When Disaster Strikes
Is Your Hospital Ready?

Chris Hayhurst

When healthcare facilities are put to the test, such as was the case for many when Hurricane Sandy hit last year, well-prepared healthcare technology management departments can make all the difference in the world.

Credit: NASA/Goddard/MODIS Rapid Response Team
The East River was rising, and rising fast. “Forty-five minutes is all it took,” recalls Chris Petillo, vice president of applications in the Information Technology Department at Langone Medical Center in New York City. NYU Langone, a nationally recognized, four-hospital facility, towers over First Avenue in the heart of Manhattan. And that river—the East River—is right outside the door.

It was Monday, Oct. 29, 2012, a date that in New York, at least, will forever be remembered as the day that Sandy came to town. Hurricane Sandy, a tropical cyclone that had already swept through Jamaica, Cuba, and the Bahamas before slamming New Jersey just north of Atlantic City, had left in its wake an East Coast trail of destruction that hadn’t been seen since Hurricane Katrina in 2005. Weather and news outlets had reported on Sandy’s approach for days, tracking its path with such precision that its time of arrival in lower Manhattan was eventually predicted to the minute. Much of the city already had been evacuated. Now, with 100-mile-per-hour winds all but inevitable and increasing chatter of an impending East River surge of 6 to 11 feet, those who remained—including much of the staff at NYU Langone, which still held more than 300 patients—were preparing for impact. It was 7 p.m. Super-storm Sandy had finally arrived.

“We’d been here all weekend,” Petillo continues, “and we’d actually come in the night before to the command center and every hour on the hour we were meeting, and everyone seemed OK and ready to do whatever needed to be done.” Then the storm hit. “And all of a sudden the first of the lights started to flash and the water started coming up—we watched it come up—and a lot of people started panicking. It was about 45 minutes between ‘Alright, everything’s going to be just fine, everything is calm,’ to ‘Uh oh, here we go,’ to ‘That’s it, damage done’ and the East River is basically part of the hospital. It was so fast. And honestly, it was scary.”

Rupert Kishun, the facility’s director of clinical engineering (at NYU Langone the CE Department reports to and works very closely with IT), picks it up from there. “We have a pool of backup and spare equipment that we keep in case of emergencies, and we’d brought in additional staff, including two technicians, to make sure we’d be ready.” As the storm approached, Kishun recalls, “We weren’t sure what the impact would be. We figured we’d probably lose power in certain areas and that my techs would be deployed to help in whatever way they could, whether it would be to move equipment or provide spare equipment. Well, we had no idea.”

No idea, that is, that most of Manhattan would soon have no power; that the streets would be flooded, subways submerged, and basements overrun with water; or that NYU Langone itself would not be spared the same fate. Once the facility lost power, recalls Kishun, what needed to happen next was perfectly clear. “We saw that we had to evacuate. And my technicians—their primary focus at that point was to work with nursing, first, to get more than 300 patients down the stairs and out of the building, and second, to keep track of the equipment that was leaving” with those patients. It was physical, back-straining, exhausting labor, recalls Kishun, the kind of work that is nowhere to be found in his techs’ formal job descriptions. “They worked right through the night until every last patient was evacuated,” he says. “There was nothing normal at all about what they had to do,” adds Petillo. “But Sandy wasn’t normal either—not in any way, shape, or form.”

So what can healthcare technology management (HTM) departments do so that they’re prepared when disasters strike their own facilities? HTM professionals who have lived through such disasters have the answers.

