

Health Care Facility and Community Strategies for Patient Care Surge Capacity

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Recent terrorist and epidemic events have underscored the potential for disasters to generate large numbers of casualties. Few surplus resources to accommodate these casualties exist in our current health care system. Plans for “surge capacity” must thus be made to accommodate a large number of patients. Surge planning should allow activation of multiple levels of capacity from the health care facility level to the federal level. Plans should be scalable and flexible to cope with the many types and varied timelines of disasters. Incident management systems and cooperative planning processes will facilitate maximal use of available resources. However, resource limitations may require implementation of triage strategies. Facility-based or “surge in place” solutions maximize health care facility capacity for patients during a disaster. When these resources are exceeded, community-based solutions, including the establishment of off-site hospital facilities, may be implemented. Selection criteria, logistics, and staffing of off-site care facilities is complex, and sample solutions from the United States, including use of local convention centers, prepackaged trailers, and state mental health and detention facilities, are reviewed. Proper pre-event planning and mechanisms for resource coordination are critical to the success of a response.

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INTRODUCTION

The terrorist attacks of 2001 and the threat of large-scale infectious disease outbreaks such as severe acute respiratory syndrome and pandemic influenza have revealed potentially large gaps in the ability of the health care system to find either the capacity or the special capabilities to cope with disasters that severely injure or infect a large number of victims.^{1,2} Although much current planning revolves around large-scale terrorist or epidemic events, the recent Rhode Island nightclub fire demonstrates that even a moderate-sized incident may generate large numbers of victims whose care requires supplemental staff and specialized resources and overwhelms local capabilities.³ There is an urgent need for communities and regions, not just individual health care facilities, to develop tiered, scalable, and flexible surge capacity plans to provide care for a large volume of patients. These plans must reflect local hazards and other variables (eg, climate, travel and tourism patterns, population).

Surge capacity is not a new concept, as auxiliary hospitals have been used in smallpox and pandemic influenza events,⁴ and field hospitals are a core component of military casualty care. However, the challenges of planning are many in the face of frequent

emergency department (ED) crowding⁵ and a loss of 38,000 hospital beds (4.4%) nationwide between 1996 and 2000,⁶ including a 20% decrease in ICU capacity between 1995 and 2001.⁷

This article reviews options for patient care surge capacity for hospital patients. These strategies do not exist in isolation but must be part of a comprehensive public health and emergency management plan for out-patient and inpatient care. In addition to the resources available to the authors, a MEDLINE search was conducted to identify articles of interest using search terms “surge capacity,” “disasters + hospital,” “disaster planning + hospital,” “field hospital,” and “surge + disasters” since 1966. Articles that seemed primarily related to surge capacity were reviewed and hand-searched for additional references.

DEFINITIONS

There are 3 broad areas in which an augmented or “surge” response may be required during a disaster. “Public health surge capacity” refers to the overall ability of the public health system to manage a large incident by increased capacity for patient care and for multiple other patient- and population-based activities (Table 1). “Health care facility-based” and “community-based patient care surge capacity” relate to making available adequate resources for the delivery of acute medical care to large numbers of patients (Table 1). “Surge capability,” by contrast, refers to more specialized resources for specific patient groups (eg, burns; Table 1).⁸

These terms refer not only to the physical space but also the organizational structure, medical and ancillary staff, support (eg, nutrition, mental health), supply, information systems, pharmaceuticals, and other resources required to support public health and patient care efforts.

INCIDENT MANAGEMENT

Surge capacity planning must address static and dynamic events throughout a variety of timelines requiring different types of resources.⁹ For example, a large-scale airborne anthrax attack will rapidly overwhelm intensive care resources such as ventilators. A smallpox outbreak may develop more slowly and place longer-term demands on hospitals, isolation facilities, and the workforce. Effective planning thus requires comprehensive resource coordination and control to allow for a flexible response.

From the local health care facility to the state and federal level, surge capacity decisionmaking must take place within an incident management system that involves key stakeholders (Figure 1). An example of a functional health incident management system is the Medical and Health Incident Management System.¹⁰ This system provides a framework for all facets of a jurisdictional or multijurisdictional health response to a disaster, including public health initiatives, patient care delivery, and epidemiologic response.

