



# Healthcare





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

Credit: HHC

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

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

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

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

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

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

## How the Healthcare System Works

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

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

### Hospitals

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

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

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

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

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

### Residential Providers

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

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

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

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

### Community-Based Providers

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

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

### Home-Based Providers

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

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

### Regulatory Framework of the Healthcare System

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

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



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





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

Credit: HHC

## Coney Island Hospital During Sandy

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

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

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

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

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

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

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

## What Happened During Sandy

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

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

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

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

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

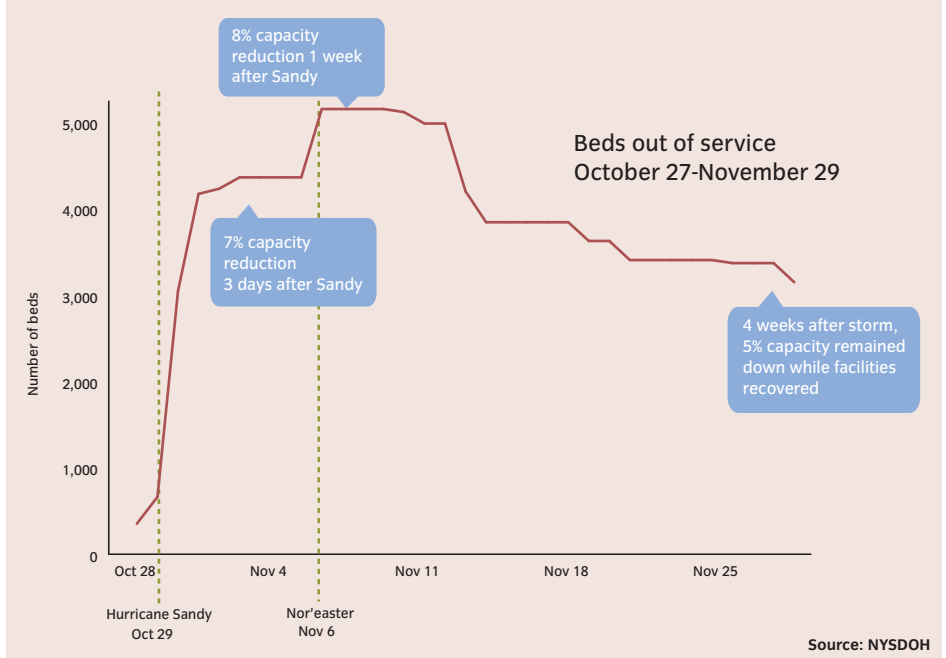
Some hospitals narrowly escaped flood damage. For example, Metropolitan Hospital in upper Manhattan just missed having its critical electrical systems flooded, and on Staten Island University Hospital's North Campus, floodwaters came within inches of the hospital entrance.

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

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



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



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

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

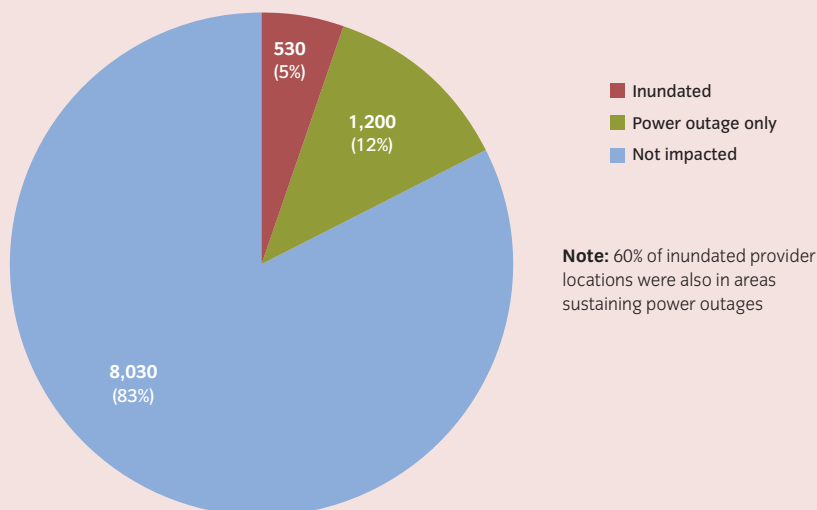
ported without medical records or proper identification, making it difficult for receiving providers to administer appropriate care or notify evacuees' families and caretakers.