Shift in the Weather
Deviation from the norm, it turns out—at least when it comes to high-impact weather events like Hurricane Sandy—is becoming more common. Or so it seems. In 2012, for example, there was Sandy, Hurricane Isaac and the flooding of the Mississippi River, record-breaking wildfires, a killer tornado outbreak, and an unprecedented line of thunderstorms so severe they caused nearly $4 billion in damage. This past spring saw another outbreak of powerful and deadly tornadoes. According to the National Oceanic and Atmospheric Administration’s National Climatic Data Center, 11 separate “extreme weather and climate events in the U.S.” are “known to have reached the $1 billion
threshold in losses” and combined to kill at least 349 people in 2012. And then, of course, there was 2011, from Hurricane Irene on the East Coast to the monster tornado in Joplin, MO. That twister destroyed (among many other places) Joplin’s hospital, St. John’s Regional Medical Center, where Keith Zorn was the facility’s director of clinical engineering. “Two of my CE techs lost their homes,” Zorn e-mailed AAMI staff not long after the disaster. “The hospital is a total loss.”

NYU Langone, on the other hand, was far more fortunate. While it did suffer extensive damage, no one was injured during the evacuation, and after two months of closure, while staff and others worked to bring the facility back up to speed, the center was mostly reopened in January 2013.

So what happened behind the scenes at NYU Langone? During and immediately after the storm, Petillo and his staff, as well as Kishun and his team, dropped everything and helped with the evacuation. But what, from an HTM perspective, was done beforehand? Is it possible, as HTM professionals, to be ready for the next earthquake, tsunami, or Superstorm Sandy? Or, for that matter, the next tornado or snowstorm, or that rogue, uncontained wildfire? And when that natural disaster comes and the damage is done, what’s next? How do you pick up the pieces and return to business as usual?

Be Prepared
“You have to be prepared,” says Yadin David, EdD, PE, CCE, an independent biomedical engineering consultant who has presented on the subject of disaster preparedness and who spent 25 years as director of the Biomedical Engineering Department at Texas Children’s Hospital in Houston. “Preparation and planning, with specific plans and processes, is a must. If you want to be useful and helpful before, during, and after a disaster, you can’t

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just wing it at the last minute.”

In 2001, remembers David, when Tropical Storm Allison sludged through Houston after bulking itself up in the Gulf of Mexico, heavy rains caused severe flooding that eventually left 30,000 of the city’s residents homeless. Before the storm, knowing it was vulnerable to flooding itself, Texas Children’s had installed water-tight doors in the sub-basement area where the Biomedical Engineering Department was located. Unfortunately, the move was no match for Allison’s wrath. “For one reason or another they weren’t shut in time, or they just didn’t work, and water did come in,” says David. The water, he recalls, swamped the facility’s generator and all its systems, “and basically took the hospital out of commission.” Patients were evacuated. A “disaster-response state” was declared. The good news? Throughout the event, says David, “the Biomedical Engineering Department functioned incredibly well because we had practiced.”

In the case of NYU Langone’s clinical engineering team, the department’s general disaster preparedness plan called for ensuring that its “pool of backup equipment” was maintained and at the ready, as well as increasing the boots on the ground. “We’d bring in additional staffing and we’d have them stay overnight,” says Kishun. “Or if it was a weekend, they’d stay the entire time.”

Biomedical engineering consultant Robert Stiefel, who for two decades served as director of clinical engineering at Johns Hopkins Hospital in Baltimore, says in his experience staff preparedness was always more of a priority than what extra equipment might be available for a disaster: “The biggest concern was having enough of the right manpower in the right place at the right time,” and equipment would be “deployed based upon the most critical needs.”

In the wake of the storm, and after replacing or upgrading much of the equipment and technology that was lost in its wake, Petillo says he and Kishun are working with hospital leadership to bolster staff so they can ramp up their departments’ preparedness tactics yet another notch. “We want to ensure we have round-the-clock coverage and not have to worry about turnaround time for an on-call person to come on site the next time something happens. With all the new technology that we’ve put in place”—including a new Epic electronic health records system and new telemetry and monitoring systems—“it’s key that we have somebody here 24 hours a day.”

