

Disaster and Urban Planning for Primary and Secondary Care Sites

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Abstract

Healthcare facilities are recognizing the need for surge capacity plans that include the establishment of temporary surge hospitals. Healthcare facilities' best option for increasing surge capacity includes the use of shuttered hospitals. A shuttered hospital should only be reopened as a surge facility during a mass casualty event or communicable disease epidemic in which an isolation facility is needed. The ideal surge facility candidate would be a partially-shuttered hospital with affiliations to a tertiary hospital that could open within three to seven days of a mass casualty incident. It is important to note that surge facilities are purely relocation facilities *for stable, ambulatory patients*. Because they lack emergency rooms, surge facilities cannot serve as the initial destination for disaster scene victims. Any community contemplating the use of a shuttered hospital as a surge facility must thoroughly assess facility appropriateness and conduct thorough, advance planning to make this an option should the situation present itself. Operating an effective surge facility requires resources for facilities, staffing, security, equipment and supplies, and patient transport. Certain legal and regulatory issues will apply and plans should advise the best ways to manage a facility in light of these issues. The Joint Commission is developing a set of standards to ensure that surge facilities provide safe, quality care. Additionally, health industry experts are looking to GIS, or Geographic Information Systems, to help them perform the types of analyses and mapping useful in the planning and management of surge facilities.

Introduction

Mass casualty events, such as bioterrorism or natural disasters, have the potential to generate a significant amount of casualties. Hospitals already operating at or near surge capacity have few additional resources to effectively combat an overload at their facility. Healthcare facilities and community planners are recognizing the need for tiered, flexible surge capacity plans to effectively provide care for a large influx of patients. These surge capacity plans should reflect the establishment of temporary surge hospitals.¹ Healthcare facilities should prepare themselves for the possibility that their facility could sustain permanent damage during a disaster and may require the use of surge facilities for an indeterminate amount of time.² Healthcare facilities planning to open surge facilities should conduct thorough, advance planning to determine the best type of surge facility to utilize and the most ideal candidates in their area.

Types of Surge Hospitals

America's healthcare facilities in both urban and rural settings are operating at or near capacity with little ability to expand in response to a mass casualty event. Most facilities lack the preparation needed to effectively manage surge capacity beyond the initial response phases.³ Healthcare facilities should therefore create plans for increasing surge capacity that include the establishment of temporary surge hospitals. The Joint Commission defines surge hospitals as "facilities designed to supplement existing hospitals in the case of an emergency."² Leaders can study the various types of surge hospitals that have been used in emergency response and build a plan that reflects the needs of the community as well as the available resources. While a definitive model does not exist, planners can incorporate the use of various surge models, including facilities of opportunity, mobile medical facilities, portable facilities, and shuttered

hospitals.²

Facilities of Opportunity

These “facilities of opportunity” are usually nonmedical buildings that can be quickly adapted into surge hospitals or centers due to their size or proximity to a medical center. These facilities include veterinary hospitals, convention centers, exhibition halls, airport hangers, schools, empty warehouses, sports arenas, and hotels. Day surgery centers and other such medical facilities can be quickly converted into surge hospitals with little cost and effort due to existing relationships with vendors.² Nursing homes could feasibly serve as surge sites, although community plans often designate them as potential surge facilities prior to preliminary assessment of the facility or involvement of the facility in the planning stages.⁴ A 2005 study conducted by the Trust for America’s Health (TFAH) revealed that hospitals in fifteen states, including New York and Pennsylvania, lack adequate preparation for the care of surge patients at non-healthcare facilities such as community centers, sports arenas, or hotels.⁵

Mobile Medical Facilities

Mobile medical facilities are another type of surge hospital that can be rapidly deployed to the scene of an emergency.² The nation’s first fully equipped mobile surgical hospital, MED-1, consists of two 53-foot tractor trailers, one of which stores equipment and other becomes a patient care facility. The facility center morphs into a 1,000-square-foot workspace featuring a 2-bed shock-resuscitation and surgical unit and a 12-bed critical and emergency care unit. MED-1 also includes materials for a climate-controlled tented area holding 130 additional beds. Developing MED-1 took 3 years and approximately \$1.5 million in Federal Metropolitan Medical Response System funding. MED-1’s use in Hurricane Katrina proved its effectiveness as a disaster response mechanism, but its inherent cost prohibits many facilities from utilizing

such a facility. It costs roughly \$80,000 per year for maintenance and storage of MED-1 when not in use versus a non-mobile facility which incurs no storage cost and generates a revenue support stream by its daily activities.⁶

