

PART I

Anticipating Sandy: When NYC shut its doors

Dr. Chris McStay was anxiously gazing through the wet panes of the large glass atrium that shielded the century-old façade of Bellevue Hospital – America’s oldest hospital that had a long tradition of serving the most destitute in what New Yorkers believe is the greatest city in the world. He was looking for telltale signs of the impending storm: rain, high winds, swirling dust, rattling panes. He knew that Hurricane Sandy was fast approaching, and all the hospitals were on high alert – as they had been, just one year ago, when Hurricane Irene had threatened to disrupt New York City (NYC).¹ Irene’s visit was largely inconsequential and New Yorkers were now skeptical of the Mayor’s abundant warnings and precautions for Hurricane Sandy.

Hurricanes over the Atlantic traveling west toward the US usually die down at sea, or continue toward the Gulf coast. One in twenty make landfall, typically in Louisiana or Mississippi (1). Therefore, a week prior, when the European Weather Center in the UK predicted that New York and New Jersey potentially lay in the path of Hurricane Sandy, meteorologists and disaster planners in the US took notice and began following the storm’s trajectory closely.² In the ensuing days it was abundantly clear that Hurricane Sandy would directly affect New York City and its surrounding areas.³ On October 26, Governor Andrew Cuomo declared a state of emergency for the entire state of New York. Michael Bloomberg, Mayor of New York City, advised the approximately 375,000 residents living closest to the water’s edge in an area demarcated “Zone A” to evacuate their homes by seeking shelter with friends or family, or to head to one of the 76 hurricane shelters set up in the city (2).

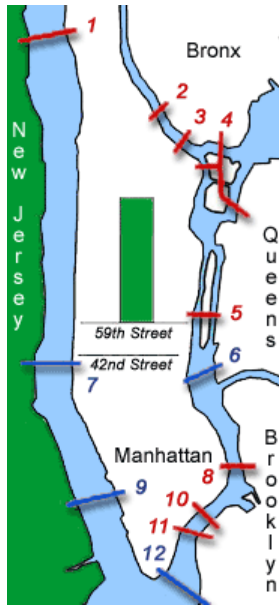
Mayor Bloomberg was entering the final year of his three terms as Mayor of the city. His team had successfully prepared for Irene, and was once again taking abundant precautions to protect the city from Hurricane Sandy. The city’s subway system was closed by October 28, and subway entrances and vents on the city’s sidewalks were boarded down. The two arterial tunnels to Manhattan--the Midtown Tunnel from Queens and Holland Tunnel from New Jersey--were closed to traffic. The Mayor ordered public schools to close on Monday, October 29, and those living in low-lying areas of NYC (Zone A) to evacuate. By Monday afternoon, bridges to Manhattan were being closed down in anticipation of high winds. The roads were empty and people were instructed to stay in-doors. By Monday evening, all roads leading to Manhattan were shut and the island city was essentially isolated from the other boroughs.

¹ New York City contains five boroughs, and the most densely settled is named Manhattan. It is geographically an island joined to the other boroughs and the mainland area of New York State by bridges and tunnels.

² While most hurricanes get weaker as they move into cooler waters, this was not the case with Sandy. According to Radley Horton of the Center for Climate Systems Research, “Parts of the North Atlantic were five degrees warmer than normal. You could see it as you watched those satellite images, as Sandy passed over that unusually warm water, it increased its strength” (1). In addition, a nor’easter had been developing inland, and was moving parallel to Sandy’s course. These two storm systems would eventually merge and create one “Super storm” that was over 1,100 statute miles in diameter at one point (3).

³ Not only did meteorologists become certain that New York and New Jersey were in Sandy’s path of destruction, but they also forecasted that the storm would hit at high tide. In another stroke of misfortune, the moon was in its full phase on both October 29. A full moon meant higher tides than usual rose along the coast in the moments before landfall (3). As anticipated, the storm arrived at the worst possible time – high tide during a full moon – creating surges of water up to 12.5 feet high (4).