Following the Sandy evacuation, he and Kishun spent much of their time surveying the damage to the facility’s infrastructure and determining what needed to be brought back online right away. “At first we focused on e-mail, communications, and our website so we could communicate with our employees, staff, and patients,” he says, “but almost at the same time we started looking at telemetry and monitoring. Because regardless of the timeline that had been established by leadership for reopening the center’s doors, “you couldn’t do that without proper telemetry or patient monitoring in place.” And
with the facility’s data center underwater, he notes, those systems were likely shot.

Fortunately, Kishun and his team had an ace up their sleeve. “They had a very good inventory of what we had before the storm in terms of telemetry and monitoring, so”—even though much of the facility was inaccessible and that hundreds of devices had just left the hospital with the evacuated patients—“they had a very good idea what we needed to replace,” explains Petillo. “It allowed us to roll in the new systems in a very short period of time. Without an accurate inventory we could not have done that.”

Certain equipment manufacturers, adds Petillo, supplied critical support throughout the process, providing technology, for example, that allowed them to take still-functional “hardware that was currently on site but in danger of being damaged in a future storm, and move it to an offsite data center in Jersey.” All in all, Petillo says, the work that was completed related to the recovery and relocation of vital equipment; reimplementation and upgrading of the facility’s various technological systems; re-wiring of parts of the hospital as floors were rearranged in a “now’s the time to do it” effort to improve the facility’s workflow; “back-end servers and interfaces that were now off-site and needed to be brought up;” and upgrading and testing of all the related software, amounted to “a miracle.” Clinical engineering, working as a “cross-functional team” with IT and vendors, “did a fantastic job,” he says. “I honestly thought there was no way they’d be able to get it done.”

Learning from Experience
That kind of collaboration—the effort, in a time of crisis, to bring departments and individuals together to hopefully find a solution—is something Joseph Mandell is familiar with.

Mandell is a biomedical maintenance course developer at Akimeka, LLC, in San Antonio, TX, where he designs web-based medical equipment training programs for soldiers in the U.S. Army. He previously worked as an Army biomedical technician. Mandell remembers how in 2007, when he was working at San Antonio’s Brooke Army Medical Center, a squirrel “took out a trans-
former” and a “perfect storm scenario” ensued. First, the power went out. Next, the facility’s backup generators failed to kick in for 15 minutes due to an electrical overload to the facility’s automatic power-switching system. And finally, the battery-powered emergency lights that were installed in stairwells and hallways didn’t work either. “So we were basically in the dark,” says Mandell.

The problem, it turns out, was “a good maintenance plan hadn’t been established to replace the batteries.” The facility went without lights for about 15 minutes, he recalls, “so nursing had to rely on their cellphone lights as flashlights. There was no serious damage, but it was a wakeup call—a kind of disaster scenario without a real disaster. It was a hard lesson learned.” That lesson, Mandell says, was to “make sure that the Biomedical Maintenance Department is coordinating with IT and with facilities management to ensure everything is covered.” In addition, he says, “it made everyone re-examine the facility’s disaster preparedness plans.” If a lone squirrel could cause that much trouble—several of the facility’s uninterruptible power supply (UPS) systems also failed—there was no telling what could happen in the event of a true natural disaster.

Now, says Mandell, the Biomedical Maintenance Department at Brooke Army Medical Center works closely with IT to prevent a similar situation from happening again. Batteries, he says, are on a regular maintenance and replacement program. And those failed UPS units? The solution there and elsewhere was in improving the lines of communication between departments. “They really have to communicate with each other. You know, there are some UPS systems where the IT Department might say, ‘Well, that’s for medical equipment and so that’s biomedical maintenance’s responsibility,’ because with computer systems being used widely throughout the hospital there’s that kind of gray area now—it’s not always clear whether something is for data or for an actual medical system.”

