



Evacuate or Stay? North Shore LIJ and Hurricane Sandy

On Friday, October 26, 2012, a massive storm named Sandy was bearing down on New York City. Municipal authorities up and down the eastern seaboard debated whether to evacuate communities, close public offices or halt public transport. The storm had reached hurricane strength and had already devastated the Caribbean.

Few entities had more at stake in a storm of this magnitude than hospitals. Moving patients out was costly, labor intensive, physically hard on the patients and a logistical nightmare. But leaving patients in a hospital in a storm's path risked the loss of heat and electricity, direct hits on roofs and buildings, stranded medical personnel or impassable roads, resulting in the threat of substandard care—even death—for the ailing.

James Romagnoli was hospital safety executive for the nonprofit North Shore-Long Island Jewish Health System (North Shore-LIJ). The network owned 15 hospitals on Long Island and in New York City. Three of them—Staten Island University Hospitals North and South, and Southside—sat in low-lying areas and were at risk of flooding in severe storms. Romagnoli, who brought broad experience in emergency preparedness and crisis management to the hospital system when he joined in 2001, had built an emergency operations center, taught crisis decision-making skills to physicians and other employees, and instituted emergency management best practices.

Just 14 months earlier, Romagnoli and North Shore-LIJ had put this infrastructure to the test when Hurricane Irene bore down on the East Coast. In August 2011, forecasters and public officials alike warned that Irene would wreak havoc on coastal communities. New York City, among other municipal authorities, evacuated low-lying areas. Romagnoli and his team decided to evacuate the three threatened hospitals, and on August 24, 2011, 947 patients moved to other facilities further inland.

At the last minute, however, Irene had altered course and greater New York escaped essentially unscathed.¹ North Shore-LIJ had effectively put its patients through an arduous evacuation exercise needlessly. There were no specific negative consequences, but the experience

¹ Vermont ultimately bore the brunt of what was still a terrible storm.

reinforced for hospital planners the pros and cons of evacuations, and the challenges of planning for weather-related events.

All this weighed on the minds of Romagnoli and COO Mark Solazzo as Hurricane Sandy approached. The storm was expected to make landfall on October 29, 2013. But for safety reasons, an effective evacuation had to be completed more than 48 hours in advance of landfall. The National Weather Service and the company's private weather consultants both painted a grim picture of the storm's strength. However, that was the prognosis before Irene as well. Romagnoli and Solazzo had only a few hours to decide whether to order an evacuation of the three at-risk hospitals, as they had with Irene, or allow patients to remain in place, with the attendant risks.

When Safety Is in Harm's Way

When disaster struck, whether it was a hurricane, earthquake, industrial accident or terrorist attack, getting the wounded to safety ultimately meant getting them to a hospital. But sometimes a disaster affected a hospital itself, forcing the facility's evacuation. Evacuating a hospital was a consequential event—a major logistical challenge that occupied a large portion of an area's emergency management labor and resources. It also limited or deprived the hospital's community of medical services during a time of crisis.

Events that led to hospital evacuations were either anticipated or unanticipated. Hurricanes, wildfires and chemical spills were anticipated events. For these, hospital staff had hours or even days of advance notice and precious time to implement evacuation procedures. Earthquakes, tornadoes, explosions and hazardous materials exposures were unanticipated events. For these, hospital staff had little or no notice and often had to evacuate patients under dangerous conditions.

There were two types of evacuations: internal and external. During an internal evacuation, patients were moved to the safest parts of a facility. Patients could be moved either horizontally, away from danger zones like windows and compromised areas, or vertically, from one floor to another. During an external evacuation, patients were moved to another facility away from the danger zone. External evacuations were either full or partial. Under partial evacuations, most of the patient population, including those dependent on mechanical ventilators and other equipment, was moved, but patients hardy enough to withstand compromised hospital conditions remained. Evacuations could also be done in sequence: horizontal (away from immediate danger), vertical (to a staging area on another floor) and then from the facility if necessary.

Protocol. Most hospital evacuation protocols provided guidance for the following:

- Assessing a hospital's vulnerabilities
- Preparing an evacuation plan

- Deciding whether to evacuate or shelter-in-place
- Determining an order for evacuating different patient populations
- Marshaling transportation resources
- Identifying facilities to receive evacuated patients
- Repatriating patients when the crisis has passed²

Many evacuation protocols focused on the immediate responsibilities of staff within a facility at the moment of crisis, including ordering the evacuation. The New York Center for Terrorism Planning and Preparedness (NYCTP) issued guidelines in March 2006: a Hospital Evacuation Protocol for state facilities.³ The protocol enumerated the responsibilities of every staff member from cafeteria workers to surgeons. For example, the hospital security staff's role was to guide evacuees out of the facility and first responders into it, and to maintain communications within the facility and to the outside world.