Internally, health care facilities accredited by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) are required to use an incident management system¹¹ (eg, the Hospital Emergency Incident

Table 1.
Definitions.

Term	Definition
Surge capacity	Ability to manage a sudden, unexpected increase in patient volume (ie, numbers of patients) that would otherwise severely challenge or exceed the current capacity of the health care system
Surge capability	Ability of the health care system to manage patients who require specialized evaluation or interventions (eg, contaminated, highly contagious, or burn patients)
Public health surge capacity	Ability of the public health system to increase capacity not only for patient care but also for epidemiologic investigation, risk communication, mass prophylaxis or vaccination, mass fatality management, mental health support, laboratory services, and other activities
Facility-based surge capacity	Actions taken at the health care facility level that augment services within the response structure of the health care facility; may include responses that are external to the actual structure of the facility but are proximate to it (eg, medical care provided in tenting on the hospital grounds). These responses are under the control of the facility's incident management system and primarily depend on the facility's emergency operations plans.
Community-based surge capacity	Actions taken at a community level to supplement health care facility responses. These may provide for triage and initial treatment, nonambulatory care overflow, or isolation (eg, off-site “hospital” facility). These responses are under the control of the jurisdictional response (eg, public health, emergency management) and represent a public effort to support and augment the health care system.

Command System)¹² that integrates with that of the community.

Response to a large-scale disaster may be improved when health care facilities and other stakeholder groups agree on a mechanism for their needs and resources to be represented at the jurisdictional or regional level (eg, area hospitals designate a single “clearinghouse” hospital to coordinate resources and response). Roles and responsibilities of each stakeholder group must be understood and documented before an event occurs.

One of the most difficult aspects of managing a public health incident is that health care systems are usually private rather than public enterprises. They have no jurisdictional boundaries and are not under any governmental or municipal operational authority or control. Because of their regulatory and policy authority, departments of public health are expected to assume responsibility for coordination of disaster medical care, but often expertise in clinical care and daily involvement with health care systems is minimal. Close cooperation of health care facilities with public health, especially in pre-event planning, is thus of paramount importance to any large-scale disaster patient care response.

HEALTH CARE FACILITY–BASED SURGE CAPACITY

The initial facility-based “surge in place” response (Table 1) occurs on notification of a multiple-casualty event. Most victims of chemical and explosion events will present within the first 6 hours to hospital EDs.¹³ Rapid clearance of the ED is accomplished by expediting the disposition of patients and clearing the ED of ambulatory patients. Elective procedures and admissions should be held or cancelled. The facility may elect a graded response, which provides for different actions to be

taken according to the number of casualties expected. According to the type of incident, additional emergency patient screening areas may be required if the volume of patients overwhelms the resources of the ED.¹⁴

Each inpatient unit may be assigned by the disaster plan to automatically accept a predetermined number of patients from the ED who do not yet have beds (eg, 2 per nursing unit, or 110% unit census). Health care facilities should be prepared to discharge inpatients to make beds available for incoming casualties. The discharge function should receive immediate attention when the health care facility disaster plan is activated. Identification of patients eligible for early discharge is an inexact science, but patients who are clinically stable and whose inpatient requirements are limited to a few parenteral medications may be appropriate candidates. Preplanning with ancillary health care services (eg, nursing homes, home health) is essential for these early discharges. A discharge holding area (eg, lounge, cafeteria area) may allow these patients to be moved from their rooms while awaiting appropriate transportation, home care, and pharmacy arrangements.

After expedited discharges, the next most immediate resource for patient care capacity comes from the adaptation of existing capacity. Private rooms may be converted to double rooms, and patients may be placed in halls.^{15,16} Closed areas may be reopened if staffing and supplies allow. Health care facilities may find that patient care areas typically reserved for postanesthesia care, chest pain observation, gastroenterology procedures, pulmonary and cardiac catheterization suites, and outpatient surgery areas provide the best opportunities to increase critical care capacity.

