceutical supplies; and training, education, drills, and exercises.<sup>61</sup> The NHPP as it has been structured to date has focused on preparedness and has not had a major role in response.

**Public Health Emergency Preparedness Program:** In 2002, Congress authorized funding for PHEP, to be administered by the CDC. PHEP provides funding to support preparedness and response activities in state, local, tribal, and territorial public health departments across the nation. These grants allow for an enhanced public health response to a variety of public health events, including terrorist attacks, infectious disease outbreaks, and natural disasters, as well as biological, chemical, nuclear, and radiological emergencies. These efforts to create emergency-ready public health departments support the NRF and the NIMS. In FY2009, \$688,914,546 was made available to upgrade the preparedness of public health jurisdictions.<sup>62</sup> Accomplishments of the PHEP include an increased number of laboratories able to detect top priority biological weapons agents, up from 83 in 2002 to 150 in 2008, and a doubling

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59 U.S. Government Accountability Office. *DoD Should Take Steps to Strengthen Management of the Civil Reserve Air Fleet Program*. September 2009. [www.gao.gov/highlights/d09625high.pdf](http://www.gao.gov/highlights/d09625high.pdf). Accessed October 13, 2009.

60 U.S. Department of Homeland Security. *Overview of Stafford Act Support to States*. January 2008. <http://www.fema.gov/pdf/emergency/nrf/nrf-stafford.pdf>. Accessed October 14, 2009.

61 Center for Biosecurity of UPMC. *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward*. Prepared for the U.S. Department of Health and Human Services under Contract No. HHSO100200700038C. 2009.

62 Marquez M, Patel P, Raphael M, et al. The danger of declining funds: Public health preparedness in NYC. *Biosecur Bioterror*. 2009;7(3):337-345.

of the number of epidemiologists in public health departments working in emergency response (from 115 in 2001 to 232 in 2006). Additionally, all 50 states and the District of Columbia have staff trained in their roles and responsibilities during an emergency, and all state health departments have staff on call continuously. Only 12 states had these capabilities in 1999.<sup>63</sup>

**Strategic National Stockpile:** The SNS is one of the most tangible federal assets.<sup>64</sup> This large inventory of medical countermeasures and related medical equipment is managed by the CDC, and its supplies are intended to supplement and resupply state and local public health agencies in the event of a large scale disaster. SNS inventory includes antibiotics, antitoxins, vaccines, critical care medications, airway management equipment, and intravenous administration supplies. The SNS is not held in a central location; rather, it is divided into separate caches that are located strategically across the nation to facilitate the rapid delivery (within 12 hours) of prepackaged assets (aka “push packs”) to affected states. A sustained supply of event specific supplies may follow. In addition to the directly held stockpile, the SNS coordinates with pharmaceutical and medical equipment manufacturers to maintain a vendor managed inventory (VMI). With both inventories, the SNS has sufficient assets to “protect people in several large cities at the same time.”

The deployment of the SNS is an exercise in cross-jurisdictional interaction and cooperation. When a governor’s office requests SNS assets, CDC triages that request and may deploy assets to that state. After the shipment has been made, it is the responsibility of state and local officials to distribute the supplies to the scene of the CHE. It should be noted that it is not necessary for a state’s pharmaceutical supplies to be exhausted before a request for federally held assets can be made. For example, the federal government has “leaned forward” assets in anticipation of a request from a governor’s office.

**Federal Ambulance Contract:** In August 2007, FEMA awarded a Federal Ambulance Contract to a privately owned emergency services provider, American Medical Response (AMR), to augment local EMS capacity during a CHE.<sup>65</sup> AMR has agreed to respond to public health emergencies in 21 states in the Gulf and Atlantic coast regions (contractual details allow for response in the remaining states on an as-needed basis). The contract calls for a transport capacity of up to 1,200 ground ambulances, 100 air ambulances, and low acuity “para-transit” for up to 14,000 individuals. In addition to patient transport, AMR personnel will provide triage and treatment and will redistribute stable patients to outlying facilities to decompress hospitals that are in close proximity to the site of the CHE. The identification, coordination, dispatch, and transit of responding units may require 1 or more days from the time assets are requested to their arrival at the scene of the CHE.