Time to go. There had been numerous hospital evacuations in the US and Canada in preceding decades. Some of the more memorable included:

- At 6 a.m. on February 9, 1971, a magnitude 6.6 earthquake struck the San Fernando Valley centered on Sylmar, California. Four buildings of the Veterans Administration Hospital collapsed, killing 49. Hospital staff evacuated 300 patients to other VA hospitals using school buses and commandeered vehicles.⁴
- Just before midnight on November 10, 1979, a freight train derailed in Mississauga, Ontario. Several propane tanker cars exploded, creating a massive fire. Hazardous chemicals in other tanker cars, including chlorine, prompted officials to order most of the city evacuated. More than 200,000 people were forced to leave, including 478 patients from the Mississauga Hospital.⁵
- At 4:30 a.m. on January 17, 1994, a magnitude 6.7 earthquake struck Northridge, California. The Sepulveda VA Hospital lost power and its emergency generators failed. Despite darkness, debris and jammed doors, the hospital's staff managed to evacuate 331 patients within an hour and a half. All told, six hospitals were fully evacuated in the aftermath of the Northridge earthquake.⁶

² Hospital Evacuation, California Hospital Association. See: <http://www.calhospitalprepare.org/evacuation>

³ Hospital Evacuation Protocol, New York Centers for Terrorism Preparedness and Planning. See: <http://www.nyc.gov/html/doh/downloads/pdf/bhbp/bhbp-hospital-nyctpevac-plan.pdf>

⁴ History of Health Care Facility Evacuation, OSHA. See: http://www.osha.gov%2Fde%2Fgrant_materials%2Ffy06%2F46j6-ht40%2F1-history-evac.ppt

⁵ Mississauga Hospital: largest evacuation in Canada's history, Health Care Delivery. See: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1801956/pdf/canmedaj01129-0086.pdf>

⁶ History of Health Care Facility Evacuation, OSHA. See: http://www.osha.gov%2Fde%2Fgrant_materials%2Ffy06%2F46j6-ht40%2F1-history-evac.ppt

In the first decade of the 21st century, flooding triggered numerous hospital evacuations:

- Shortly after midnight on June 9, 2001, floodwaters from Tropical Storm Allison inundated the ground floor and basement of the Memorial Hermann Hospital in Houston. With all power out, the staff evacuated 406 patients down stairwells using flashlights and backboards.⁷
- On June 7, 2008, following days of heavy rainfall, Haw Creek in Columbus, Indiana overflowed its banks. Floodwaters inundated the basement and ground floor of Columbus Regional Hospital. The hospital evacuated 157 patients within three hours.⁸
- On June 13, 2008, the Cedar River in Cedar Rapids, Iowa crested at a record 31 feet. Despite the efforts of hundreds of volunteers using sandbags, floodwater filled Mercy Medical Center's basement and knocked out power. That night, staff and volunteers evacuated 176 patients in seven hours.⁹

Katrina. One of the starkest examples was Memorial Medical Center in New Orleans. When Hurricane Katrina struck the city on the morning of Monday, August 29, 2005, the hospital lost main power and switched to backup generators. The next morning, floodwaters breached the city's levees and advanced toward the hospital.

A chaotic attempt to evacuate the hospital's 187 patients ensued. Coast Guard and private ambulance service helicopters made repeated trips to evacuate patients. By the early hours of Wednesday, August 31, with 130 patients remaining in the hospital, the floodwaters knocked out the hospital's electrical system. Helicopter flights continued, but many of the weakest patients, including four who had been on mechanical ventilators, did not survive long enough to be evacuated. Medical workers were forced to make the gut-wrenching decision to place dying patients in the hospital's chapel in order to focus on patients with a chance of survival. When rescue workers later entered the hospital, they found 45 corpses in the chapel. Overall, Hurricane Katrina forced 30 hospitals to evacuate a total of 5,048 patients and 22,200 staff.¹⁰

Hospitals and federal, state and local governments regularly honed hospital evacuation protocols, and major disasters that affected hospitals tended to prompt reviews. Hurricane Katrina, in particular, was a wake-up call for coastal hospitals about the threat of flooding from hurricanes. Many hospitals had their electrical systems and backup generators at or below ground level, which left them vulnerable to complete loss of power if their facilities flooded. Long term, many hospitals

⁷ Ibid.