FIGURE 1: Bridges and Tunnels to and from Manhattan



Bridges and Tunnels to Manhattan

1. George Washington Bridge
2. Third Avenue Bridge
3. Willis Avenue Bridge
4. Triborough Bridge
5. Queensborough (59th Street) Bridge
6. Queens Midtown Tunnel
7. Lincoln Tunnel
8. Williamsburg Bridge
9. Holland Tunnel
10. Manhattan Bridge
11. Brooklyn Bridge
12. Brooklyn Battery Tunnel

Red: Bridges Blue: Tunnels

Adapted from <http://www.ny.com/transportation/crossings/> Accessed April 1 2016.

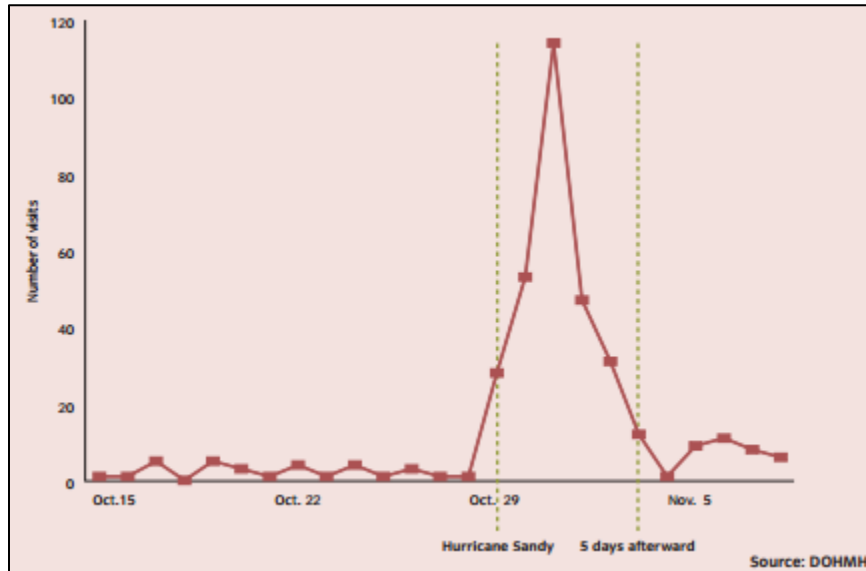
Hospitals would stay open

In August 2011, prior to Hurricane Irene, several hospitals in NYC had been instructed to evacuate their patients in a controlled environment. State Health Commissioner Dr. Thomas Farley and City Health Commissioner Dr. Nirav Shah had overseen the transfer of over 10,000 patients from seven acute-care hospitals and 39 psychiatric, adult-care, and nursing homes in preparation of Hurricane Irene. However, a year later, in 2012, the health commissioners had decided against a proactive evacuation plan for Hurricane Sandy given the risks entailed in these large volume patient transfers. They stated that the costs to the system and the potential losses to the hospitals had not been a consideration in the decision process (5). Joseph Bruno, the Commissioner of the city's Office for Emergency Management (OEM) was also satisfied by the inter-hospital coordination and medical preparedness for Sandy. The teams at OEM supporting health facilities had been assigned a larger coordination space than during Irene.

Subsequently, the Mayor had exempted hospitals and nursing homes in Zone A from his evacuation order, advising them to shelter in place. The commissioners did however ask vulnerable nursing homes to increase staffing at their facilities and to transfer out patients that required mechanical ventilation. They instructed area hospitals to make preparations for prolonged power outages; cancel elective procedures and discharge patients who were healthy enough; evacuate patients who were utility dependent (i.e. on ventilators, etc.); increase staffing to 150% of normal rates by 5 pm for long-term care facilities (LTC) and adult-care facilities (ACF); transfer LTC patients on ventilators to safer locations; and to override normal approved capacity when receiving patients, if necessary. They also encouraged dialysis centers to remain in operation on Sunday, October 28 (2).

Manhattan (25). In the immediate aftermath, 27 patients in the ED were awaiting dialysis.

FIGURE 3: ED visits needing dialysis in New York City



Source: City of New York. (2013). Retrieved from http://s-media.nyc.gov/agencies/sirr/SIRR_spreads_Hi_Res.pdf Accessed April 1, 2016

This “on-your-feet-improvisation” was a mantra that Beth Israel staff recall was almost ubiquitous. Hospital staff “task-shifted” to take on responsibilities outside their usual scope of work. Clinicians answered phones, helped keep the ED clean and distribute meals to the patients. An influx of outpatient providers helped relieve ED staff during the busiest days of the immediate response. Although many of these doctors were primary care physicians and had not worked in an emergency department for years, their presence helped ED physicians focus on incoming patients (25).