Generally, approximately 10% to 20% of a hospital’s operating bed capacity can be mobilized within a few hours using these strategies, with an additional 10% from conversion of “flat space” areas such as lobbies, waiting rooms, classrooms, conference facilities, physical therapy areas, and hallways. Inova Health System’s 4 hospitals in northern Virginia, for example, made 343 additional beds (of 1,500 total) and 43 operating rooms available within 3 hours of the 2001 Pentagon attack. The District of Columbia made available 200 beds from their existing 2,904 staffed beds. Thus, for any given facility, surge capacity planning should incorporate the availability of about 20% to 30% of operating beds for immediate or near-term patient use. Some institutions may have significantly different numbers according to their elective admission rates, critical case resources, and availability of additional staffed beds. ICU bed availability is likely to be significantly lower.

Figure 1.

Key community and regional stakeholders.

- EMS (and other patient transportation resources)
- Emergency management
- Public health
- Public safety/law enforcement
- Health care systems
- Hospitals and hospital associations
- American Red Cross
- Mental health
- Jurisdictional legal authorities
- Professional associations, including pharmacy, medical, nursing, mental health
- Health professional training institutions

Protocols must be in place for revision of staff work hours (eg, 12-hour shift standard in disasters), callback of off-duty personnel, use of nonclinical staff (eg, nurse administration, continuous quality improvement coordinator) in clinical roles as appropriate, reallocation of outpatient staff resources (eg, cancel subspecialty clinics and reallocate staff), and use of solicited (former employees, retirees) and unsolicited volunteers. Credentialing of nonemployees should be consonant with institutional bylaws and legislative and accrediting body regulations.¹⁷ Untraditional patient care providers such as family members and nonprofessional personnel (eg, city employees) should be considered. Partnerships can be established before an event, with local Medical Reserve Corps¹⁸ and other preidentified service organizations.

Specialty patient care surge capability (eg, burns, pediatrics) may be created to address patient needs temporarily but ideally only pending transfer to a specialty center with adequate resources. Consulting with experts from a hospital’s usual referral centers may be helpful in planning for these situations.

Temporary external shelters (eg, tents or mobile trailers) for patient holding may be an option. Their practicality will be influenced by the need to have staff familiar with their operation, climate, and the ability to ensure that the shelter(s), the required exterior space for their placement, and any needed infrastructure support (eg, water, utilities) are available. In cases in which the standard of care must be adjusted because of a lack of resources, immediate requests for assistance and patient transfers should be made to allow the best standard of care possible to be applied across the community or region.

COMMUNITY-BASED SURGE CAPACITY

A community planning process that integrates regional health care facilities is critical to develop a systematic process to increase health care capacity.¹⁹ The individual health care facility represents the “first tier” of response. The mission for the facility is to take steps to increase facility capacity by revising staffing and patient care practices as outlined in the previous sections. Should these responses prove inadequate, the “second tier” of resources—other local health care facilities—is activated.

Barbera and Macintyre⁸ describe a tiered system that allows facilities to organize before an incident and understand their role within their jurisdiction (Table 2). At each level, resources and a coordination mechanism are available. If the resources at one level are inadequate, the next tier is activated, and so on. An incident management

system must be in place that incorporates each of these tiers. The definitions for each tier may vary because health care facilities may organize within a jurisdiction (eg, county or city) or span several jurisdictions, depending on their geography.

Cooperative regional planning by health care facilities allows for more streamlined response and requests for resources. Cooperative agreements should include staff and supply sharing and describe a process for communication and resource request or reallocation during an incident. A mechanism for interacting with jurisdictional authorities should be described and practiced. Transfer agreements should be in place within the region so that patients can be moved from one facility to another (although some contagions may alter these referral plans). Interregional agreements are also encouraged and may be facilitated by state health authorities.

Movement of casualties to areas that have adequate resources is one of the key functions of the cooperative system. In most disasters, health care facilities only a few miles from the incident receive few casualties, and those closest may be overwhelmed.²⁰ A communications coordination point can facilitate local casualty redistribution by ambulance, bus, and other means. It is important that decisionmakers at the regional level have access to accurate information about hospital capacity so that early, appropriate requests for assistance can be made. Regional patient redistribution should occur when required. In certain cases, particularly in a localized outbreak of a highly contagious disease, resources may need to be brought to the area rather than transferring patients out.