Existing Healthcare Facilities

Healthcare facilities can also investigate the use of portable medical facilities to address their surge capacity needs. These facilities are truly “hospitals in a box” as they can be put together quickly and can provide care in just a few hours. An up and coming prototype, the Advanced Surgical Suite for Trauma Casualties (ASSTC), has both military and civilian applications. This lightweight, all-in-one facility can be put together in less than 30 minutes and is stored within a 5 foot x 5 foot x 10 foot box. The ASSTC can be outfitted with various medications and equipment depending on the specific incident.² Logistical challenges associated with mobile facilities include the availability of plumbing and water and the high operating cost per bed.¹

Project ER One

A national prototype known as Project ER One exemplifies the ideals of an “all-risks ready” scalable surge facility.⁷ Located at the Washington Hospital Center in Washington, D.C., Project ER One serves as the model for all new emergency departments constructed in the nation.² This project aims to create a department capable of handling five times the amount of typical patients during the first two hours of an emergency. Such a department could handle 350 patients in universal patient rooms outfitted for any purpose.⁷ Project One features state-of-the-art elements including treatment areas designed to combat cross-contamination and focuses on the three principles of surge facility planning: dual use, scalability, and modularity.² The government has spent about \$3.5 million on the development phase of Project ER One and plans

on ultimately spending \$100 million for the overall project.⁷

Shuttered Hospitals and Care Facilities

Healthcare facilities' best option for increasing surge capacity is the use of shuttered hospitals. The term shuttered refers to a formerly closed hospital or healthcare facility. Communities in this country are experiencing hospital closures and conversions and in many instances, these shuttered hospitals have yet to be converted for other uses. Former hospitals carry advantages over other surge facilities such as hotels, churches, and schools because of their plumbing, wiring, and original design for inpatient care.³ A shuttered hospital should only be reopened as a surge facility in two scenarios: during a mass casualty event or communicable disease epidemic in which an isolation facility is needed.³ Any community contemplating the use of a shuttered hospital as a surge facility must thoroughly assess facility appropriateness and conduct thorough, advance planning to make this an option should the situation present itself. Facilities that fail to conduct advance planning and wait until they are in the midst of an event will not be able to open such a facility quickly in the event of a mass casualty. Truly, no type of surge facility can be opened without some degree of advanced planning.³

Evaluating the Options for Surge Capability

When evaluating the options for surge facilities, emergency planners should begin at the neighborhood level and work outward.² Planners should evaluate candidate facilities in light of specific criteria. The Agency for Healthcare Research and Quality (AHRQ) suggests that planners should eliminate as candidates those facilities that are abandoned or vacant.³ In its opinion, a totally shuttered facility could not be safely converted to an operating facility in a reasonable time frame. Additionally, an unused facility may not have functioning cafeterias,

certified life systems, and phone switchboards and any amount of physical deterioration could jeopardize patient safety. Planners should also assess location and relative real estate value to determine whether the facility will be converted to other purposes in the near future.^{3,4,5}

A more feasible candidate would be a partially-shuttered facility with affiliations to a tertiary hospital as organizational/contractual agreements would already be in place. Partially-shuttered facilities maintain some degree of inpatient services, such as walk-in clinics or urgent care and are often affiliated with “tertiary” hospitals that provide comprehensive services across the spectrum of care. Size is a factor, as larger shuttered facilities present more options for surge capacity than smaller facilities. Location becomes a factor as ideal surge facilities would be located near major tertiary medical centers in an effort to minimize patient transport times. Planners must also assess whether the facility could open within three to seven days of a mass casualty event and sustain operations for two to eight weeks, or longer if needed. The last hurdle planners will face is obtaining permission and cooperation from the current facility owners.^{3,4,5}