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

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

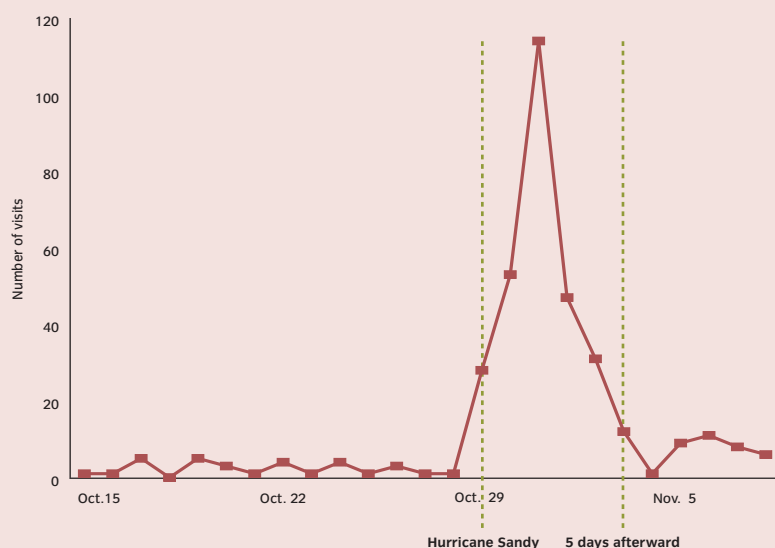
## Impact of Sandy on Buildings Housing Community-Based Providers

### Provider locations impacted by Sandy



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

## Citywide Emergency Department Visits Needing Dialysis



Source: DOHMH

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

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

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

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

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

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

## What Could Happen in the Future

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

### Major Risks

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

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



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

Major Risk Moderate Risk Minor Risk

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

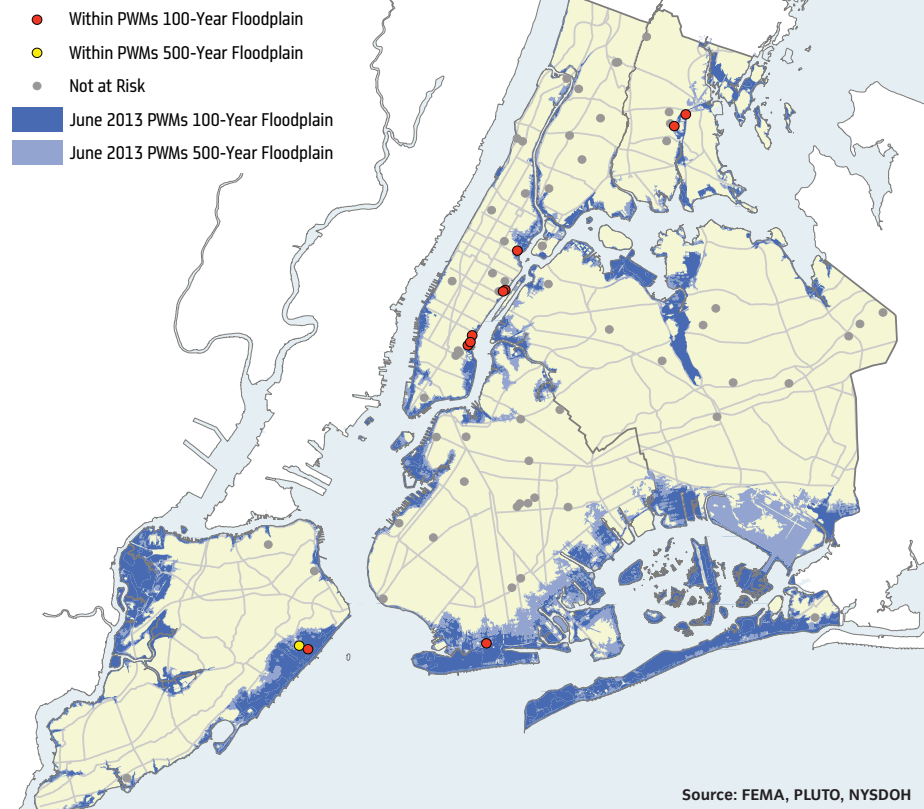
Meanwhile, 37 nursing homes and adult care facilities, representing 14 percent of citywide bed capacity, are in the 100-year floodplain, as indicated by the PWMs, with seven more likely to be in the floodplain by the 2020s. By the 2050s, 33 nursing homes and 25 adult care facilities are likely to be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