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63 Vanderwagen WC. Testimony before the Committee on Homeland Security, United States House of Representatives. July 22, 2008. <http://www.hhs.gov/asl/testify/2008/07/t20080722a.html>. Accessed November 25, 2009.

64 Strategic National Stockpile website. U.S. Centers for Disease Control and Prevention. March 2009. <http://www.bt.cdc.gov/stockpile/>. Accessed October 14, 2009.

65 FEMA awards AMR disaster response contract [news release]. Greenwood Village, CO: American Medical Response; August 2, 2007. <http://www.amr.net/getattachment/db8ebec5-054a-4d72-82c2-e830640cb8ad/FEMA-Awards-AMR-Disaster-Response-Contract.aspx>. Accessed October 14, 2009.

**CBRNE Consequence Management Response Force:** United States Northern Command (NORTHCOM), DoD's organizational structure for operations within the U.S., has established a chemical, biological, radiological, nuclear, and explosive (CBRNE) Consequence Management Response Force (CCMRF). When fully implemented, this force will comprise 1 unit of approximately 4,500 troops, drawn from all branches of the military, with the mission of providing military support to civilian response operations in the event of a large scale disaster. Once an incident has been confirmed, these units will be deployed and arrive at the disaster site within 48 to 96 hours. Their capabilities include search and rescue, biological agent detection and identification, emergency medical care, and decontamination. While the added manpower and resources will be of use during the response to a CHE, a recent GAO report noted that the DoD response effort is not well integrated with civilian response plans.<sup>66</sup>

### III. State, Tribal, and Local Response Structures, Programs, and Resources

Under the NRF, responsibility for disaster preparedness and response efforts rests primarily with local authorities. Additionally, the concept of a tiered response requires that an event is managed at the lowest possible level. As a result, building an equally robust local response capability remains a priority and an ongoing process for communities across the country.