By the end of the first week, the ED was seeing a daily average of 500 patients (up from its norm of 300). Ambulance arrivals rose by 64% in the first month; and the inpatient daily census rose to 750 from the baseline of 650. An additional ED area was opened to accommodate the influx, and the inpatient area was expanded by 5% by adding beds to in the inpatient rooms (26). Due to this voluminous surge, some patients that would normally be admitted had to be sent home. Eventually, a cardiologist was stationed in the ED to manage and fast-track patients with chest pain that could be discharged after lab tests and an expedited stress test. Not originally a part of the hospital’s surge plan, these operational innovations helped optimize patient care in the days following Sandy.

Social workers who would typically see up to ten patients/day had to assist approximately 200 patients by November 1, as patients sought help because they were unable to return to their “flooded, waterless and powerless homes” (26).

No time for red-tape

Following the decision to evacuate, residents, nurses, and other hospital support staff at NYU Langone and Bellevue were incredibly anxious. Hospital administrators assured the staff that no one would lose their job. The surge of patients at the other hospitals would require an expanded workforce to care for all the additional patients. Sending providers from the flood-affected hospitals to the receiving hospitals seemed to be the logical solution.

FIGURE 4: Evacuations in New York City

	Hospitals	Nursing Homes	Adult Care Facilities	TOTAL
Patients evacuated, re-evacuated and repatriated	1,379	3,102	1,520	6,001
Pre-storm evacuation of ventilator dependent patients	579	57	49	685
Healthcare facilities that lost power during the storm	9	43	21	73
Healthcare facilities that operated using a generator	5	32	12	49
Healthcare facilities that remain partially-closed [†]	3	0	0	3
Healthcare facilities that remain fully closed [†]	0	4	1	5
HCFs requiring post-storm evacuations (5,316 persons)	6	18	12	36
HCFs within NYC that received patients (4,436 persons)**	45	73	18	136
HCFs outside NYC that received patients (30 persons)**	0	4	1	5

[†] Figures as of April 1, 2013
^{**} Note: many of these patients were evacuated more than once. First evacuations were emergent, so not all patients went to the most appropriate HCF. Second evacuations were from shelters to more appropriate HCFs. Third transport was to repatriate patients back to their original facility (if it was still operational).
^{***} Note: 7 special medical needs shelters received 1,523 persons

Source: Diglio, M., Benedetto, N. A., & Raneri, J. (2013). Retrieved from http://www.nycremsco.org/images/articlesserver/Sandy_Article-1305JEMS32-39.pdf Accessed April 1 2016.

The New York City Health and Hospitals Corporation (HHC), now branded New York Health + Hospitals, was formed in 1969 and operates 11 hospitals across the city, including some of the nation's oldest public hospitals. In addition, three large hospital systems, including New York-Presbyterian, Mount Sinai Health System, and North Shore - LIJ Health System (now Northwell Health), control the majority of hospitals in the New York Greater area. Each system had its own set of rules and regulations around physician recruitment and credentialing. The process would routinely take several weeks; even months. Hospitals were now being asked to expedite the credentialing process to facilitate physicians that had traveled with the transferred patients on the night of the storm to care for their patients in the new host facilities (2).

Mount Sinai, on the upper east side of Manhattan, was one such hospital. Between 1am and 5pm, the hospital received 57 patients in its PACU (Post Anesthesia Care Unit). The

majority were critically ill ICU-bound patients. Nine patients went to the labor and delivery ward. For NYU patients, the hospital switched to its “downtime” operational procedures replacing the electronic medical record with paper charts. The pharmacy was allowed to enter orders into the automated dispensing systems under “downtime” provisions. The State allowed emergency credentialing and approval for the NYU providers to practice at Mt. Sinai. An additional set of “read-only” access users were created by Mt. Sinai’s IT department for NYU staff to access patient records. Within 30 hours of arrival, the patients were transferred to their final in-patient locations.