⁸ Columbus Regional Health website. See: <http://www.crh.org/about-us/default.aspx>

⁹ Iowa Flood Stories 2008: Cedar Rapids. See: <http://www.iptv.org/iowajournal/story.cfm/396/feature>

¹⁰ Sheri Fink, "The Deadly Choices at Memorial," *ProPublica*, August 27, 2009. See: <http://www.propublica.org/article/the-deadly-choices-at-memorial-826>

planned to reconfigure their electrical infrastructures. In the meantime, hospitals with basement electrical systems prepared to combat flooding via sandbagging and pumping. But the threat of complete power loss remained, and with it the need to be able to safely and efficiently evacuate.

Emergency Preparedness Man

James A. Romagnoli became a New York City police officer in September 1980. He came from a family of emergency services workers; the men in his family were either police officers or firefighters. After years as a patrol officer, Romagnoli was promoted in 1993 to the Police Department's Emergency Services Unit (ESU), which did urban search and rescue, and special weapons and tactics (SWAT). Romagnoli became the ESU's Urban Search and Rescue administrative coordinator, which made him liaison to the New York City Office of Emergency Management (OEM). OEM planned for emergencies, coordinated emergency preparedness drills and exercises, and coordinated emergency response to major events to ensure that the city's emergency services functioned together.¹¹

In the new job, Romagnoli received extensive emergency management training. He graduated from the Emergency Management Institute at the National Emergency Training Center in Emmitsburg, Maryland, which also housed the National Fire Academy. He took courses on hazardous materials, weapons of mass destruction and incident command during hurricanes. During the hurricane training, "you actually work through an approaching hurricane and the recovery phase over the course of five days," says Romagnoli.¹² He also volunteered as a firefighter in Nassau County on Long Island and, like many New York City police officers, worked a second job, moonlighting as a paramedic. In June 1999, North Shore-Long Island Jewish Hospitals hired Romagnoli as a paramedic on a per diem basis.

North Shore-LIJ. North Shore-LIJ was a nonprofit chain of hospitals and healthcare facilities that spanned New York City and western Long Island, headquartered in Manhasset, New York. In 2012, the system had 16 hospitals: five tertiary (meaning full-service), seven community, three specialty and one affiliate. It also included three skilled-nursing facilities, 34 affiliated nursing homes and senior-living facilities, and nearly 400 physician practices. It also included the Feinstein Institute for Medical Research and North Shore-LIJ Hofstra Medical School.

In 2011, North Shore-LIJ registered four million patient contacts, 640,065 emergency visits, 503,646 home-care visits, 133,411 ambulatory surgeries, 91,400 ambulance transports and 25,609 births. It had over 43,000 employees, including more than 10,000 nurses, 9,430 physicians and more

¹¹ New York City Office of Emergency Management. See: <http://www.nyc.gov/html/oem/html/about/about.shtml>

¹² Author's interview with James Romagnoli on February 19, 2013, in Manhasset, NY. All further quotes from Romagnoli, unless otherwise attributed, are from this interview.

than 1,500 medical residents and fellows. That year, North Shore-LIJ recorded more than \$6.3 billion in revenue. It was the third largest nonprofit, secular healthcare system in the country.

Romagnoli had just retired from the police force and started full-time as a paramedic at North Shore-LIJ when the terrorist attack struck New York City on September 11, 2001. "The 14 members of the NYPD Emergency Services Unit that were killed, that was my work squad," says Romagnoli.

I trained in the Trade Center. I rappelled down the Trade Center. I worked with the people that were trapped there. I think it's fortunate for me that I did retire. I certainly would have been there. I told my bosses—I had just started working—'Hey, listen, my friends are in that pile. I have to go.' My boss, Michael Dowling, the CEO of the health system, said, 'I'm going with you.' I said, 'You can't go with me. This is way too dangerous.' He goes, 'I'm a pretty tough guy.'

After digging through the rubble of the World Trade Center for a few days, Romagnoli and North Shore-LIJ CEO Michael Dowling organized a drive at the company to collect supplies. They took several truckloads of needed materials to the workers at the 9/11 site.

In the wake of 9/11, Dowling tapped Romagnoli to form a central emergency management unit for the hospital system. Over the next five years, Romagnoli created an emergency operations center, taught crisis decision making skills to physicians and other employees, and instituted emergency management best practices developed over decades by municipal, emergency services and hospital planners. After decades of work in New York City's emergency management structure, Romagnoli made it his mission to introduce a different way of thinking in a corporate environment. "That was my challenge," he says.