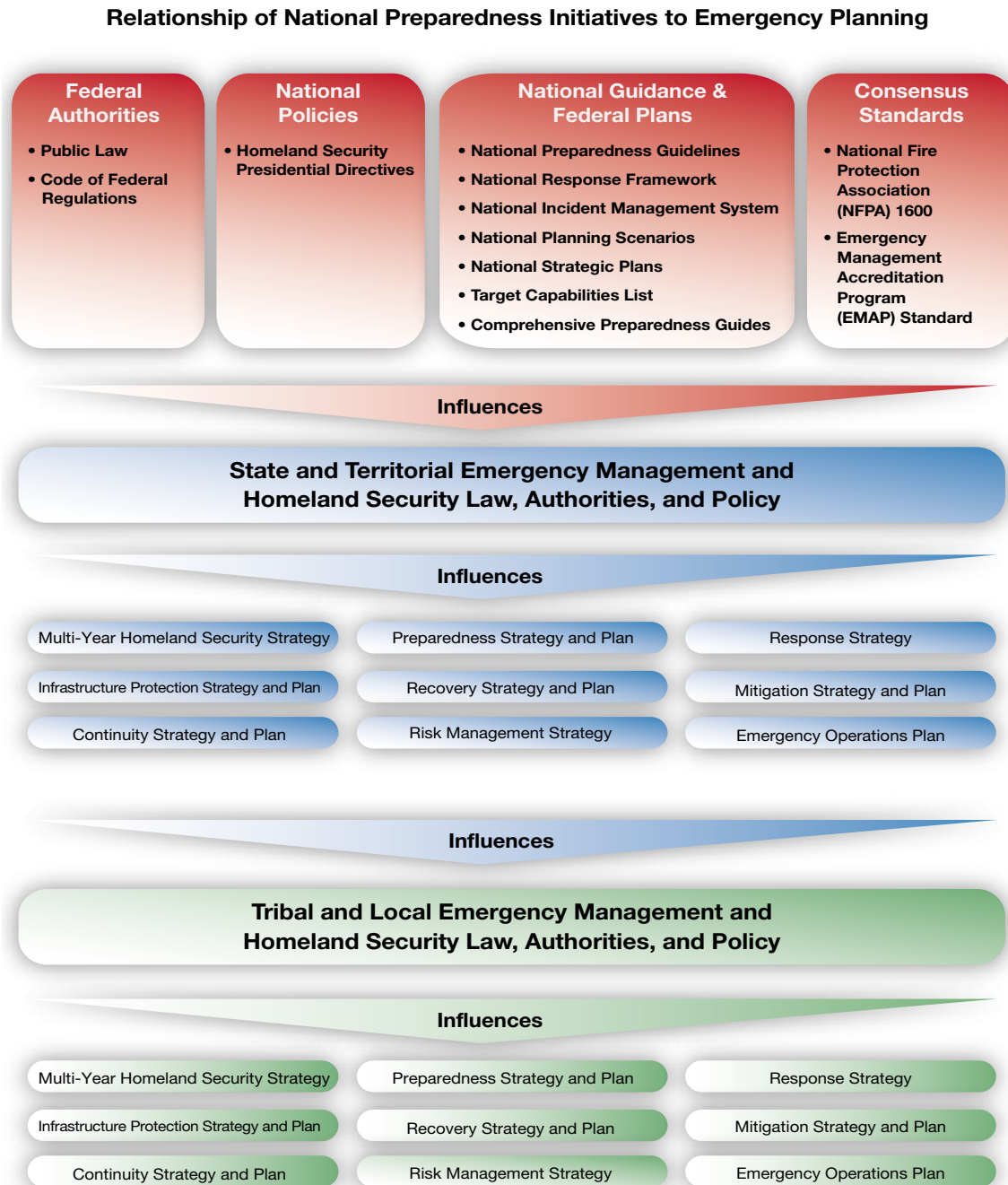
Most federal preparedness grants, including the HPP, require that public health and emergency management officials at the state and local levels conduct individual hazard vulnerability analyses as a condition of funding. Based on the threats identified by the (HVAs), plans are then made in an effort to prepare for a prompt and efficacious disaster response. The following graphic from FEMA's *Comprehensive Preparedness Guide*<sup>67</sup> illustrates FEMA's vision of how federal, state, tribal, and local planning efforts would be integrated.

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66 U.S. Government Accountability Office. *Planning, Resourcing, and Training Issues Challenge DoD's Response to Domestic Chemical, Biological, Radiological, Nuclear and High-Yield Explosive Incidents*. October 2009. <http://www.gao.gov/products/GAO-10-123>. Accessed October 14, 2009.

67 U.S. Department of Homeland Security. Federal Emergency Management Agency. *Comprehensive Preparedness Guide 101*. March 2009. <http://www.fema.gov/about/divisions/cpg.shtm>. Accessed January 22, 2010.

**Figure 3. FEMA Comprehensive Preparedness Guide Illustration of National Preparedness Initiatives and Their Relationship to Ongoing Emergency Planning**



U.S. Department of Homeland Security Federal Emergency Management Agency. *Comprehensive Preparedness Guide: Developing and Maintaining State, Territorial, Tribal, and Local Government Emergency Plans*. March 2009. Page 4-3. [http://www.fema.gov/pdf/about/divisions/npd/cpg\\_101\\_layout.pdf](http://www.fema.gov/pdf/about/divisions/npd/cpg_101_layout.pdf). Accessed January 21, 2010.



**Metropolitan Medical Response System:** MMRS is designed to enhance local medical response capabilities in major cities during a disaster until state and federal resources become available. The MMRS is unique in that it is one of few currently operating disaster response systems that pre-dates the 2001 terror attacks. It was originally developed in the National Capital Region (NCR) and 29 other cities in the mid-1990s, following 2 separate terrorist attacks: Aum Shinrikyo's sarin gas attack on a Tokyo subway, and the Oklahoma City bombing. MMRS grew by approximately 25 cities each year from 1999-2002. By 2002, the MMRS was established in 124 of the nation's most populous cities. The system is currently administered by the DHS through FEMA and is funded through the Homeland Security Grant Program (HSGP).<sup>68</sup> MMRS activities are intended to be coordinated with CDC PHEP and ASPR NBHPP grant activities. Participation from all sectors is expected, including first responders, fire departments, Public Health, Emergency Management, law enforcement, and medical and mental health services.

