An Rx for Resiliency

Faced with increasing hazards associated with climate change, health care systems are finding that an ounce of planning prevention is worth a pound of cure.

PHOTO BY MAX BECHERER/AP

The newly opened University Medical Center was built to replace Charity Hospital. It's in an area of New Orleans prone to catastophic flooding, but is designed to withstand hazards.

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AS THIS PAST YEAR HAS TAUGHT US, weather-related natural disasters are on the rise. In fact, a recent study by *Proceedings of the National Academy of Sciences* has found that the probability of Hurricane Harvey forming—the Category 4 storm that hit Texas last August—went from a likelihood of once every 100 years in the late 19th century to once every 16 years today.

Because of this storm and others, the nation is more aware of the impact disasters have on population centers. But that doesn't mean everyone is prepared. When Hurricane Maria hit Puerto Rico in September 2017, it knocked out electricity, roads, hospitals, schools, and offices for months, permanently in some locations, and caused up to

$72 billion in damage and an as yet untold number of deaths.

Resiliency—the ability to withstand and quickly recover from a disruptive event like a hurricane—is now essential for communities to understand and implement as climate change impacts continue to escalate. This is especially true for health care facilities—perhaps the most critical public resource a community has in times of disaster.

We've seen what happens when health care systems don't plan for resiliency. When Hurricane Katrina struck New Orleans in August 2005, several hospitals flooded and were forced to suspend operations during the storm, resulting in unnecessary patient deaths and billions of dollars' worth of damage.

Planning professionals have a crucial role to play in creating more resilient health care because solutions at the system, community, district, and even regional scales offer the best hope for resisting unforeseen natural and man-made stresses. The few health care systems that are ahead of the curve when it comes to implementing resiliency strategies offer profound insights into how we as planners can make our communities more resilient.

These strategies can be categorized in three ways: planning solutions, architectural solutions (with planning implications), and larger urban design solutions that impact industries beyond health care.

Planning solutions

The logical place for planners to begin exploring how they can contribute to the resiliency of their local health care systems and broader communities are through the traditional planning practices that they carry out in their everyday work.

ZONING. Municipal zoning codes and ordinances are perhaps one of the most critical realms in which planners can impact resiliency. Establishing the base flood elevation is an essential first step.

These elevations are typically established by the Federal Emergency Management Agency, but in some regions the established guidelines might not be adequate. It is up to local authorities to determine construction requirements in response to those elevations (a jurisdictional fact made painfully evident by the executive order rolling back Obama-era regulations that set minimum elevations for federal construction).

For example, when leading a community-based planning effort and then designing two new, post-Katrina hospitals in New Orleans—the University Medical Center and the Veterans Affairs-operated Southeast Louisiana Veterans Health Care System—our firm, NBBJ, worked with FEMA and the U.S. Army Corps of Engineers to establish not only the hospitals' ground floors, at three feet above flood elevation, but also to elevate the second floor of critical care services out of harm's way.

While this was mandated by the VA, it should be an unquestioned first step for any health care project in flood-prone areas. Unfortunately, this level of preparation is not currently required by code in many areas. These strict code standards should apply in even greater measure when planners are helping to site critical facilities like power generation plants, electrical substations, and emergency shelters.

FACILITIES AND INFRASTRUCTURE ASSESSMENT. Most large health care providers often occupy a whole neighborhood or campus, with an entire chain of codependent and linked buildings, parks, and other facilities. As a result, most campuses have at least one facility nearing the end of its functional lifespan, whose sudden failure could interrupt key infrastructure campus-wide. In this context, it is essential for planners to continually assess the condition of campus facilities, their connection to the city, and plans to retrofit—or replace—vulnerable elements as soon as they are discovered.

In a similar vein, health care planning presents an opportunity to plan for upgraded infrastructure such as roadways and transit to better connect hospitals to the city for ease of access, or utilities such as steam systems that could function as backups for continuity during a natural disaster. Wherever possible, health care planners should advise their clients to tie new systems back into adjacent hospital structures, to increase the resiliency of the entire campus.

PARTNERSHIPS. Planners can also help uncover opportunities for hospital executives to look beyond their own walls and form districtwide solutions with neighbors. Many organizations already exist that are leading the charge on these discussions, including the Community Development Society and the International Downtown Association.

