WAITING FOR SPACE Emergency-room capacity is stressed under normal conditions, but after a large-scale event such as flooding, it cannot accommodate everyone. In July 2009, the ER at Ben Taub General Hospital, Houston, was so crowded that patients were placed in the hall.

When DISASTER STRIKES

By Dr. Steven J. Phillips and Rear Admiral George R. Worthington, U.S. Navy (Retired)

In the wake of the next big storm, disease, or attack, we can be ready—by preparing now.

Experience has demonstrated that U.S. hospitals cannot absorb the thousands of victims of a disastrous event. Following the attacks on 11 September 2001, New York's premier level I trauma center was overwhelmed. Bellevue Hospital lost track of patients, ran out of supplies, and struggled with doctor staffing. New York University Downtown Hospital lost electricity, steam, gas, phone, and computer services, and had dangerously reduced water pressure.

When the 2003 Rhode Island nightclub fire injured 200 and killed 100, Kent County Hospital received 40 patients in the first hour; 25 of them required ventilators. The hospital ran out of critical supplies and ventilators and struggled to support family members. Ultimately, 16 other New England hospitals received 196 burn victims, including a pediatric hospital that received 16 adults. The dismal response to Hurricane Katrina is on the record and need not be elaborated upon.

On any given day, the emergency rooms of most U.S. hospitals are at or near capacity, and it is unrealistic to expect them to respond effectively to sudden large-scale needs. The reasons for this state of affairs include decades of managed care and associated financial issues, uncompensated services, personnel shortages, credentialing issues, and a dramatically reduced number of inpatient beds. ER capacity is further stressed by patients admitted to the hospital who crowd the ER while awaiting a bed.

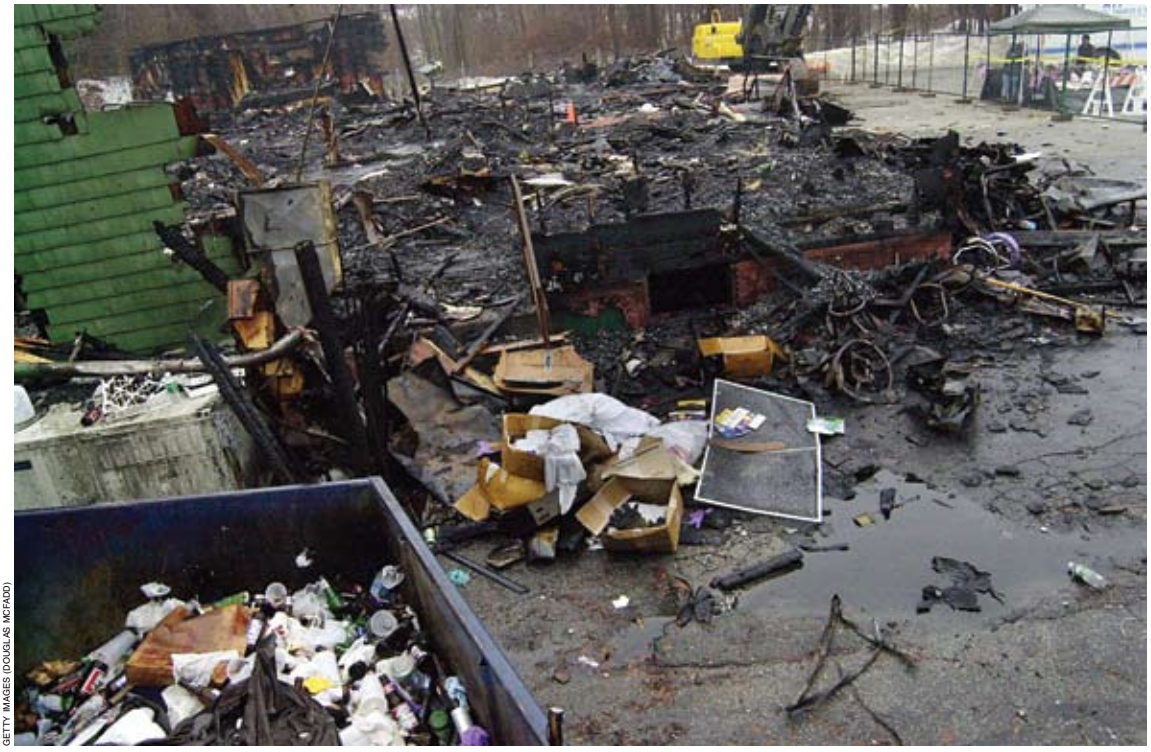
Managed-care programs and hospitals do not have the financial resources to maintain a program of disaster preparedness that would include unused beds, equipment, medications, and on-call staff in anticipation of a surge need. And new Medicaid regulations will shrink federal payments to hospitals by $623 million annually. If states choose to withdraw matching funds, hospitals could face a reduction of about $1.2 billion—which could mean fewer emergency services. Such a huge loss of resources would lead, inevitably, to a curtailing of critical healthcare. But we can alleviate this situation with proper planning.