The decision-making process in an emergency, explains Romagnoli, was entirely different from the usual decision-making. For most purposes, North Shore-LIJ had instituted a committee-oriented approach to decision-making because a committee was inherently safer, simply because more people were involved. Committees ensured a checks-and-balances process to matters of treatment and medical protocol. But says Romagnoli, it does not work in emergencies, "Unfortunately, time is not on our side in an emergency, so the [emergency] decision-making process has to have a more vertical structure," he notes.

In 2010, Romagnoli was appointed vice president of Protective Services at North Shore-LIJ.

Hanging in the Balance

Coordinated response. North Shore-LIJ's system-wide emergency management practices dated back to 1997, when the company centralized emergency preparedness and issued a directive

that emergency preparedness training be part of leadership core competency.¹³ The company adopted the Hospital Emergency Incident Command System (HEICS), a variant of the Incident Command System (ICS) developed by the federal government. ICS was a standard method of managing emergencies that unified and organized a community's or organization's response. The system aimed to bring all available resources and people into a common organizational structure, coordinate actions across jurisdictions and organizational boundaries, and provide a common terminology.

ICS provided a clear chain of command in an organizational structure:

- An incident commander
- Public information, liaison, and safety and security officers
- Logistics, planning, finance and operations units¹⁴

North Shore-LIJ modified the HEICS into a Network Emergency Incident Command System (NEICS). "Scale is important," says Mark J. Solazzo, executive vice president and chief operating officer. "We can direct resources for the betterment of the whole system."

That's important because when you make decision like an evacuation... you're able to do it in a way that is much more coordinated and effective than if you were in a stand-alone institution. So having thousands of hospital beds at your disposal instead of 450 or 900 is important. We have somewhere in the neighborhood of 6,000 hospital beds these days. Having all of the transport services available weighs in your decision. Having home care available [and] having the ambulatory sites available [are] all important in your decision-making process.¹⁵

Patient safety. All hospital incident response planning methods put patient safety above all else. The challenge in evacuations was weighing the risks. In the case of an earthquake or fire, the decision could be straightforward. Often there was no question about the need to move patients out of the facility. In preparing for a hurricane, however, hospital officials had to weigh the probability of a hazard -- that a storm would hit a given area and that it would result in damage to a facility -- against the certain hazard of moving patients. "It's all about minimizing risk to the patient: the risk of transfer versus the risk of staying," says Solazzo. He explains:

No administrator wants to move vulnerable patients. We're talking about sick, sick people. We're talking about our most vulnerable: surgical cases,

¹³ North Shore-LIJ Emergency Preparedness presentation

¹⁴ Incident Command System. See: <http://www.fema.gov/incident-command-system>

¹⁵ Author's interview with Mark Solazzo on February 19, 2013 in Manhasset, NY. All further quotes from Solazzo, unless otherwise attributed, are from this interview.

medicine cases, intubated patients, babies that are sick. When you move a patient in that kind of state, you risk their lives. Is there greater risk to leave a patient in that environment and weather the storm? Or do you need to move that sick patient? Is anyone going to die because of the decision you made? You'll never know if you saved a life because of it, but you will know if you hurt somebody.

The challenge for an incident commander was understanding that you never have enough information but you still have to make a decision, says Solazzo. In the case of hurricanes, wind speed was an important factor in timing evacuations. It was unsafe to operate ambulances in winds over 45 mph. This meant administrators had to make an evacuation decision in enough time to complete the evacuation before winds reached that intensity. This put the decision point at 48 hours or more before the hurricane was forecast to make landfall, long before forecasters could be certain about the hurricane's track. Solazzo explains:

You just have to make that decision based on the best information that you have available. Emergency management is about making decisions with incomplete information. You'll never have all the information you want or have it with a degree of confidence that will make you rest easy. You just don't. [But] you still have to have the ability to make a decision, because the lack of action is a decision.

Beyond safety, moving patients also imposed emotional and logistical burdens on the patients' families, says Solazzo:

There's a lot of issues when you move patients. Not only the clinical issues, but also the psycho-social issues. If you're moving a sick patient from Staten Island University Hospital to Lenox Hill, you've got a whole lot of family members to worry about. How are we going to get in touch with them in a timely [manner], make certain they know where their loved one is, make certain they know that they're safe? And then how do we help them see that patient?

Ripples. Burdening families was just one consequence of evacuating a hospital. The patients being evacuated and the loss of services from the closed hospital were a wave that spread through the surrounding community's healthcare system. "There's such a ripple effect when you evacuate hospitals," says Romagnoli.