When Shuttered Facilities are Appropriate

The AHRQ suggests two scenarios in which using a partially-shuttered hospital as a surge facility is deemed appropriate. The first scenario involves a generic mass casualty event necessitating the transfer of ambulatory patients from tertiary care hospitals to combat the increase in surge capacity from the mass casualty victims. Hospitals would cancel all elective and non-urgent admissions and transfer as many patients to other surge facilities. Only the most stable patients would be transferred to the surge facility; critically ill patients would stay at the tertiary facility. The second scenario involves an infectious bioterrorism agent or epidemic in which the surge facility would serve as the isolation or quarantine hospital. Certain issues become relevant in such a scenario, including the prophylaxis of facility staff, perimeter control,

and obtaining permission from facility owners. It is important to note that surge facilities are purely relocation facilities for stable, ambulatory patients. Because they lack emergency rooms, surge facilities cannot serve as the initial destination for disaster scene victims. Responsibility falls to the physicians at the tertiary hospitals to determine what patients can be safely transferred to the surge facility.^{3,4,5}

Standards of Care

Surge facilities operate with the goal and intention of maintaining high standards of care. In reality, surge facilities might exist at only a sufficiency of care level due to the difficult circumstances surrounding facility operation. Substandard care is not permitted.² In order to maintain community standards of care, certain services should not be instituted at a surge facility. These include the establishment of an intensive care unit, emergency department, operating room, or a large acute burn or trauma unit. Experts advise that certain patient populations should never be relocated to a surge facility, including acutely ill oncology patients, psychiatric inpatients, and pediatric patients. These patients should remain at the tertiary hospital due to their sophisticated needs. Using a shuttered hospital as a surge facility would be an inappropriate site for victims of an airborne, infectious bioterrorism agent that has no vaccine as the shuttered hospital would most likely lack a sufficient airflow system. Surge facilities should also not serve as hospice sites for patients dying from chemical or radiation events as there will no need for a large inpatient hospice facility but more for deployment of corpse decontamination and storage.^{3,4,5}

The Role of GIS in Planning

Increasingly, health industry experts are looking to GIS, or Geographic Information

Systems, to help them perform the types of analyses and mapping useful in the planning and management of surge facilities. GIS is a computer-based system that takes advantage of location information to enhance analysis and mapping and support decision-making. Where non-spatial databases can hold classification information about things, such as *type* and *capacity* of surge facilities, it may be extremely useful for planners to also know:

- *where* these facilities are located;
- *spatial context* or what else is around them;
- *systems* they are related to (linear as well as geopolitical);
- *how far* they are from each other (and from various other facilities);
- how they are *connected*.

GIS is instrumental in enabling all of this *dynamically*. In other words, it is not necessary for the results of spatial operations (e.g., proximity or distance) to be stored discretely in the database. In considering how experts might use GIS to help plan for and manage surge facilities, it may be helpful to first discuss the basics of data, imagery, analysis, and mapping.

Data and Imagery

There are various kinds of spatial data that would be useful in planning for surge facilities. *Base data* such as roads, public transit systems, streams, geopolitical districts, etc., are often publicly available through local, county, regional, or state governments. Some of these, such as roads, are also available through commercial vendors for a fee (e.g., TeleAtlas North America, Lebanon, NH). *Aerial imagery*, either vertical or “straight-down” as well as oblique or “angular,” are often available through government sources (e.g., digital orthophotography from USGS, state, or local) or private contractors (e.g., Pictometry, Rochester, NY).

Thematic data specific to surge facility locations will likely be “best-effort”, since there are no up-to-date, standards-based national databases of surge facilities or facilities of opportunity.

Therefore, planners and leaders need to be aware of “metadata,” or data about data, to determine

usefulness and reliability of various spatial data.

Examples of spatial data useful to health industry experts planning surge facilities may include:

- Approved surge facilities
 - Recently closed hospitals
- Facilities of opportunity
 - Veterinary hospitals
 - Convention centers
 - Exhibition halls
 - Schools
 - Airport hangers
 - Empty warehouses
- Related facilities
 - Hotels (to house staff during events)
 - Ambulance service providers
 - Medical equipment and supplies providers
- Reference data and imagery (i.e., basemap data)
 - Ortho imagery (vertical imagery such as the “satellite view” in Google)
 - Transportation and routable networks (roads, rail, transit, evacuation routes, etc.)
 - Land use and zoning (institution, commercial, industrial, residential, etc.)
 - Streams and other natural features
 - Elevation data (e.g., topography and digital elevation model)
 - Political divisions (e.g., jurisdictions and other boundaries)
 - Place names and geographic names
 - Physical infrastructure (buildings, bridges, utilities, etc.)