The National Disaster Medical System is a federal program that can provide medical response to a disaster area in the form of teams, supplies, equipment, patient movement from a disaster site to unaffected areas of the

Table 2.
Tiers of health care disaster response.

Response Tier	Response Scope	Response Role
Tier 1	Individual health care facility	Facility-based “surge in place” response
Tier 2	Health care coalition	Multiple facility response using facility and coalition agreements/plans
Tier 3	Jurisdictional incident management	Community response, coordination at emergency operations center
Tier 4	Regional incident management	Cooperation between jurisdictions/coalitions
Tier 5	State response	Support to jurisdictions
Tier 6	Federal response	Support to state

nation, and definitive medical care at participating hospitals in unaffected areas.^{21,22} The National Disaster Medical System thus may provide a national surge capacity for large disasters. Concerns exist that National Disaster Medical System resources might be limited or nonexistent in contagious illness and other disasters that may affect multiple sites or that may occur during a major military contingency.

Community measures to provide the public with adequate health information and mental health support will be in significant demand^{23,24} after a disaster. These responses may reduce the need for patient care surge capacity by preventing the health care system from being submerged under a deluge of patients who may not be ill but have concerns and seek further information or evaluation.

Outpatient care systems may see higher volumes of patients because of disaster-related early hospital discharges, visits by patients who were less seriously ill or injured, and visits by patients who are experiencing indirect effects of the event (eg, asthma symptoms from dust). Stresses on home care services from disaster-related hospital discharges can also be expected. Home care agencies and clinics must have surge plans that may include canceling or delaying appointments or visits, increasing staffing, or expanding or limiting services in conjunction with the community response plans.

Public health agencies may need to facilitate home care and family-based care or recommend modifications to the health care framework of the community to meet the needs of the incident (eg, opening screening clinics). One of the goals of ambulatory care surge capacity development is to reduce pressure on the hospitals, allowing them to concentrate on nonambulatory care.

OFF-SITE PATIENT CARE

If a large number of ambulatory “walking wounded” or “potentially exposed” victims are generated by an event, triage and initial treatment sites may be immediately needed to relieve pressure on the emergency transportation and care system. For every casualty injured or infected, hundreds more may seek evaluation.^{25,26} Such sites may also be required when the local health care infrastructure is severely damaged. For example, auxiliary care sites have been proposed to cope with health care facility damage after earthquakes.²⁷ Many localities rely on emergency medical services (EMS) to organize triage and initial treatment sites. A process to provide health care workers from other agencies, special teams, or less-

affected facilities to the scene should be in place to reduce convergent volunteerism.²⁸

Materials for these sites may be predeployed with response agencies. Supplies should be standardized when possible to facilitate use by mutual aid providers. These sites usually must be rapidly deployed to be effective and may be staffed for hours to days.

Nonambulatory patients should be accommodated within the existing health care infrastructure as much as possible (see facility-based surge capacity above), with patient transfer as a later step. In select situations, usually in the setting of a contagious disease epidemic, but sometimes in the setting of a hospital evacuation or other circumstance, these mechanisms will be inadequate, and an off-site hospital facility may be required. Each hospital accredited by JCAHO is required to plan for such facilities.¹¹ The need for such a facility should be anticipated as early as possible according to patient load, hospital capacity, and event data. The authority to initiate an off-site facility and the administrative, staffing, logistic, and legal issues should be detailed and drilled in advance. Public health will also potentially need sites in the community for outpatient care and vaccination or prophylaxis, and it is important that the same sites not be considered for conflicting missions. Because of economies of scale, it may be appropriate to plan for a few larger off-site facilities in a region than for many smaller ones, which may require cooperative agreements between public health entities. Rural hospitals that must provide off-site care because of facility evacuation or capacity overflow are particularly challenged by a lack of bed capacity, staff, and transportation resources.