**Medical Reserve Corps:** Following the 2001 attacks on the World Trade Center and the Pentagon, an influx of volunteers, some of whom had medical training, responded to those locations independent of traditional first responders to offer aid. However, much of the help they offered was turned away due to an inability to verify a volunteer's identities and/or skills. Recognizing the potential contributions of nontraditional responders that include physicians, nurses, and public health professionals, the Office of the Surgeon General, in 2002, established the MRC.<sup>69</sup> An MRC unit is a community-based organization that recruits, organizes, trains, and certifies (often through the ESAR-VHP) medical volunteers who work to improve the health and safety of the community throughout the year, and who can be deployed to the scene of a disaster in order to augment medical staffing. To date, the MRC comprises 856 units and 188,863 volunteers.<sup>70</sup> The skill level of many volunteers is variable because many MRC participants are retired healthcare professionals and others are lay persons. It is also unclear how many of these volunteers have experience providing care outside of the hospital environment.

**National Guard and Expeditionary Medical Support:** The NG is a disaster response resource available to all state governments. As an institution, the NG's mission has varied throughout its history. Its current responsibilities include assistance in the medical response to a domestic disaster. The NG's primary medical response asset is the Expeditionary Medical Support (EMEDS).<sup>71</sup> EMEDS is a scalable medical response capability used primarily to stabilize soldiers in the field prior to transport to definitive care. During the response to a CHE, EMEDS would serve the same purpose. EMEDS is organized into the following units:

- **Small Portable Expeditionary Aerospace Rapid Response (SPEARR):** 12 medical providers, 1 tent, and associated equipment; appropriate for a population at risk (PAR) of up to 500; provides rapid response; used primarily to gain situational awareness.
- **EMEDS Basic:** 28 medical providers, 3 tents, and additional equipment; PAR = 500 to 2000; located in every state, Washington, DC, and Puerto Rico.

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68 FY 2009 Homeland Security Grant Program webpage. U.S. Department of Homeland Security. June 2009. <http://www.fema.gov/government/grant/hsgp/index.shtm>. Accessed October 14, 2009.

69 Middleton G. Medical Reserve Corps: Engaging volunteers in public health preparedness and response. *Biosecur Bioterror*. 2008;6(4):359-360

70 U.S. Surgeon General. Medical Reserve Corps website. <http://www.medicalreservecorps.gov/HomePage>. Accessed October 14, 2009.

71 U.S. National Guard. *EMEDS Factsheet*. February 2009. <http://www.ng.mil/media/factsheets/EMEDS.pdf>. Accessed October 14, 2009.

- **EMEDS 10:** 57 medical providers, 6 tents, and additional equipment; PAR = 2000 to 3000; 17 units located throughout the U.S., at least 1 per FEMA region; these units are known as chemical, biological, explosive, radiological, nuclear, and high-yield explosive Enhanced Response Force Packages (CERFP). They specialize in search and rescue, decontamination, and medical operations.
- **EMEDS 25:** 84 medical providers, 9 tents, and additional equipment; PAR = 3000 to 5000; EMEDS 25+ package can provide care for up to 25 medical and surgical inpatients. Three existing units based in the mid-Atlantic, midwest, and Pacific Northwest regions. Five additional units are planned.

**The Emergency Management Assistance Compact:** EMAC is a mutual aid agreement among states that facilitates cooperation and resource sharing during a disaster.<sup>72</sup> The legal framework provided by an EMAC agreement allows for an improved regional response capability when the resources of one state have been overwhelmed by a CHE. In locations where healthcare coalitions cross state lines, EMAC agreements have been integrated into preparedness planning, as they offer a mechanism to permit the sharing of scarce resources.