You burden the other hospitals nearby who've taken on those patients. And then we're going to have the amount of injuries and sheltering needed from the storm or the event, which is going to put a larger burden on them.

This ripple effect forced a high degree of cooperation among otherwise competing healthcare systems. "What we do with one hospital will significantly affect another hospital five miles away," says Solazzo. He explains:

In disasters there's no competition. If my competitor health systems and institutions don't do well, that has a negative impact on my institution during a disaster. So we all want to make certain that everyone does well during these things.

Our Plan Doesn't Work

In the aftermath of Hurricane Katrina, North Shore-LIJ sent Mary Mahoney, director of Emergency Planning and Preparedness, to New Orleans to learn as much as possible about what happened at Memorial Medical Center and the other affected hospitals. "Katrina changed the way we think," says Romagnoli.

When we saw patients left behind, when we saw that healthcare was now not being delivered for New Orleans... we said, 'That can't happen to us. Absolutely, positively, we cannot let that happen to us. So what are we going to do about that? Is our evacuation plan good enough?' We took out our plans and we reviewed them and we tweaked them.

North Shore-LIJ officials were confident that their evacuation plan was effective. They tested it by running a drill at Southside Hospital in Bay Shore on Long Island. Southside was particularly vulnerable to storm surge flooding, and Romagnoli knew that it was likely to need evacuation if a major storm hit the area. On Sunday, November 20, 2005, with hundreds of Boy Scouts and Girl Scouts standing in for patients, North Shore-LIJ carried out its evacuation plan. To Romagnoli's dismay, it failed badly. They didn't get everybody out:

My great plan didn't work. We were shocked. We thought the plan was solid. And I think anybody who looked at that plan would have thought it was solid. But the fact of the matter is, when push came to shove and we really had to move bodies, words did not translate into actions. We started at 9 a.m. By 12, we had hoped to move about 100 patients. We had moved four. We had hundreds of [transportation] resources waiting in the parking lot, and patients never made it to them. It was a logjam. We had people stacked up in the hallways.¹⁶

The Southside drill showed that established practices for moving patients broke down when time was short and the number of patients large. The practice of individually matching

¹⁶ Author's telephone interview with James Romagnoli on April 15, 2013

evacuees to available beds in other hospitals simply took too long. Transporting patients one by one was also impractical.

Romagnoli and his team went back to the drawing board and devised an evacuation procedure that centered on moving groups of patients at a time. Hospitals were designated to receive specific types of patients, and those patients were transported as groups. Tertiary hospitals received critical care patients, and community hospitals received general medical and surgical patients. The designations made it easier for receiving hospitals to prepare beds, supplies and staff for the new patients. Evacuating hospitals moved groups of patients concurrently. Previously, patients were evacuated according to a priority list, which meant a delay in moving one patient held up everyone else in the queue.¹⁷

On Sunday, July 22, 2007, after months of training and tabletop exercises, North Shore-LIJ repeated the evacuation drill, and this time all of the *faux* patients were evacuated successfully. "It worked like a charm," says Romagnoli. North Shore-LIJ learned significant lessons in those drills, says Solazzo. "What we learned was we have to batch evacuate... We know we have 10 beds at LIJ [Long Island Jewish Medical Center] that are ICU beds. Ten patients are moved from Southside to those 10 beds."

Put to the Test: Hurricane Irene

For the next four years, LIJ thankfully faced no major natural or manmade disasters. But late on Saturday, August 20, 2011, Tropical Storm Irene formed over the Atlantic Ocean 120 miles east of the Caribbean. On Wednesday, August 24, weather forecasts indicated a high probability that Irene—then a Category 3 hurricane just north of Haiti—would hit the New York metropolitan area. North Shore-LIJ activated its Emergency Operations Center in Syosset, NY and began preparing for the storm.

Solazzo, Romagnoli, Mahoney and the other members of North Shore-LIJ's Incident Command team prepared for the possibility of evacuating one or more hospitals. They alerted the system's employees to prepare for the hurricane and initiated a rapid discharge throughout the system to open as many beds as possible. They canceled all elective procedures. They reviewed evacuation plans for Southside Hospital and the two Staten Island University Hospitals. "It was really tense," recalls Romagnoli.

We had never evacuated before. As the storm gets closer and the track continues to hold and the winds continue to be sustained at hurricane force, we are coming quickly to the realization that we have to evacuate.

¹⁷ Ibid.