On Wednesday, October 31, Bellevue began evacuation. Phone communication was lost, and Mt. Sinai did not know how many patients to expect during this second wave. They created “virtual patient units” in their EMR, and re-purposed existing physical wards to accommodate the incoming patients. Additional printers were made available for printing identity bands for patients, and labels for laboratory samples. Hand-scrawled bed numbers in this newly assigned unit coincided with the bed numbers in the “virtual unit” created in the EMR. Medical students were recruited as runners. Though the new unit did not eventually receive many patients, it served as an overflow unit during the subsequent flu season (peak season December to February) that continued to overwhelm the inpatient bed capacity of New York City,

The credentialing process for NYU staff at Beth Israel was delayed due to protracted negotiations between the two hospitals. The over-worked staff at Beth Israel would only get some respite when Bellevue re-opened its emergency department weeks later.

Coordinating Response

The Healthcare Facility Evacuation Center (HEC)

The Department of Health activated the Healthcare Facility Evacuation Center (HEC), a Department of Health-run entity set up to coordinate the evacuation, shelter-in-place, and repatriation of healthcare facilities in conjunction with other response agencies (27). It is responsible for finding beds, arranging transport and giving guidance to receiving facilities (28). It coordinates these processes with the DOH, the OEM, the Greater New York Hospital Association (GNYHA), the Health and Hospitals Corporation (HHC), the Veterans Administration, the NY State Office of Mental Health and various nursing home associations. It coordinates transport via FDNY, the Regional EMS Council, the Metropolitan Transport Authority (MTA), the Taxi and Limousine Commission (TLC) and the NYC Department of Education.

The HEC was in the midst of consolidating lessons learned from Hurricane Irene. It had finalized its Command and Control plans, and its Transportation logistics. But HEC’s facility was itself not completed and its plans on finance, repatriation and data systems were only partially completed. While the HEC was largely responsible for coordination of safe inter-hospital evacuations and transfers, the unique demands of Sandy compelled HEC to expand its scope of services significantly. The HEC found itself coordinating dialysis centers, fueling for emergency vehicles and generators, procuring interim housing, supporting home care staff, providing logistics to health care facilities including meals and equipment, and tracking patients until a better system was put in place. In all, the HEC coordinated the emergency evacuation of over 2,000 patients (6).

After Sandy, HEC released a set of guidelines and online resources (eFINDS) to help health care facilities optimize HEC's use during disasters, allowing HEC to focus on its core mission of coordinating bed-matching, transportation and shelter-in-place directives. eFINDS can be found at <http://www.oasas.ny.gov/pio/eFINDS/>.

EMS

The Bureau of EMS in New York is the country's largest Fire Department-based EMS system and contributes 67% of the ambulances on New York's 911 network (29). A majority of the remaining 33% are considered volunteer ambulances and are provided by hospitals across the city. FDNY EMS is responsible for all mass casualty incidents across the city. Its annual call volume is over 1.3 million (29).

Several local FDNY ambulances could not reach their fueling stations and were out of commission. Others had low clearances and could not navigate the flooded roads. The lack of familiarity of out-of-state EMS providers with routes to closest hospitals, especially during the various road closures and diversions, contributed to patients ending up at wrong hospitals.

In the immediate aftermath of Sandy (and the blackout), FDNY responded to calls for rescuing the many people who were trapped in elevators across downtown Manhattan. The elderly called for assistance with navigating stairs. Owing to road closures, widespread power failures, unlit roads, and the long walks up and down stairwells, many of these rescue calls took upwards of three hours to respond to, completely saturating the department's capacity to respond promptly. Provider fatigue was substantial in the initial days after Sandy (2).

OEM and FEMA

On October 26, the New York State OEM activated the Emergency Operations Center to serve as the coordination nucleus for all emergency response activities (27). Thousands of response personnel would converge in the area from multiple agencies across the country. During peak deployment, there were 212, 282 personnel from 23 agencies (30). In addition, 1,061 volunteers from 29 states responded to Sandy. FEMA deployed 1200 personnel for reconnaissance in affected neighborhoods (31). It also activated the Surge Capacity Force, which allowed volunteers from the Department of Homeland Security to rapidly deploy to disaster-affected areas.