Prior to the incident with the squirrel, Mandell says, his biggest brush with disaster came when he was stationed at Martin Army Community Hospital in Fort Benning, GA. It

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Lessons Learned

Healthcare technology experts who have lived through natural disasters offer the following advice:

1. **Keep an accurate inventory of all monitoring systems on site.** “That way, if you ever have a situation in which you need to bring in a new system in a very short period of time,” says NYU Langone’s Chris Petillo, “you can do it.” Looking ahead, he notes, his facility is “moving toward the use of technologies like RTLS that will help us maintain and track our inventory far more easily.” Real time location system technology, he explains, uses “radio frequency tags that work over Wi-Fi, allowing you to tag equipment, beds, people, you name it, and verify your inventory” from off-site (and disaster-free) locations. The main catch? Your wireless network must be up and running.

2. **Do away with onsite data centers.** “We knew it was a bad idea to have an onsite data center,” says Petillo. “And we’d been thinking about moving it for years. There were plans to do so, but there was never a real push.” Sandy, he adds, with its storm-surge flooding of the facility’s basement, where the data center was housed, became “the catalyst for finally getting it done.”

3. **Maintain strong and strategic relationships with vendors.** Thanks to their close connections with vendors like Philips, says NYU Langone’s Rupert Kishun, “they really pulled through to help us out.”

was 1995, and Hurricane Opal had just hit the Gulf Coast. The hospital was more than 150 miles inland, but high winds “came through and knocked down trees left and right.” The facility’s emergency management protocol required essential personnel to report to the hospital, and no one from biomedical maintenance was on that day, so Mandell, who only lived 10 miles away, had to get in to work—even though he’d have to leave his wife and newborn baby at home without electricity.

“It was pretty much a straight shot, but with the downed trees it still took over an hour to get there,” he recalls. Other essential personnel never made it in, says Mandell. “Luckily the facility was well stocked and able to provide care, and patient load was minimal,” but the staff challenge was another wakeup call, and the hospital adjusted its protocol accordingly. “If they know that a situation like that is about to occur,” explains Mandell, it is now expected that “biomedical maintenance personnel will be at the facility at the time of the incident.”

It’s the same basic policy at Beth Israel Medical Center in Manhattan, a 900-bed teaching hospital just a few blocks from NYU Langone. “We’ve had the same plan in place since 9/11—that biomed, in case of a hurricane or any other disaster, reports immediately to the command center.” says Jacob Shnayder, director of the facility’s Biomedical Engineering Department. In the case of Hurricane Sandy, says Shnayder, “based on an assessment of the situation, we decided that biomed needed to be present at the facility 24 hours a day” until the crisis had passed. When the electricity went out, Shnayder recalls, Beth Israel’s generators kicked in as planned. “But apparently the quality of power on one of them was not good. So all of a sudden, we started to receive calls that telemetry wasn’t working.” When his department investigated, he says, they found the batteries in their UPS units were depleted. “We switched the converters to normal mode so they worked from the generator without the UPSs. Basically, we eliminated the problem, everything came back on, and a lot of people in cardiology were very happy.” Happy also because Beth Israel was the last major hospital in lower Manhattan with its doors still open.

Throughout the storm and its aftermath, for “two or three days and nights,” says Shnayder, “we had at least two technicians here twenty-four hours a day. It was the only way to keep all the equipment up and running.” Most problems were power-switching related, he says. In some cases, areas that needed power did not have enough receptacles to do the job (receptacles have since been added to avoid similar problems in the future). Eventually, he says, “the main power kicked in,” and the ordeal was over. “The bottom line is, we handled all the problems that came up, and that was the key. But we learned a lot.” Now, says Shnayder, to avoid similar problems with the UPS units when the next Sandy hits, biomed has adjusted its “PM schedule to include more exercises that simulate power loss.” Next time, he says, “we should be in better shape.”