Pressuring Complex Systems

Homeland Security Presidential Directive 21 defines a catastrophic health event as "any natural or manmade incident, including terrorism, that results in a number of ill or injured persons sufficient to overwhelm the capabilities of immediate local and regional emergency response and health care systems."

When disasters occur, the pressure on the medical system is called a healthcare surge. Surge capacity means the system's ability to expand rapidly beyond normal services to meet needs for care, personnel, supplies, medications, and equipment. Hospitals are highly complex facilities: in addition

REUTERS (JESSICA RINALDI)



GETTY IMAGES (DOUGLAS MCFADD)

EXPECT LARGE ACCIDENTS In 2003, the band Great White's pyrotechnics started a fire in a Rhode Island nightclub, leaving 100 dead and 200 wounded. With the local hospital overwhelmed, patients had to be sent to other New England hospitals.

to providing routine services, they must also function as hotels, office buildings, laboratories, transportation centers, and warehouses. Their functioning depends on numerous subsystems: supply delivery, information technology infrastructure, telephone and internet, paging, medical supplies, gas, water, power, security, and more.

U.S. NAVY (MICHAEL B. WATKINS)

GOOD NEGATIVE EXAMPLE **After 2005's Hurricane Katrina, poorly coordinated efforts led to a dismal response time. Here, U.S. Navy Sailors assigned to the USS *Tortuga* (LSD-46) search for survivors. Evacuees were brought to the ship for treatment and assistance. The Navy participated in Federal Emergency Management Agency–led rescues.**

Any disaster increases the demand on all of this. Systems become disrupted, critical resources are in short supply, and staff is asked to handle things they customarily do not. Yet hospitals are expected to continue to function under these conditions. To do so, they are in urgent need of collaborative, streamlined processes.

Expecting H1N1

The World Health Organization has declared novel H1N1 (swine flu) a global pandemic. This is the first time it has used that designation in 41 years. Expectations are that the pandemic will be of moderate severity, but may become worse in countries with limited resources, poor healthcare, and a high prevalence of underlying medical problems.

This new virus strain, of swine origin, first caused illness in Mexico and the United States in March–April 2009. The flu probably spreads in the same way as do regular seasonal influenza viruses, through coughs and sneezes, but touching infected objects and then one's nose or mouth may also spread it. The novel H1N1 infection has been reported to cause a wide range of symptoms, including fever, cough, sore throat, body aches, headache, chills and fatigue, nausea, and vomiting and/or diarrhea.

Vaccine manufacturers that supply the United States expect the vaccine to be distributed by late October or November and be administered in two doses. Healthcare workers, pregnant women, and those with no acquired immunity (children and young adults) will have a high priority for vaccination. With this kind of foreknowledge, regional hospitals should be rehearsing their collaborative plans in preparation.

This will require more than just allocations of beds, staff, and supplies. The possibility that 300,000 Americans may need assisted ventilation far exceeds the number of available machines and staff qualified to run them. Just as we must stockpile medications, we must rapidly accumulate ventilators and train staff in their usage. Because the response to a major disaster is initially local and regional, preparation requires serious cooperation among these healthcare partners.