Within three days, FEMA had provided 1.9 million meals and distributed 1.3 million liters of water (31). FEMA established 147 shelters in conjunction with the American Red Cross. The Temporary Sheltering Assistance program facilitated the relocation of displaced residents from shelters to hotels. So that those with homes but without power could return home sooner, FEMA's Sheltering and Temporary Essential Power (STEP) Program assisted the city in paying contractors to perform emergency repairs on their homes (31). In total, 11,531 emergency repairs were facilitated in New York City and Long Island (30). Estimates of people totally displaced by Sandy range from 30-40,000.

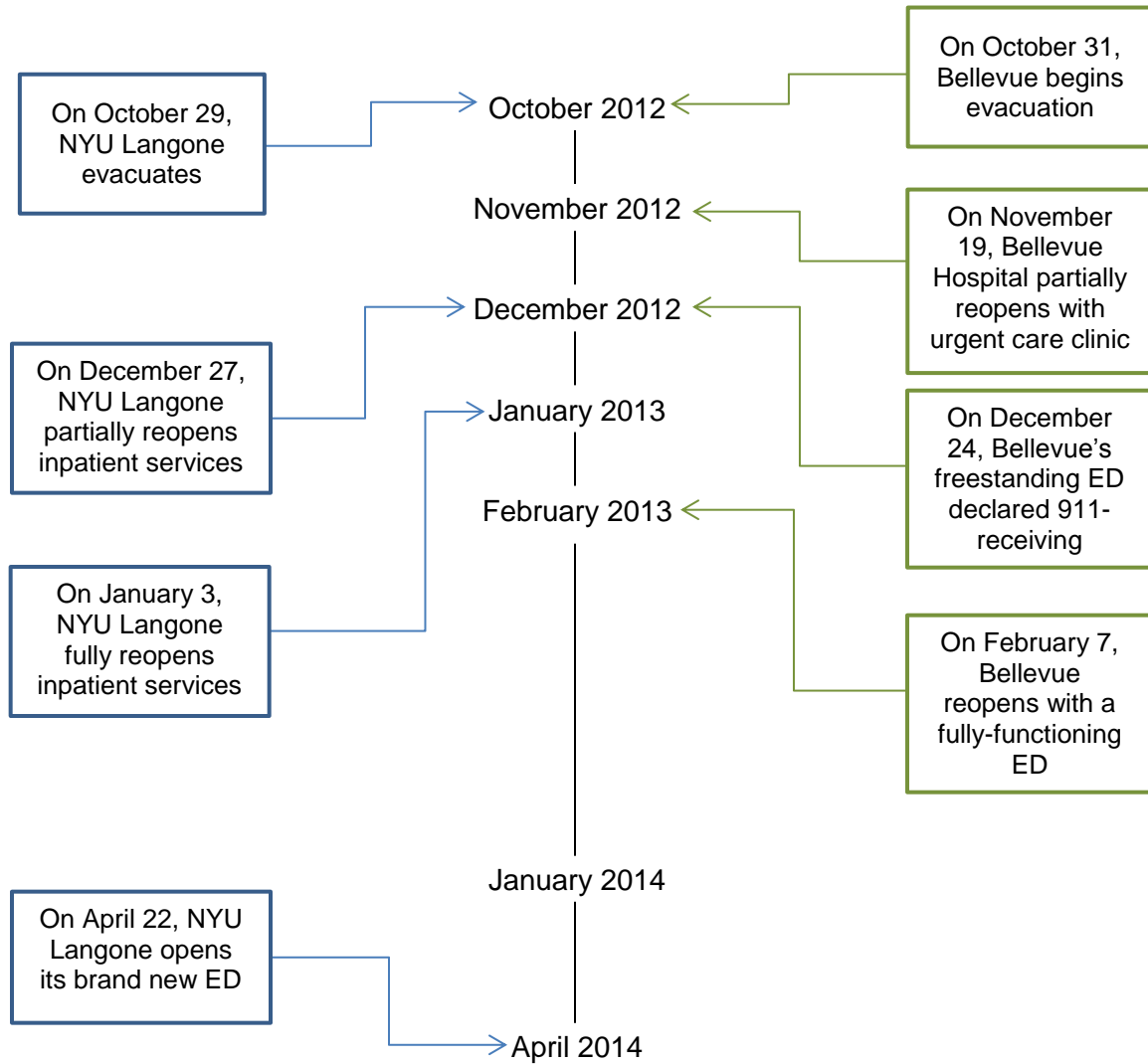
The estimated assessment of damage in New York City was \$15 billion, including damage to homes, businesses, infrastructure, the healthcare system, and other areas of the city (38). See Exhibit 2.