Many possible locations for an off-site hospital facility can be considered (Figure 2). The selection of an appropriate site is an imprecise science. Figure 3 lists factors that may be reasonable to consider in the evaluation of a possible site.²⁹ Some items may be of lesser importance, depending on the event and its timing (eg, wide doors when the facility will treat only ambulatory patients or heating capability during summer months). A spreadsheet can be developed with these items on one axis, allowing multiple potential sites to be “graded” and compared. This approach has been demonstrated to be useful in a site-selection exercise, using a 0 to 5 rating scale (bad to good) for each category and was used to evaluate sites for the Athens 2004 Summer Olympics (Col. R. Gum, MC, USA, personal communication, November 2003).²⁹ Ideally, the facility would be publicly owned and rapidly available. Agreements for use of the facility should be in place in advance. The

timeframe for converting the facility to patient care use should be understood.

Site suitability will change according to the type of event. For example, a hotel may be an excellent choice for less acutely ill patients but may not be appropriate for sicker patients who would be more easily observed and cared for in a single large room (“ward”). Mobile facilities, although avoiding stigma issues, may present logistic challenges, such as availability of plumbing and water, and may have high incremental costs per bed. Surgical centers and other outpatient health care facilities should also be considered and may be more suitable sites to provide critical care than more austere environments.

Guidelines specifying the level of care to be provided and the patient admission and discharge criteria for the facility should be developed and can facilitate planning. Basic nursing care, intravenous fluids, nasogastric feeds, medications (including gravity-administered intravenous medications), and bedside laboratory testing may be the limit of care that can reasonably be provided, with more advanced care provided at the health care facility as part of the “surge in place” response. Field critical care³⁰ poses significant obstacles because even oxygen provision for more than a small number of patients presents logistic issues that should carefully be considered and may be unsolvable.³¹

Guidance and templates from the US Army Soldier and Biological Chemical Command have been particularly helpful for planning off-site facility operations.^{32,33} Examples of local and regional strategies that are being implemented are noted in Figure 4.

Generally, planning should be modular, perhaps in 50-patient increments. Staffing, supplies, food, and administrative needs will be driven by the number of

modules activated. Documentation, order mechanisms, treatment protocols, pharmacy, and laboratory resources should be planned as much as possible and drilled. Contingencies for making all or part of the facility an isolation area should be in place. Incorporation of state and federal assets (eg, Disaster Medical Assistance Teams) should be anticipated if these resources are available.

Plans should also address transportation to and from the site. Untraditional forms of transport may be needed because EMS assets will be challenged to meet the needs of the disaster, as well as the ongoing needs of the community.

Staff, especially those providing nursing care, are likely to be the key restriction on the number of patients who can be accommodated. In the epidemic setting, health care facilities may be unable to staff their own facilities, let alone off-site facilities, especially because their workers become ill or are unavailable because of family obligations. A plan for staffing the facility for the first few days should be arranged, ideally with a local medical reserve corps or by a hospital coalition. Planning for long-term staffing should begin as soon as a decision is made to activate the facility and is likely to be an ongoing effort.

There are many unresolved regulatory issues regarding the establishment of an off-site hospital. Certain public health regulations may or may not apply, depending on whether the facility is an extension of the hospital or

Figure 2.
Potential alternative care sites.

- Aircraft hangers
- Churches
- Community/recreation centers
- Convalescent care facilities
- Fairgrounds
- Government buildings
- Hotels/motels
- Meeting halls
- Military facilities
- National Guard armories
- Surgical centers/medical clinics
- Sports facilities/stadiums
- Trailers
- Tents
- Warehouses

Figure 3.
Factors to consider in alternative care site selection.

- Ability to lock down facility
- Adequate building security personnel
- Adequate lighting
- Air conditioning/ventilation
- Area for equipment storage
- Biohazard and other waste disposal
- Communications capability
- Door size adequate for gurneys
- Electrical power with backup
- Family areas
- Floor and walls adequate
- Food supply/preparation area
- Heating
- Laboratory/specimen handling area
- Laundry area
- Loading dock
- Oxygen delivery capability
- Parking for staff/visitors
- Patient decontamination areas
- Pharmacy areas
- Proximity to hospital
- Toilet facilities/showers/waste
- Two-way radio capability
- Water supply
- Wired for information technology/Internet access

under public health authority, which should be determined ahead of time. Liability coverage, narcotics handling, patient records, reimbursement for staff time and expenses, and the use of licensed and unlicensed volunteers are all issues that deserve mention and will require guidance or legislative efforts at the state and federal level.