Organize Before the Event

Disaster planning must anticipate how demands imposed by a disaster reconcile with the capacity of the treating facility. Resources must be organized *before* an event so that they are optimally used to treat as many victims as possible, as well as to avoid overwhelming available resources. The occurrence of a natural disaster such as Hurricane Katrina, the emergence of novel pandemics such as H1N1, a terrorist attack similar to 9/11 or one using biological, chemical, or radiologic or nuclear agents are threats capable of imposing significant demands on healthcare resources and statewide healthcare delivery systems.

The Hospital Preparedness Program was established after 9/11, with a goal to improve the readiness of American hospitals and healthcare systems to manage all types of disasters and public health emergencies. A 2006 report from the Institute of Medicine recommended the creation of a coordinated, regionalized, accountable system based on the current trauma-care system model (Committee on the Future of Emergency Care in the United States Health System, *Hospital-Based Emergency Care: At the Break-*

ing Point [Washington, D.C.: National Academies Press, 2006]).

The U.S. Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response found that local hospitals were better prepared for disasters in 2007 than they had been in 2002, but that our system was still not capable of responding effectively to a sudden surge in demand that would occur during a catastrophic event or pandemic, as described in the Department of Homeland Security National Planning Scenarios.

A 2008 congressional study titled "The Lack of Hospital Emergency Surge Capacity" (House Oversight and Government Reform Committee) also found that American hospitals were unprepared for a disaster surge in terms of facilities, staff, beds, and infrastructure. While many hospitals, clinics, and other providers have developed surge plans, it is evident that individual facilities, no matter how diligently they plan, do not have the capacity to respond separately to a sudden large medical need. Thus, the sheer magnitude of these disasters will require a different planning approach.

A Model for Change

One such approach can be modeled after the Bethesda Hospital Emergency Partnership Plan (BHEPP). In 2004, three adjacent hospitals in Bethesda, Maryland, created a surge plan that would allow for response to a dramatic increase in the number of those requiring medical assistance resulting from a catastrophic event in the National Capital Region. The community-based, not-for-profit Suburban Hospital, the National Naval Medical Center, and the National Institutes of Health Clinical Center agreed to pool resources. The concept was that pre-identified stable patients would be rapidly transferred from the two trauma centers—Suburban Hospital and the National Naval Medical Center—to the National Institutes of Health Clinical Center, thus opening up receiving beds at the trauma centers.

In 2007, the National Library of Medicine (NLM, of which coauthor Dr. Phillips is the associate director) joined the BHEPP as its fourth partner. The largest biomedical library in the world and member of the National Institutes of Health, NLM offers the BHEPP immediate research and dissemination of information for health responders worldwide. This internationally renowned library, unequaled in medical reference material, had already developed a Disaster Information Management Research Center (DIMRC).

The center is specifically oriented toward real-time information that can improve the overall management of emergency response during disasters. The NLM and DIMRC will carry out and oversee research in support of the BHEPP, facilitating delivery of the model to other partnerships.

Physically, the four partners are within a mile of one another. They have signed a memorandum of agreement to cover logistical activities. BHEPP functions include weekly planning meetings; yearly full-dress disaster drills; and the sharing of critical staff, information technologies, transportation services, equipment, supplies, security, and several redundant communications systems.

REUTERS (ROBERT GALBRAITH)

H1N1 IS COMING **The World Health Organization has declared swine flu a global pandemic. It may be only moderately severe, but we must be ready. In August 2009, this nurse from the California Nurses Association was among those who believe that we are not. Wearing a surgical mask, she attended a rally at the University of California San Francisco Medical Center, to protest safety gaps.**

To support this unique partnership between the Department of Defense, Health and Human Services, and the private sector, Congressmen Chris Van Hollen (D-MD) and Bill Young (R-FL) legislated a four-year funding stream totaling $12.9 million for development of the BHEPP. Congress mandated that in addition to preparing for a National Capital Region disaster, BHEPP should also be designed as a model that could be adopted throughout the nation.