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

### Other Risks

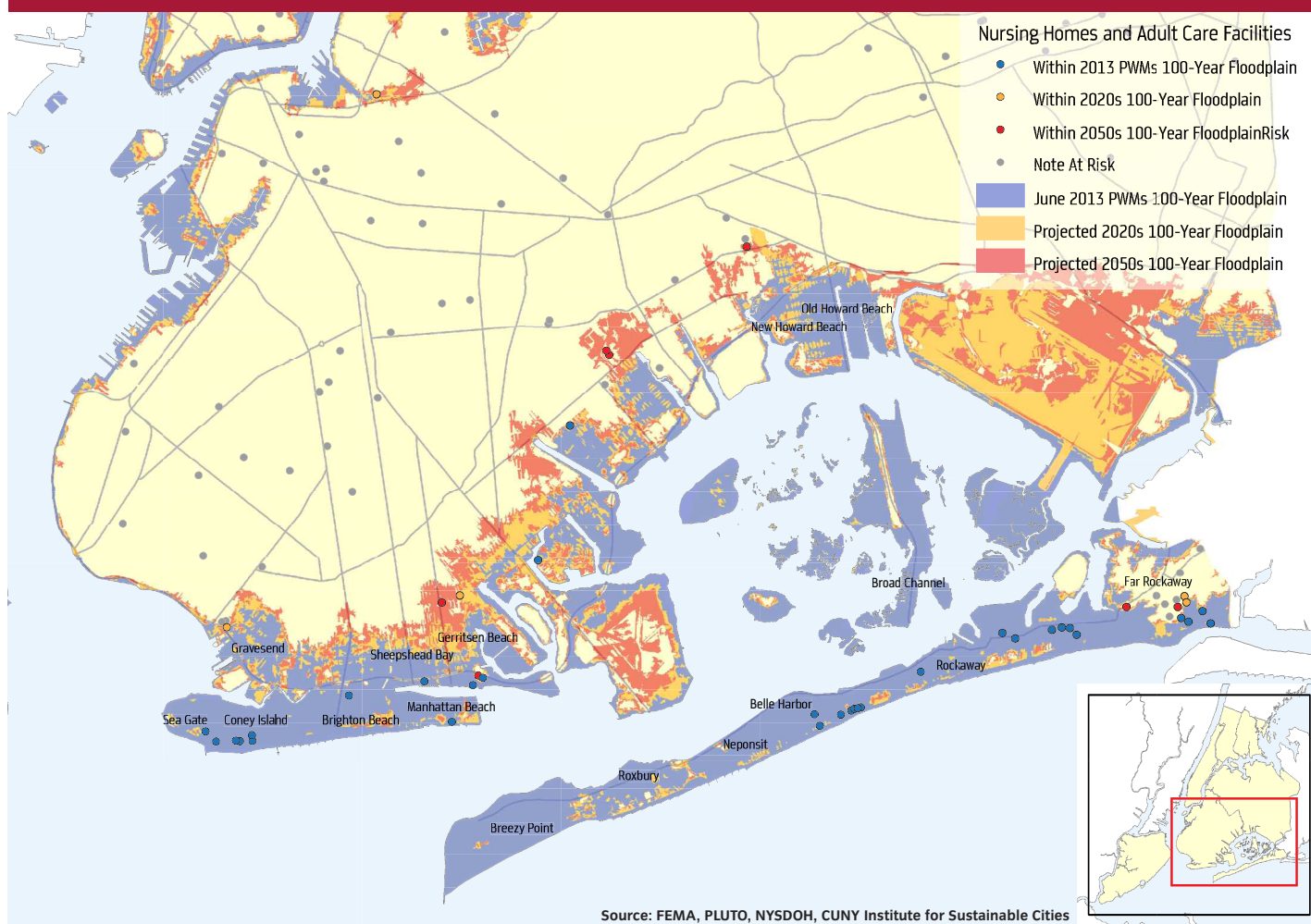
In addition to storm surge, heat waves pose a serious health risk to New Yorkers. They can cause