Mandatory. On Thursday, August 25, the City of New York ordered that low-lying coastal areas—Flood Zone A—be evacuated by 8 p.m. on August 27.¹⁸ The order was mandatory. The city determined flood zones using the federal government's Sea, Lake and Overland Surge from Hurricanes (SLOSH) Model. A storm surge was a temporary rise in sea level caused by a storm's winds. The wider the storm and the stronger the winds, the higher the storm surge. Coastal geography also played an important role. Storm surges that hit the New York metropolitan area were boosted in size and speed by the natural funnel formed by northern New Jersey and Long Island. Zone A marked areas at risk of flooding from the surge of a Category One hurricane.¹⁹

North Shore-LIJ's Staten Island hospitals were in Zone A. Because of the logistical challenges of evacuating hospitals on short notice, the city had no choice but to give healthcare facilities the option—unavailable to other individuals or businesses—to shelter in place. Romagnoli, as chief of protective services, recommended that LIJ evacuate those hospitals. That night, as EVP/COO Solazzo weighed his decision, the three vulnerable North Shore-LIJ hospitals moved to the next stage of the evacuation process and began moving mechanically dependent patients, including those on ventilators.

The Incident Command team determined that Staten Island University North was the hospital most vulnerable to the storm surge, predicted to be five feet. They made the assessment that if the surge went that high, the hospital was right at the line of being able to maintain generator power. However, floodwater knocking out backup power wasn't the only risk Irene posed. "You've got to understand all the threats to your institution," says Solazzo.

There was a significant chance that Irene's storm surge would breach Staten Island's sewage treatment facility. If that happened, sewage could be forced back into the hospitals. "We tried to get from our engineers and from the city engineers their best estimate, and it became basically a 50-50 shot," says Solazzo. "I was not comfortable riding out a 50-50 and not having any backup plan if that happened." The team considered vertical evacuations within the Staten Island facilities, but in the end determined that the risk was too great and a full evacuation was warranted. "So we pulled the trigger on Staten Island at that point," says Solazzo. "That was a little over 48 hours to the storm."

The decision. It was the first time hospitals in the region were evacuated in advance of a hurricane. It was a decision "none of us thought we would make," says Romagnoli.

It's hundreds of people. And I have to tell you, it's tough. The thing that makes it hard is you have to make [the decision] so far out. You have to

¹⁸ New York City press release PR-308-11. See: http://www.nyc.gov/html/om/html/2011b/pr308-11_alt.html

¹⁹ New York City Natural Hazard Mitigation Plan, Coastal Storms: Multi-Hazard Analysis for New York City. See: http://www.nyc.gov/html/oem/downloads/pdf/hazard_mitigation/section_3f_coastal_storm_hazard_analysis.pdf

make it while you leave yourself a nice window of time that you can complete the evacuation prior to the storm.

Confirms Solazzo: "It's probably one of the most significant, most difficult decisions I've made in my career. After you make the decision, you're holding your breath."

North Shore-LIJ's two Staten Island hospitals were evacuated the next day: Friday, August 26. It was a sunny day. Patients were brought to a staging area at each hospital. An official checked each patient's identification wristband to confirm that the patient was going to the right facility in the right type of vehicle. Each hospital maintained a list of evacuees and periodically sent the list to the Emergency Operations Center. The patients were moved on ambulances and buses. A few were moved by helicopter.²⁰ That afternoon, the city expanded the evacuation order to include portions of the Rockaways in Zone B, and moved the deadline to 5 p.m. on the 27th.²¹

The North Shore-LIJ Incident Command team weighed their options for the third vulnerable facility, Southside Hospital, on the evening of the 26th. It appeared that the storm surge was not likely to reach the hospital from the shore, however, a creek flowed behind the facility and some of the company's engineers were concerned that it could channel the storm surge into the hospital. Solazzo determined the risk was sufficient to warrant evacuating the hospital. They began a phased evacuation that evening and completed it by the middle of the next day. In all, North Shore-LIJ evacuated 947 patients from three at-risk hospitals long before Irene's winds lashed the buildings. Despite the evacuations, the three hospitals remained open with sufficient staff to treat emergency cases. "You can't have a closed sign on the door," says Romagnoli.

North Shore-LIJ's evacuation plan worked smoothly. It also turned out to be unnecessary. At 5:35 a.m. on Sunday, August 28, 2011, Irene made landfall near Atlantic City, New Jersey. Irene weakened shortly before hitting the shore, losing some of her punch. Winds dropped from 86 to 69 miles per hour. The storm's rainfall produced devastating floods in Vermont and upstate New York, but Irene's winds and 4-foot storm surge brought relatively little damage to the coast.