In the meantime, health care institutions are beginning to realize that redundant systems for secondary or tertiary power and heat and steam generation can be shared. Boston Children's Hospital and Brigham and Women's Hospital started such a discussion recently. After all, in times of crisis, organizational boundaries matter much less than the

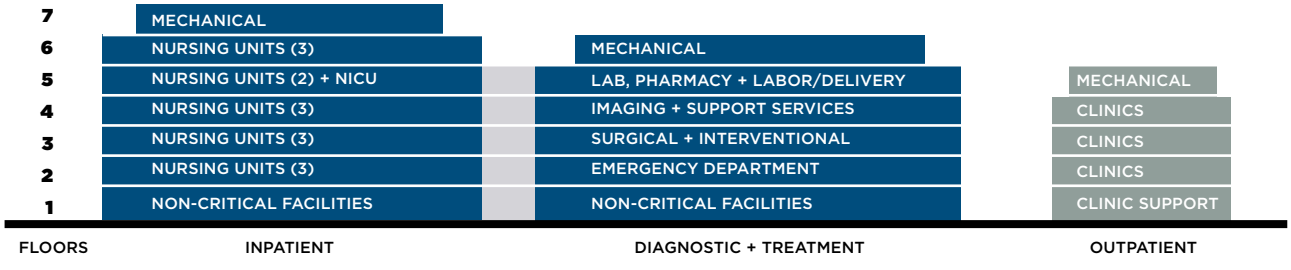
WEATHERING THE STORM

THE SOUTHEAST LOUISIANA HEALTHCARE SYSTEM, which replaces the VA Medical Center lost in Hurricane Katrina, can remain fully operational without outside support during a disaster, with enough provisions and accommodations for up to 1,000 staff and patients.

1. All single-occupancy rooms can be converted to double occupancy in an emergency.
2. The glass, metal, and concrete building envelope can withstand at least a Category 3 storm.
3. Mission-critical components, including the emergency department, are at least 21 feet above flood elevation.
4. The emergency department ramp doubles as a boat launch in the event of a flood.
5. A million-gallon rainwater storage tank operates cooling systems and reduces city water dependence.
6. The parking garage can accommodate Blackhawk-class helicopters.
7. A 6,000-square-foot warehouse stores food, water, and emergency supplies.
8. Primary utility distribution is on the fourth level to avoid flood damage.
9. The central energy plant stores 320,000 gallons of fuel, enough to generate one week of power.

DESIGNING FOR DISASTER MITIGATION

THE UNIVERSITY MEDICAL CENTER's design was rooted was rooted in the mandate that no critical hospital functions occur at grade level. The ground floor was relegated to public and office functions, and all mission-critical components, including the emergency department, are located at least 21 feet above base flood elevation. Also, design technology and emergency power will allow the hospital to operate after a Category 3 hurricane for up to a week with virtually no outside support or supplies.



SOURCE: NBBJ.COM

health and safety of the community, and the failure of one institution can negatively impact other nearby institutions that are forced to take up the slack.

Architectural design solutions

Health care planning and design firms have pioneered the use of architectural features to ensure health care resiliency, but some of these design features have broader planning implications as well.

UPSIDE-DOWN DESIGN. On the design side, the University Medical Center and the Southeast Louisiana Veterans Health Care System hospitals in New Orleans are oriented "upside-down," placing "sacrificial," non-mission-critical functions, such as cafeterias and conference centers, on the lower levels. They can be temporarily suspended and are easier to renovate than treatment rooms if there is a flood.

Critical functions like inpatient rooms, surgery/interventional areas, and the emergency department, on the other hand, are located on higher floors, above the flood line. The higher floors also include a secure emergency operations center connected to city, state, and federal officials and first responders for use during a natural disaster, along with technology for communicating information to the public.

While this "upside-down" strategy is more relevant to health care planners than urban planners, it has planning implications for the surrounding city: It works at a districtwide level, too. Take South Boston, or what's commonly called the Seaport District. In the 19th century, it was built with two levels of transportation: a ground level with railway access, and a street level that sits 15 feet higher for horse carriages and buildings' main entrances. As a result, the district is already beautifully set up to anticipate sea-level rise and flooding.

While most cities do not have the luxury of multilevel street systems, the lesson for planners here is to think creatively about how to repurpose "aging" infrastructure to accommodate modern-day resiliency needs.

STREETSCAPE DESIGN. On the flip side, upside-down hospitals can have a detrimental impact on the urban fabric. Planners and architects must balance the often bunker-like mentality of resiliency with a hospital's need to be a welcoming, urban-facing institution that integrates within the larger community.

For example, the Medical University of South Carolina's Ashley River Tower in Charleston is elevated 10 feet above street level, above empty space that in other applications would typically be devoted to parking, and potentially create a dead streetscape. In Charleston, however, street-facing spaces on this level are devoted to noncritical "sacrificial" programs that can be suspended during a flood and then easily and inexpensively repaired afterward. With the additional pedestrian activity these programs provide, along with a partially shaded walkway and landscaping, the hospital maintains a more welcoming frontage at street level and more connectivity to the community.