### Hospitals in the Floodplain

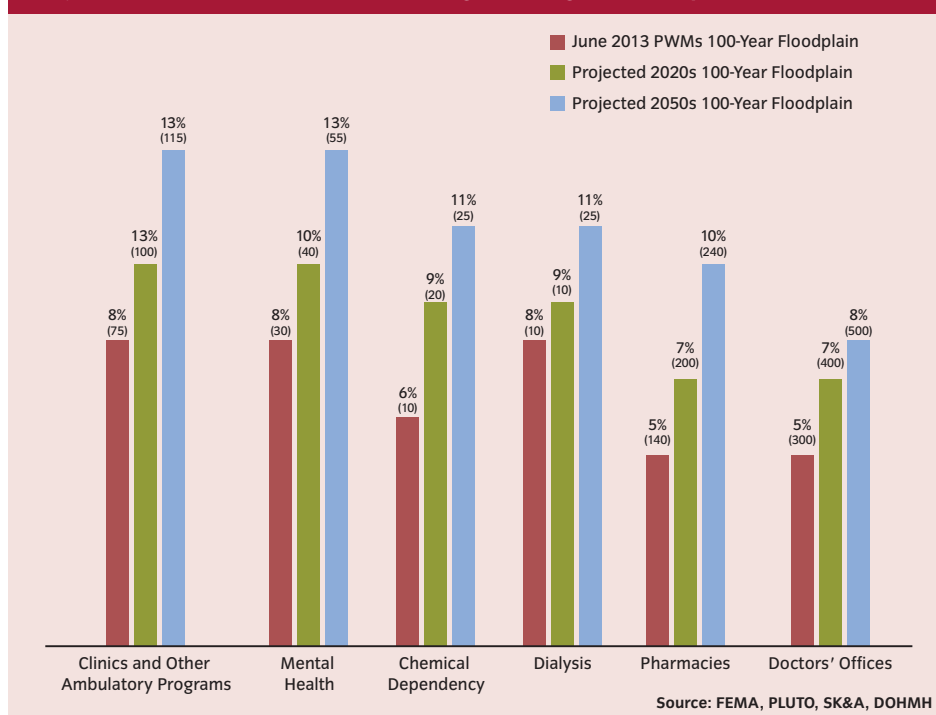




## Nursing Homes and Adult Care Facilities in Southern Brooklyn and South Queens



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



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

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

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

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

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

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



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

Credit: FEMA

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

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

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

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

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

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

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

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

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





Credit: FEMA

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

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

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

## Initiative 2

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

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

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

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

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

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

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

## Initiative 3

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

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

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

## Initiative 4

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

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



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

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

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

#### **Initiative 5** **Require the retrofitting of existing nursing homes in the 100-year floodplain**

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

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

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

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



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

Credit: MJHS

## **Shorefront Center During Sandy**

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

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

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

#### **Initiative 6** **Require the retrofitting of existing adult care facilities in the 100-year floodplain**

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

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



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

Credit: Shore View Nursing Home

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

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

## Initiative 7

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

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

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

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

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

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

## Initiative 8

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

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

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

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

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

## Initiative 9

### Harden primary care and mental health clinics

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

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



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

Credit: Shore View Nursing Home





Patient health records were damaged by floodwaters.

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

### Initiative 10 Improve pharmacies' power resiliency

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

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

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

### Initiative 11 Encourage telecommunications resiliency

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

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

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

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

### Initiative 12 Encourage electronic health record-keeping

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

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

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



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

Credit: DuaneReade