‘We Are Very Well Prepared’

And there will be a next time. That, anyway, is Jeff Hooper’s approach to the specter of natural disaster—that those “Frankenstorms,” as the Halloween-crashing Sandy was dubbed, do in fact happen, and therefore it’s best to be ready and constantly improving your defenses. Hooper, who leads the Biomedical Engineering and Instrumentation Department at Children’s National Medical Center in Washington, DC, describes his facility as the “highest building in the city, 15 stories, with a façade completely made of glass.” High winds “are definitely a concern,” he says, but “probably the one thing that keeps me the most up at night is just getting here during a natural disaster. We’re not a 24x7 department, and most of my staff, myself included, live at least an hour and a half away from the hospital.” Commutes like that are a fact of life in Washington, he explains. That means a disaster could potentially unfold with no one from his department available to help.

Children’s National’s disaster plan, says Hooper, is not specific to his department, but it does dictate that he and his staff of 15 maintain a “loaner pool of medical devices that are set aside for emergencies” in the event the facility’s patient population is suddenly increased significantly. This happened both on 9/11 and when Katrina hit,
COMING UP WITH A PLAN

While all Joint Commission accredited hospitals are required to have an emergency operations plan in compliance with the commission’s Emergency Management Standards, those plans often neglect the specific role of the healthcare technology management (HTM) professional during a natural disaster. “The emphasis in healthcare is on patients and management workflow,” notes biomedical engineering consultant Yadin David, “and on business continuing during a disaster. The focus is usually not on technology and devices.” The upshot is that “many of those in the clinical engineering community are not being trained properly and are therefore not in a position to deal” with a crisis, says David. “Because what you need to do during a disaster is very different than what you would otherwise do running a biomedical shop in a hospital.”

Consider, for example, what might happen when a hospital with infrastructure damage incurred in a tornado is suddenly faced with an influx of patients. “Everybody expects that the injured can be brought to a hospital and taken care of, and they don’t realize that the hospital itself might be part of the disaster,” says David. Such a scenario “puts a lot of pressure not only a facility’s medical professionals, he notes, but also on its HTM staff, who must know for certain which technologies and devices are critical and need to be up and running, and which are not. “So it’s not just taking care of the infusion pumps and monitors and other machines. Now you’re talking about the systems, like the vacuum system, the alternator system, lighting, air conditioning.” The key to avoiding a colossal mess? Good planning.

Some tips from David:

1. **Develop a dedicated emergency plan for the HTM department.** “You need to have your own plan subjugated to the hospital’s general plan,” says David. “It should be tied into the hospital’s plan, and reviewed by the facility’s disaster preparedness committee, but have specific instructions and activities for the clinical engineering department.” For example, he notes, consider that many HTM departments are located in hospital basements. “So what do you do and how do you function if there is a flood and you don’t have your department to operate in? How do you do that work someplace else? You have to think it through.” One point to consider, for example, is relocation, determining where the department would move should a disaster render its usual space useless. And the entire department should practice such a relocation, David advises.

2. **Agree on priorities.** “You have to reach an agreement with the other departments in the hospital regarding which systems are most important to sustain,” says David. Without one, HTM departments can quickly become overwhelmed under a sea of immediate service requests and work orders that all appear to have the same level of urgency. “Is getting a call from a nurse that she needs an infusion pump as important as a call to get the central vacuum system running? Since you have limited capacity during a crisis, you have to develop the metrics of all the technical systems and equipment at your facility and determine what priority they have when disaster strikes.”

3. **Define specific roles for staff.** Roles will vary during what David refers to as the “three stages” of disaster-related preparedness: before-disaster preparation, during-disaster operation, and post-disaster recovery. “Individuals should be trained in their specific roles in each of those stages so there is no doubt they’ll be able to execute,” he says. Consider the following scenario, offers David: “If you say, “Well, during a disaster I know that I will need to have five people here to make sure that the vacuum system or individual vacuum devices are available” for patients, and then the disaster occurs “and one of those people couldn’t come in because the weather was so bad they couldn’t get to the hospital, what do you do then? And what if your replacements for those four who are there cannot get there either? So now you need a plan for everyone who is there to stay.” Consider everything, says David. “Male and female personal hygiene, food, sleeping quarters. All of that must be easy to access and plentiful, because if you don’t have a place for people to rest, to take a short nap and recover, then all you have is tired people who can’t complete their mission.”