Lessons Learned

North Shore-LIJ's evacuation of Staten Island University Hospitals North and South and Southside Hospital went smoothly, but there was room for improvement. The Incident Command team performed an after-action assessment, or "hot wash," to evaluate performance and identify what would be better for the next evacuation. Solazzo explains:

²⁰ "A Hospital System's Response To A Hurricane Offers Lessons, Including The Need For Mandatory Interfacility Drills," *Health Affairs*, 31, no.8 (2012):1814-1821

²¹ New York City press release PR-308-11. See: http://www.nyc.gov/html/om/html/2011b/pr308-11_alt.html

You learn from each event. We do a hot wash... a post-action understanding of how we continuously can improve. So from that perspective you look at it as a very large-scale drill. What did we do right? Where can we continue to improve our situation? So it's never ending. I think we get better as time goes on, but the bar keeps on getting higher.

The major takeaway from Irene was that the Incident Command staff had focused almost exclusively on the evacuating hospitals and hadn't paid enough attention to the receiving hospitals. "We really needed to split up our staff in the Emergency Operations Center at the leadership level to concentrate just as much on the hospitals receiving evacuated patients as the hospitals that we were evacuating," says Romagnoli. "As difficult as it was to evacuate those people, it was putting tremendous strain on our other facilities. "The solution was to move staff, medications and resources along with evacuated patients. Romagnoli amplifies:

If you're sending me 10 patients, you should be sending me four or five nurses, too. When there's patients going, staff has to go with them. If they need a three-day supply of meds, send it with the patient or you're going to clean their pharmacy out overnight. Those support mechanisms such as medications, staffing, they should come with the patient.

The hot wash identified three other changes that would improve performance during evacuations and other emergencies:

- Increase backup, reduce shift lengths and stagger shifts for Incident Command staff at the Emergency Operations Center (to reduce fatigue and improve decision-making)
- Increase communications updates to employees (to reduce the volume of inbound calls from employees)
- Tap licensed and certified healthcare professionals from among the corporate staff (to reduce the need for outside staffing)²²

The hot wash also found that two planned upgrades to the hospitals' patient tracking systems—Electronic Health Records and bar-coded wristbands—would have reduced the workloads of staff performing the evacuation had they been in place. Finally, the assessment called for renovations and new construction at the hospitals to take flooding into account and move power systems and critical service areas above ground level.²³

Government. Hospital officials were keenly aware of the ripple effect that occurred during emergencies, and placed a high value on cooperation among competing hospital systems. This

²² "A Hospital System's Response To A Hurricane Offers Lessons, Including The Need For Mandatory Interfacility Drills," *Health Affairs*, 31, no.8 (2012):1814-1821

²³ Ibid.

cooperation, however, was informal and ad hoc, usually in the form of telephone calls to ask for assistance and share knowledge of available beds and other resources.

In the aftermath of Irene, North Shore-LIJ and officials at other hospital systems identified a role for government in coordinating and formalizing the interactions between government and private hospital systems and among the systems. There were two barriers to achieving this: hospitals tended to fall outside the scope of municipal emergency management agencies, and most hospital systems spanned multiple jurisdictions. For instance, North Shore-LIJ had one facility, Long Island Jewish Medical Center, which straddled the New York City-Nassau County border.

The lack of government coordination with private hospital systems became especially evident when the New York City Emergency Medical Services continued to send emergency patients to hospitals that were evacuating. In general, New York City officials knew how many police officers were on duty and how many fire trucks in service, but they did not know how many hospitals had crowded emergency rooms. The city's Office of Emergency Management needed an official responsible for tracking healthcare resources, says Romagnoli. "Health care could be better coordinated at the municipal level. There's an expectation that hospitals can take care of themselves. Not true."

Federal funding was another issue. Very little of the federal funding to improve emergency services that flowed into the city after the 9/11 terrorist attack went to hospitals, observes Romagnoli. The focus on emergency services was on first responders: firefighters, police officers and emergency medical technicians. First responders delivered people to safety and to help. "We were that safety and help," notes Romagnoli. "We're the first receivers. The emergency eventually ends up at our doorstep."

On November 28, 2011, New York State Department of Health Commissioner Nirav Shah met with Dowling, Solazzo, Romagnoli, Mahoney and North Shore-LIJ Corporate Director of Security Scott Strauss to discuss North Shore-LIJ's response to Hurricane Irene and its role as Regional Resource Center for healthcare in Nassau County. The North Shore-LIJ executives presented their improved evacuation plan, which included a Patient Evacuation Transfer Form, an Asset List, and hurricane maps.