LIMITATIONS AND TRIAGE

Disaster planning is often not a high priority for health care facilities, despite JCAHO¹¹ and federal grant requirements, often because of the precarious financial situation of many institutions.³⁴ Thirty-two percent of hospitals operated at a deficit in 2002, and this number is

Figure 4.

System examples.

Minneapolis/St. Paul

- Population of 2.6 million persons in 7 counties; 22 acute care and 5 specialty hospitals with approximately 4,500 beds organized under compact agreement signed April 2002, including supplying staff to regional off-site care facilities for the first 48 hours.
- Hospitals prepared to surge internally to 110% capacity at minimum, including ICU beds.
- Victims are distributed by EMS or bus to facilities with available resources by continuous Medical Resource Coordination Center. Triage/treatment points established as needed by EMS Branch Command by request to Medical Resource Coordination Center.
- Hospital patient and resource reallocation by coordination with regional hospital resource center. Unmet needs communicated to state emergency operations center by jurisdictional emergency operations center.
- An event that might prompt off-site facility establishment (eg, epidemic event) activates a regional coordination center with public health, emergency management, EMS, and hospitals present to plan response. Primary off-site care facilities are 2 large convention centers.

Massachusetts

- Seventy-four hospitals with EDs serve a population of 6.5 million people.
- Regional hospital planning groups to implement facility and community planning. These groups also incorporate representation from skilled nursing facilities, health clinics, and home health agencies. Mass care such as prophylaxis or vaccination is assigned to the local public health departments, allowing hospitals to reserve their capacity for the ill.
- Four large, state-owned hospital facilities (currently assigned for mental health care) would provide hospital-level care if off-site facilities were required.
- Volunteers willing to be preidentified will be incorporated into specific "reserve" teams assigned to a particular hospital or public health agency and issued formal identification. They will periodically train and drill with the facility or agency. These groups will include practicing health personnel ("redeployment") and "nontraditional" disaster providers such as dentists ("adaptation").
- The state expects to issue identifying decals for driver's licenses to licensed medical providers to allow quick on-scene "credential verification." Health care professions students ("promotion") or retirees ("rejuvenation") will be able to apply for such designation as well.

Colorado

- Two million people in Denver metropolitan area; 3,349,929 population, including "front range" cities up to 90 miles from Denver.
- Twenty-three frontier counties (of 63) with 6 or fewer persons per square mile.
- Regional planning efforts have included Federal Region VIII states: Colorado, Utah, Wyoming, Montana, North and South Dakota.
- Two levels of caches have been defined and are being implemented. Level I Hospital Augmentation Cache (approximately \$20,000 including trailer) is the most basic unit of supply support for 50 patients, consisting only of items that have extended shelf life: cots, linens, masks, gowns, gloves, IV poles, etc. No pharmaceuticals are included. It could be used as a supply cache for an existing hospital (eg, to set up a medical ward in a cafeteria, using other items as necessary from the hospital) or could offer supplies for an austere off-site facility. If each hospital in the Denver metropolitan area acquired a single cache, a surge capacity for 550 patients would be provided. One of these units has been purchased and has been positioned for use in the Denver area.
- Level II or Regional Alternative Site Cache (approximately \$100,000) represents a more complete list of materials to supply an off-site facility for 500 patients. Six copies of this cache are being purchased, one for each health region of the state. They are packaged in a modular fashion so material to support multiples of 50 or 100 beds could be easily extracted from the cache (similar in concept to the packaging of the Strategic National Stockpile). The supply list for this cache provides expanded support for an alternative care site compared with the Level I cache. Pharmaceuticals are excluded and only items with extremely long shelf life are included.