Bellevue reopens

It would be many months before New York City would return to normal life. The destitute that sought routine care at Bellevue Hospital found it hard to seek care elsewhere. Responding to their needs, Bellevue first opened its urgent care center on November 19th, transformed it into a free-standing ED, and finally declared it a 911 receiving center on December 24th (19). Patients that accessed these services were the most vulnerable among New Yorkers - those that “did not have an inlet into the healthcare system” (39). These patients had delayed seeking care because they could not seek care elsewhere or did not know how to. They had missed clinic appointments. Though the free-standing ED was to only receive non-critical patients by ambulances, many that arrived at their door were critically ill because of delayed access to care. Though these patients knew that Bellevue was closed they came to the ED because they considered it “their hospital” and did not know where else to go. Physicians in the Bellevue ED, unable to always find ICU beds in other hospitals to which to transfer these patients, resuscitated and cared for many patients in the Bellevue ED for sustained periods of time (39).

Bellevue re-opened on February 7, 2013, 99 days after it had been forced to close.

EXHIBIT 1: NYU Lagone and Bellevue operation timeline



Adapted from Adalja, A. A., Watson, M., Bouri, N., Minton, K., Morhard, R. C., & Toner, E. S. (2014a). Absorbing citywide patient surge during Hurricane Sandy: A case study in accommodating multiple hospital evacuations. *Annals of Emergency Medicine*, 64(1), 1–9. <http://doi.org/10.1016/j.annemergmed.2013.12.010>

EXHIBIT 2: Damage Assessment Estimates in USD millions

Categories	NYC	Counties					Total by Category
		Suffolk	Nassau	Westchester	Rockland	Other Counties ¹	
Government Response & Repair	486.0	144.0	257.1	17.0	16.2	707.0	1,627.3
Housing	4,738.0	833.0	4,016.0	50.0	35.0	-	9,672.0
Business	4,512.1	492.4	486.8	400.6	90.0	18.1	6,000.0
Infrastructure	1,130.0	25.8	1,086.5	32.4	-	6,133.7	8,408.4
Health	2,799.0	3.0	43.0	-	-	236.0	3,081.0
Parks & Environment	300.0	100.7	265.0	27.0	-	101.2	793.9
Other ²	1,080.0	186.0	448.2	0.8	2.5	10,584.8	12,302.3
Total	\$15,045.1	\$1,784.9	\$6,602.6	\$527.8	\$143.7	\$17,780.8	\$41,884.9

Source: U.S. Department of Commerce. (2013). *Economic Impact of Hurricane Sandy*. Retrieved from <http://www.esa.doc.gov/sites/default/files/sandyfinal101713.pdf>

ADDITIONAL READINGS

An assessment of Manhattan's hospital response to Sandy

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4110437/>

Hospital Emergency Preparedness and Response During Superstorm Sandy

<http://oig.hhs.gov/oei/reports/oei-06-13-00260.asp>

A Stronger, More Resilient New York

http://s-media.nyc.gov/agencies/sirr/SIRR_spreads_Hi_Res.pdf

EXERCISE

It is Hurricane season again.

Which hospitals in your city are vulnerable to severe weather events? What events? What are the hospitals' vulnerabilities?

What is the contingency plan for electricity and water?

What are the communication channels within and among hospitals in case of a disaster event requiring the evacuation of a hospital?

What preparedness and mitigation steps must hospitals in your city undertake to ensure adequate communication, transport and redistribution of personnel between hospitals? What exists? What does not? And how will you address these gaps?

In case of a severe crippling storm like Hurricane Sandy, who in your city would be among the most vulnerable? How will you identify, protect, assist or rescue them? What measures can your city undertake to minimize their vulnerability?

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