The Patient Evacuation Transfer Form provided hospitals and nursing homes throughout Long Island with a standard way to produce a set of abbreviated medical records to accompany evacuated patients. The Asset List was a centralized inventory of beds, equipment and resources at healthcare facilities throughout Long Island. The hurricane maps were versions of SLOSH Model maps, which show the areas vulnerable to hurricane surges, that the team modified to include information about healthcare facilities.

The team had developed in the evacuation plan to better meet North Shore-LIJ's needs for hurricane evacuations and to better serve its role as Nassau County Regional Resource Center. The

North Shore-LIJ executives recommended that the commissioner present their evacuation plan as an option for other healthcare systems throughout the state, says Romagnoli.²⁴

Conflicted. When Irene's impact proved less than anticipated and the storm surge did not disable the three hospitals, second-guessing began. Moving patients was risky. To justify a move, the threat to patient safety from a storm or other disaster had to be greater than the threat to patient safety from the evacuation. In hindsight, North Shore-LIJ's patients would have been safer remaining in the facilities. But happily, North Shore-LIJ carried out the evacuation without adverse consequences. The company's quality control staff reviewed the evacuation and validated the Incident Command team's observations. "We had absolutely no patient come to harm whatsoever," says Solazzo.

This gave Solazzo and Romagnoli contrary impulses when considering future storms: the effectiveness of the evacuation reduced the risk associated with moving patients and the minimal impact of the storm reduced the risk of keeping patients in the facilities. "So you have these two balancing factors in your mind now, one pushing you to evacuate more quickly and one pushing you to say there's just no need," says Solazzo. He and Romagnoli were confident in North Shore-LIJ's ability to evacuate patients, and convinced in retrospect that a storm of Irene's magnitude did not meet the threshold for triggering an evacuation.

Lesser of Two Evils

At 8 a.m. Eastern Daylight Time on Wednesday, October 24, 2012, Tropical Storm Sandy became a hurricane. The storm was 80 miles south of Kingston, Jamaica. Most weather models at that point anticipated Sandy moving harmlessly out to sea. Nevertheless, emergency management officials along the eastern seaboard kept an eye on the storm. By the next morning, some models began showing the hurricane approaching the New York-New Jersey area.

Fourteen months after Irene, Romagnoli and Solazzo were once again dealing with the threat of a hurricane hitting the New York metropolitan area. "Something we never thought either one of us would ever do—second year in a row," says Romagnoli. North Shore-LIJ's Incident Command team began preparing. They ordered a rapid discharge at Staten Island University Hospitals North and South and Southside Hospital. They transferred high-risk patients—mechanically dependent and neonatal patients—to other facilities in the system. "We decompressed the hospitals as much as we could," says Romagnoli.

The hospitals canceled elective procedures and accelerated the schedules for dialysis and infusion patients to ensure they wouldn't face delays in treatment if the storm disrupted services. They had home care nurses make all their visits in advance of the storm. They closely monitored

²⁴ Author's telephone interview with James Romagnoli on April 15, 2013.

their in-house weather service. They also prepared the facilities. "We pre-stocked supplies, we topped off everything, we tested everything," says Solazzo.

With the threat of a storm surge foremost in their minds, the Incident Command team prepared the three hospitals for flooding. They sandbagged the buildings and the generator complexes and positioned pumper trucks to be ready should floodwaters breach the sandbags. If Sandy turned out to be worse than Irene, the hospitals had multiple lines of defense, says Solazzo.

Prepared. North Shore-LIJ had "decompressed" Staten Island University Hospitals North and South and Southside Hospital. They had discharged patients who could be sent home and transferred those most vulnerable to power outages and other disruptions, reducing the patient population at the three at-risk hospitals by about half. The question now was what to do about the remaining 573 patients?

If Sandy played out like Irene, there would be no need to evacuate. But how can they know 48 hours in advance? Irene had been menacing right up until it reached shore. What if Sandy was worse than Irene? How much stronger than Irene could a storm be before it posed a threat to the hospitals? The time had come for Solazzo and Romagnoli to make their call. "As I'm trying to make the decision [whether] to evacuate, I've got two things weighing on me," says Solazzo:

One is that it went very well before, so I know we can do it. But two was trying to assess the storm surge, because that was the thing that was most critical. We were checking in probably three or four times a day with the people in the state [and] with the weather forecasters we work with to understand the storm surge.

Looking back at Irene, Romagnoli was convinced that North Shore-LIJ could have gotten away without evacuating. Forecasts for Sandy at that point projected a storm surge comparable to Irene's, maybe a little worse, he says. "Evacuation is still my last resort. I really don't want to do it unless I absolutely have to."