EXPANDING PUBLIC UTILITIES. The new Perkins + Will-designed Spaulding Rehabilitation Hospital in Boston also incorporated lessons from Hurricane Katrina. Designers noted how all electricity-reliant systems stopped working at New Orleans's Memorial Hospital. As a result, Spaulding was one of the first health care institutions in the U.S. to convince its electric utility that transformer vaults should be located on the roof, above 100-year flood levels.
That may not sound particularly relevant to a planner, but it means that high-voltage lines must extend through the building superstructure to the roof before the voltage can be reduced to a usable level. Essentially, Spaulding Rehabilitation Hospital is a private, habitable building with a public utility core running vertically up it. That core had to be protected and the utility given permanent access in order to service it when necessary.

The lesson here? Often the best solutions require health care institutions to engage with infrastructure—which conventionally runs underneath public, city streets—and with utility providers in ways that planners are uniquely adept at facilitating.

Broader urban design solutions

While several of the aforementioned solutions require planners, architects, city officials, and others to be seated at the same table, there are a few other ways in which planning for resiliency can engage with and impact industries beyond just health care.

ACCESS. The most disaster-resilient facility in the world is of no use if it can't be accessed in an emergency. Architectural features can ensure continued access to some extent: helicopter landing pads, for example—though they will be unusable during a hurricane—or, in the case of University Medical Center and the Southeast Louisiana Veterans Health

Care System in New Orleans, parking ramps that can double as boat launches in cases of severe flooding. But planning at a regional scale plays an even more important role.

In New Orleans, Interstate 10 is elevated 25 feet above grade, which made it a place of refuge and a staging area for airlift evacuations during Hurricane Katrina. Recognizing this, the designers of University Medical Center, along with the state, considered building a vehicular ramp directly off I-10 into the hospital's elevated emergency department—until someone pointed out that I-10 returns to grade only a few miles to the north and south, greatly limiting its use as an evacuation route. Planners can play an essential role in working with authorities to define evacuation routes that account for the challenges and opportunities of infrastructure and topography.

GREEN INFRASTRUCTURE. Also in South Boston, a recent planning concept published in the *Boston Globe* proposed to adaptively reuse an obsolete, city-owned dry dock and convert it to public swimming pools. As the number of "dog days" each summer increases, and as poor transportation infrastructure and lack of resources prevent much of the urban population from accessing places like Cape Cod, cooling the population through public swimming—whether in pools, the river, or the harbor—might emerge as a direct response to resiliency.

Moreover, planners could engage health care providers as partners in implementing cooling infrastructure, as ultimately their operations will be the ones affected by the number of people potentially seeking emergency care in a heat wave or power outage.

We know that natural systems have tremendous power to mitigate flooding. In the 1960s, on the upper reaches of the Charles River near Boston, rather than build levees like in New Orleans, the U.S. Army Corps of Engineers purchased thousands of acres of wetlands that now serve as a civic-scale stormwater retention system. This protected, natural "sponge" has maintained the river's ability to resist inundation during major rain events.

The next challenge for planners is to reproduce a similar condition as best we can in dense, urban environments. A regional response to resiliency will continue to emphasize the importance of permeable surfaces that allow water to percolate naturally through the ground.

Some health care institutions have been proactive in this regard. Neighborcare Health in Seattle and OhioHealth in Columbus, Ohio, are just two systems that have built bioswales and stormwater retention landscapes on their campuses. The more we can mimic these natural conditions at an urban scale, the more resilient our communities and health care facilities will become.

Reframing the conversation

With all the extra cost and effort that goes into planning for resiliency, it's reasonable to ask why we locate health care in vulnerable areas in the first place. That's a good question, but the answer is not so simple. Institutions can't always move away from the problem. Hospitals must serve people where they live, and if that's a flood-prone area, they must plan accordingly. A large percentage of the U.S. population lives on the coasts; hospitals can't simply abandon every coastal city. Also, for academic medical centers, the clinical, academic, and research components are all symbiotic; one side can't divorce itself from the others, and relocating everything is prohibitively expensive. Even the best available sites might be less than ideal. So the question must be how to plan and design facilities in those areas.

Although resiliency matters to everyone, planners must focus a significant portion of their efforts on health care, the effectiveness of which is even more profound when done so in cooperation with—if not at the initiative of—health care institutions themselves.

Partners Healthcare, which runs a consortium of hospitals in Boston and throughout New England, recognized Boston's susceptibility to sea-level rise, so they convened a full-day conference that brought world experts on sea-level rise and resiliency together with the planning and design community. The roundtable was the first of many conversations to anticipate what to do as a community, what to advocate for, and how hospitals can steel themselves.

This sense of responsibility, perhaps, derives from the respective cultures of the planning and health care professions. Planners seek to build a better life and equitable cities for all; health care providers seek to anticipate human suffering and eliminate it in advance. But together, these seemingly disparate groups can become community leaders by driving the conversation and pulling government and the private sector along to realize that resiliency is something we neglect to plan for at our peril. ■

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