**Healthcare Coalitions:** An important outcome of recent preparedness efforts has been the development of healthcare coalitions of hospitals and public health and emergency response agencies that are beginning to work together in some locations to plan for and respond to mass casualty events. These healthcare coalitions currently embody a range of structures, membership, and functional capacities, but several core functions critical to preparedness are shared by the most successful coalitions.<sup>73</sup>

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<sup>72</sup> EMAC website. National Emergency Management Association. <http://www.emacweb.org/>. Accessed October 14, 2009.

<sup>73</sup> Center for Biosecurity of UPMC. *Hospitals Rising to the Challenge: The First Five Years of the U.S. Hospital Preparedness Program and Priorities Going Forward*. Prepared for the U.S. Department of Health and Human Services under Contract No. HHSO100200700038C. 2009.

## Appendix D. Second Issue Analysis Group Meeting Participants

**Terry Adirim, MD, MPH** – Office of Health Affairs, DHS

**Patti Iles Aymond, PhD** – Innovative Emergency Management, Inc. (IEM)

**Debra E. Berg, MD** – Bureau of Communicable Diseases, NYC Health

**Kathryn Brinsfield, MD, MPH, FACEP** – Office of Health Affairs, DHS

**Torrance T. Brown** – HHS/OS/ASPR/OPEO

**Norm Coleman, MD** – NCI, National Institutes of Health

**H. Allen Dobbs, MD, CAPT, USPHS** – National Disaster Medical System, HHS/ASPR/OPEO

**Robert S. Dugas, MPH** – HPP, HFPP, and ECare Partnership Programs, HHS/ASPR/OPEO

**Andrew L. Garrett, MD, MPH** – National Center for Disaster Preparedness, Mailman School of Public Health, Columbia University

**David W. Gruber** – New Jersey Department of Health and Senior Services

**Dan Hanfling, MD** – Inova Health System

**Cynthia Hansen, PhD** – HHS/OS/ASPR/OPEP

**John L. Hick, MD** – University of Minnesota and Hennepin County Medical Center

**RADM Ann R. Knebel, RN, DNSc, FAAN** – HHS/ASPR

**Jon R. Krohmer, MD** – Office of Health Affairs, DHS

**Monica Lathan Dye, MPH** – CHES – HHS/OS/ASPR/OPEO

**James V. Lawler, MD, MPH, FACP** – NIAID, NIH

**David Marcozzi, MD, MHS CL, FACEP** – White House Homeland Security Council

**Kathie S. McCracken, RN, MHA, FACHE** – Office of Health Affairs, DHS

**Gregg A. Pane, MD, MPA, FACEP** – National Healthcare Preparedness Programs, HHS/OS/ASPR

**Deborah Patrick, PhD** – HHS/ASPR/BARDA

**Sally Phillips, RN, PhD** – Public Health Emergency Preparedness Program, AHRQ

**Steven Pixley, RN** – Dartmouth Hitchcock Medical Center

**Irwin Redlener, MD** – National Center for Disaster Preparedness, Mailman School of Public Health, Columbia University

**Lewis Rubinson, MD, PhD** – Division of Healthcare Quality Promotion, CDC

**Jeffrey Stiefel, MD, PhD** – Office of Health Affairs, DHS

**Kevin Yeskey, MD** – HHS/ASPR

**Stephanie Zaza, MD, MPH** – Coordinating Office for Terrorism Preparedness and Emergency Response, CDC

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### **Center for Biosecurity of UPMC**

621 E. Pratt Street, Suite 210  
Baltimore, Maryland 21202  
443-573-3304

**<http://www.upmc-biosecurity.org>**

## Editorial, Design, and Production Team: Center for Biosecurity of UPMC

**Mary Beth Hansen, Editor**

Chief Information Officer

**Davia Lilly, Design and Production**

Director of Design and Production

**Molly D'Esopo**

Senior Communications Specialist

**Jackie Fox**

Senior Science Writer

**Richard Messick**

Web, Print, and Multimedia Technician



**Center for Biosecurity of UPMC**

621 E. Pratt Street, Suite 210  
Baltimore, Maryland 21202  
443-573-3304

<http://www.upmc-biosecurity.org>