4. **Practice disaster-scenario communication.** If you don’t, says David, when disaster hits confusion will be certain. “What do you do when the pagers or the systems that you’re using now to communicate are not operating?” he asks. “If all of a sudden you can’t text? You have to think about it and you have to practice.”

5. **Get a whiteboard.** A whiteboard, says David, is among the most important and least expensive investments an HTM department can make. “You don’t know if your computers will work during a disaster, so you should have a very large whiteboard you can use to keep track of who is present, what their tasks are, where and when they’re going to be getting food and sleep, those kinds of things. Write it all up before the disaster happens, so everything is very clear.”
FDA Recommendations

The U.S. Food and Drug Administration is studying how extreme weather and natural disasters affect the quality and supply of medical devices. “Anticipating and planning for the challenges of extreme weather can help the FDA and medical device manufacturers minimize potentially dangerous effects on the safety, effectiveness, and availability of medical devices,” says Steve Silverman, director of the Office of Compliance in the FDA’s Center for Devices and Radiological Health. The agency offers the following recommendations for home users of medical devices during and after extreme weather events.

- Keep your device and supplies clean, dry, and secure.
- If you have a life-sustaining device that requires electricity, discuss with your physician what you should do in the event of a loss of power, water, or phone service—before severe weather happens. Notify your local public health authority to request evacuation prior to adverse weather events.
- Always use battery-powered flashlights or lanterns rather than gas lights or torches when oxygen is in use (to minimize the risk of fire).
- If your device appears to be damaged or if you need a backup device, contact your distributor or device manufacturer.
- Check all power cords and batteries to make sure they are not wet or damaged by water. If electrical circuits and electrical equipment have gotten wet, turn off the power in your home at the main breaker.
- Maintain your device in a well-lit area so you can assess your device’s performance (e.g., refilling your insulin pump, checking your glucose meter).
- Always make sure your device is clean before you use it (e.g., syringes, mechanical devices).
- Store the backup equipment for your device (such as spare batteries and accessories) in the same location as the rest of your emergency gear.
- Keep backup batteries for your cellular phone. If there’s a problem with your medical device during an emergency, your phone might be your lifeline to let someone know that your device is not working, and more importantly, that you need help.

departments, there are practice drills. “Obviously, regulatory agencies require a certain number of drills, so we go through those, and they’re discussed and critiqued by the emergency management safety committee on a monthly basis.”

If there was a storm that could threaten the building itself, says Hooper, his team would be responsible not only for maintaining power, but also for helping to move critical patients out of harm’s way. For example, he says, “we have a 50-bed neonatal intensive care unit on the 10th floor, so there are things like slings and slides and stretchers that are available to get them out of there easier” in the event of an emergency, he says. Flashlights have been placed in every patient room, he adds. And the problem of staff potentially being home, nearly two hours away, when disaster strikes? First, he notes, if it was a forecasted storm, he and at least two members of his staff would spend the night. Beyond that, “we would rely on the general labor pool, with multiple parties taking on multiple roles delegated out by the command center.”

His department has developed a checklist, Hooper explains, for leaders in the facility’s disaster-time command center to reference. If present, he’d “be a part of that leadership team.” But if things unfolded suddenly or after hours, all parties would “still know what to do,” he says.

“So these are the things we’d want to check, and you need to go unit by unit, starting with the critical patients, and verify that the generators came on, that indeed the equipment is operating and everything is plugged into the generator outlets, that the batteries did not fail, that we do have a supply of emergency power sources that can be deployed if there is a generator problem... and the list goes on. The bottom line is that “the focus during a disaster is on the critical patients and on power management to make sure the devices” being used for those patients are working according to Hooper. “Nobody’s going to be worried about MRIs or CTs, and nobody’s going to be doing elective surgery.” So are he and his staff ready for the next natural disaster? “Yes,” says Hooper. “We’re very well prepared.”
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