Northern Virginia

- Seventeen acute health care facilities serving 2.2 million residents in 8 counties and a number of incorporated cities.
- Northern Virginia Hospital Alliance was created in October 2002 to better coordinate regional hospital preparedness. Each of the 17 participating hospitals is a signatory to a regional hospital memorandum of understanding that governs the sharing of medical resources, beds, and staff as needed during a disaster response.
- Operational coordination occurs through MEDCOMM (medical communications clearing house), a voice and data communications clearinghouse located at Inova Fairfax Hospital (Falls Church, VA).
- Regional off-site surge facility located at the Fairfax County Adult Detention Center. Use of this facility is predicated on the safe transfer of the existing detention center population out of the facility.
- During a recent drill, a request for staffing was made through the regional communication system to all 12 northern Virginia hospitals, and a staff of 50 nurses and 5 physicians was immediately made available to the regional clearinghouse hospital.
- In an extended event, the largest proportion of available staff will be drawn from the hospitals according to a previously established memorandum of understanding. Another source for staffing will be home health and nonacute nursing and medical staff and interstate staffing support.

expected to increase.⁶ Furthermore, any disaster, particularly one involving a contagious organism, has the potential to financially cripple involved health care entities because of increased costs (including staff time) that are exacerbated by decreased revenues from cancelled elective appointments and procedures.

Because of limited available surplus resources,³⁵ developing significant surge capacity while maintaining usual standards of care may be difficult, especially for critical care and isolation capacity. Current federal hospital funding programs will not provide a significant increase in capacity. For example, the amount of funding received by the average hospital under the current Health Resources and Services Administration grant will not purchase the equipment in use in a single critical care room or pay to retrofit one airborne infection isolation room. Thus, creative use of “low-tech” solutions is required and may provide efficient care but will not meet the quotidian standard of care (eg, using pulse oximetry and inexpensive oxygen-flow ventilators rather than standard ICU equipment or using inexpensive in-room high-efficiency particulate air filtration rather than purpose-built isolation rooms). Considering dual use in future facility planning (eg, building oxygen supply into meeting rooms) has been explored in limited settings³⁶ and would be of great benefit but often is cost prohibitive.

In some facilities in which beds are available, staffing is insufficient because of nursing shortages, which may be exacerbated during a disaster.³⁷

A number of potential catastrophic events exist for which the health and medical response will rapidly consume available resources. Managing expectations in these situations is a significant issue for the medical community, as well as for political leadership and the general public. Triage of resources will have to occur, and patients will be provided with an adjusted standard of care. This standard may evolve during an incident. It is critical that the public understand that preparedness does not necessarily equate to availability of standard medical care during a disaster. Although triage concepts have been discussed in the medical literature,³⁸⁻⁴⁰ operational systems for health care facility-based triage, particularly of inpatients, are lacking. A system of triage in which those with the best survival probability are offered available resources that could be implemented uniformly would be of great value, particularly for epidemic events.

In conclusion, although general information exists on components of surge capacity, further research and functional exercising are required to better identify the

strengths and weaknesses of particular strategies. Such efforts will benefit greatly from the progress that is being made integrating public health and health care into emergency preparedness planning and response.

Planning for patient care surge capacity requires an immense health care facility and community effort by entities with little historical emergency planning experience. Formation of health care facility cooperative agreements and integration with public health and emergency management planning are key first steps in formulating an effective response. Involvement of political leaders is encouraged because, during a health care emergency, many of the decisions have significant political impact, and these authorities must understand the issues and trust the input of public health and health care agencies.

Incident management systems, until recently foreign concepts to many public health and private health care systems, are a necessary component of any effective disaster response. Operational plans must take into consideration the communities' resources, hazards, climate, and other unique factors. Proper planning and drilling for multiple contingencies are important and will help drive changes in response, equipment, and training.

We must be prepared to use all the resources available to ensure the best care possible for the greatest number of individuals. Although this method has always been the goal of disaster medicine, terrorism and the specter of evolving infectious diseases present us with new challenges. With a health care system that is often operating at or over capacity daily, we will never have the resources to be prepared for every disaster, but with appropriate partnerships, incident management systems, and a tiered response framework, we can be prepared to respond to any challenge.

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