Support equipment includes a line-of-sight laser communication system, dedicated fiber-optic cables between the hospitals, and two mobile hospitals. Sundry medical-

specific technologies have been researched, such as interfacing disparate medical-record systems, a radio-frequency patient- and equipment-tracking system, a lost-patient finder, and an electronic triage-recording computer pen. With its research-and-development projects, the BHEPP collaborative partnership provides a template for a national model. This exportation and sustenance are two BHEPP goals for 2009.

We Are Already at Crisis Stage

Numerous reports from varied sources indicate that the U.S. emergency care system is in crisis. The Institute of Medicine's 2006 report found that the numbers of patients requiring emergency care was continuing to increase, while emergency facilities nationwide continued to decline. The study detailed trends that contribute to long waits, increased demand, staff shortages, and hospital closings.

The American Hospital Association and lay media including the *Washington Post* and ABC news all concluded that emergency visits were increasing while the number of facilities was decreasing. From 1996 to 2006, visits to the emergency room rose from 90.3 million to 119.2 million annually, while emergency departments decreased from 4,019 to 3,833. A 2006 survey of 362 hospital emergency departments reported that the average wait for a patient to see a physician was 56 minutes—a 36 percent increase since 1997.

A 2009 nationwide survey by the hospital-consulting firm Press Ganey found that of nearly 1.4 million patients treated at 1,725 emergency departments, the average patient spent more than four hours in the emergency room. New York City was last among the nation's ten largest metropolitan areas for satisfaction in emergency-department care, and New York State was 46th in overall waiting time. South Dakota came in first, with an average waiting time of 172 minutes. New York narrowly beat out New Mexico, averaging 288 minutes.

Create Partnerships

Exporting the Bethesda model across the country is a long-range challenge. An effort is in the preliminary stages to transport some aspects of BHEPP cooperation to the Naval Medical Center West's Balboa Hospital (San Diego) and the Sarasota Memorial Hospital (Florida). As in most communities, state and county offices of emergency management have agreements in place with local institutions, trauma centers, hospitals, and clinics. A BHEPP model need not be superimposed onto local response structures; its collaborative aspects can be universally applicable, such as the memorandum of agreement, sharing of equipment and staff, triage using all local facilities as agreed, and other joint efforts.

In larger metropolitan areas, it may be advantageous to group partnerships into clusters. National oversight is direly needed and could be established as a national hospital partnership alliance, with a goal of creating partnerships across the country to help meet surge requirements. This alliance would not supplant functions afforded in the National Disaster Medical System, which provides medical teams to regions hit by disasters.

Instead, the partnership alliance would facilitate regional hospitals' efforts to prepare to function in their own environments and legal infrastructures. These differ from one area to the next. To ensure that emergency preparedness efforts continue in the National Capital Region and improve in others, legislation and funding are needed.

Preplanning is key. In his 2005 book *Catastrophic Event Response Planning*, Matthew Pope says: "A catastrophic event—regardless of whether it is mechanical, technological, biological, physical, chemical, or meteorological—is generally characterized by an utter failure or total disruption." This was the case with Hurricane Katrina, as it usually is annually with the California wildfires. Individual hospitals must prepare now for the next surge.

Established communication links based on BHEPP would be regionally beneficial. In addition, BHEPP en-

Preparing for Swine Flu

By Captain James Howe, U.S. Coast Guard (Retired)

The prospect for an outbreak of a more virulent strain of the H1N1 influenza poses a host of challenges—for our armed forces, law enforcement, and the security agencies that guard our borders.

Military readiness is a primary concern, as John Barry shows in his book *The Great Influenza* (New York: Penguin, 2004), the story of the disastrous 1918 pandemic. As the book opens, the virus is spreading rapidly among Navy crews in Philadelphia, leaving hundreds of Sailors incapacitated and dozens dead. In vignettes, Barry illustrates the explosive spread of the disease through Army barracks across the nation and in Europe. The effect on unit readiness was devastating. During the Great Offensive in late October 1918, "more Third Division troops were evacuated from the front with influenza than with wounds" (p. 306).

Such a rate of infection and incapacitation in today's overseas operations would be a grim scenario—but our contemporary military is far more aware of the epidemiology of the flu, as well as more capable of limiting its spread. Nevertheless, our military forces live and operate in congested quarters, whether in stateside barracks, underway ships, or tent compounds in Afghanistan. Even with the best of precautions, it is likely that the flu will spread to some extent among the troops. Depending on the potency of the strain, this could seriously impact the readiness of a military that is already stretched thin.

joys three backup communication systems beyond local phone and cell connectivity. These practices should be studied and copied.

Regional groups of hospitals—such as Veteran Administration, civilian, and military—can determine how much of what can be applied during a disaster. Annual drills are required by the Joint Commission on Accreditation of Healthcare Organizations, the not-for-profit national body that oversees safety and quality of healthcare. BHEEP runs an annual drill that encompasses all Bethesda first responders and much of the NCR emergency agencies.

But beyond Bethesda, very little is now under way to address this problem. The BHEPP model is applicable to other national, civilian-military populations such as San Diego (home to the largest military complex in the Continental United States), Norfolk, Honolulu, and Anchorage. The civilian model could include two community trauma hospitals and a non-trauma receiver such as a local VA.

Efforts continue in the National Capital Region. The communication and information links exist to take the initiative further, with the National Library of Medicine and its national network of approximately 5,800 medical libraries. The Disaster Information Management Research Center is exploring the concept of adding the services of a specialist librarian. This would be a proactive approach to providing just-in-time and just-what-I-need information to prepare for and respond to emergencies. The NLM can also be enlisted for local assistance with law enforcement and medical institutions.

It's past time to start the effort. If history is any lesson, the next natural disaster, terrorist attack, or pandemic is around the corner. We need to be ready.

U.S. NAVY (SETH ROSSMAN)

HOW TO COORDINATE **The Bethesda Hospital Emergency Partnership Plan offers an example of how local and regional facilities can work together. The Suburban Hospital, National Naval Medical Center (pictured here), National Institutes of Health Clinical Center, and National Library of Medicine have pooled resources to maximize the strengths of each partner in a concerted effort.**

Dr. Phillips, a cardiac surgeon, is associate director of the National Library of Medicine and director of its Special Information Services Division, which includes the Disaster Information Management Research Center. Rear Admiral Worthington is a former commander of the Naval Special Warfare Command in San Diego, responsible for training and equipping Navy Special Operations Forces, SEALs, and Special Boat Teams.

The situation is equally difficult for frontline personnel from the Department of Homeland Security. At the nation's 360 ports of entry, DHS workers are continuously in face-to-face contact with the traveling public. A person can be contagious before becoming symptomatic; thus, security personnel from Customs and Border Protection, the Transportation Security Administration, and other agencies will encounter travelers who appear healthy but are unknowingly spreading H1N1. As in the military, unit cohesion and operational performance could suffer.

As difficult as they are, broader questions overshadow these issues. At what point should we consider quarantining visitors to the United States? When the traveler is symptomatic, suspected of infection, or never? If a more lethal virus originates in another country, will we close our borders? What would be the economic impact of such a closure? Considering the frequency of international travel and the incubation period of the flu, it is unlikely that such efforts would prevent the spread of a virus into the United States. Decision makers will have to wrestle with these questions.

The DHS, DOD, and other agencies have already made a strong and concerted effort to prepare for the potential spread of a resurgent H1N1. But much of their planning depends on the public-health response—in particular, on the distribution of an effective vaccine. Should a novel and more lethal strain course through the nation, the ability to balance workforce protection, freedom of travel and commerce, and the health of the general population will seriously test our preparedness-and-response architecture.

Captain Howe is a deputy assistant secretary at the Department of Homeland Security.