Issues often surrounding spatial data:

- *Ownership* – who is the data “owner” and are they maintaining their data as part of a regular business process?
- *Metadata* – is there current and accurate information about data such as status, source, contact/ownership, keywords, resolution, spatial reference, etc.?
- *Access* – are data and imagery readily accessible and freely distributed?
- *Cost* – is there a cost, such as acquisition, construction, maintenance or licensing associated with data and imagery?

Spatial Analysis and Mapping

Typically, planners use spatial data to perform analysis and mapping. In other words, data and imagery are used to make a decision or draw a conclusion and the results reported or

mapped.

Spatial analytical operations that may be useful to planners of surge facilities include:

- *Proximity analyses*
 - Where are the closest surge facilities to active hospitals?
 - Which surge facilities are associated with each hospital?
- *Network analyses*
 - How many ambulance services providers are within a 30 minute drive of designated surge facilities?
 - How many surge facilities are with a 10-minute walk of a public transit system?
 - How do I get from my hospital to the nearest surge facility?
- *Overlay analyses*
 - What jurisdictional districts are surge facilities of opportunity located within?
 - Which 911 district is my facility within?

Mapping is often thought to be a static process created with sophisticated (i.e., hard to use) desktop software, used to simply report the result of spatial operations or portray a situation or relationship. However, interactive mapping, or the ability to quickly change parameters and instantly see the result, is often more useful and more suitable for these purposes. This is often done in a web-enabled fashion consumable through a web browser rather than a “heavy” desktop GIS client.

When technologically feasible, the utilization of GIS can bring together various services and data sources across the Internet (or intranet) and relies more on server-side processes rather than the desktop. Cloud computing will often lower up-front costs and allow planners to pull together data from disparate sources in a “best-effort” fashion. Conversely, there can be on-going costs related to data licensing (from commercial vendors, for example, for spatial data such as routable commercial street centerlines). However, these web services and “mash-ups” are useful in situations where data and imagery are not affordable, sources are variable, spatial operations are narrowly defined, and “best-effort,” indicator-level results are acceptable or often the only alternative in the absence of more reliable data. This should be particularly interesting

to planners and leaders working with surge facilities since there are no national data sources or standards and there is likely a narrowly-defined scope of spatial operations and mapping.

Generally, base data will be useful, supplemented with best-available information about surge facilities, facilities of opportunity, and support facilities. Spatial operations will likely be limited to data discovery and collection, basic proximity analysis, basic network analysis, and interactive web mapping to report results and enable planning and situational awareness.

Planning for the Surge

A significant degree of advance planning must occur before a shuttered hospital can be reopened as a surge facility in the immediate aftermath of a disaster.³ Response planners that incorporate the use of shuttered hospitals need to coordinate with key local authorities to institute a feasible plan of action. Local authorities should look towards the federal government for guidance during the planning phase.⁸ Planners should conduct in-depth facility assessment to select the appropriate facilities and determine the status of life systems at the facility. Planners should also estimate the cost of reopening a shuttered hospital and determine how these costs will be returned to the system. By determining what goods and services can be borrowed from other facilities, planners can decide what materials will need to be contracted out or outsourced or even obtained through disaster declaration.³ Plans should designate authority over the surge facility; ideally, a major tertiary hospital would open the surge facility as a temporary satellite location.⁸ Operating an effective surge facility requires resources for facilities, staffing, security, equipment and supplies, and patient transport. Certain legal and regulatory issues will apply and plans should advise the best ways to manage a facility in light of these issues.

The Need for Existing Arrangements

With regards to the facilities planning, certain contracts or formal arrangements should be made in advance for bulk and portable medical gas supplies and fire safety equipment. Advance contact should be established with commercial cleaning services, moving companies, refrigerated truck rentals, and medical gas mask suppliers. If the fire suppression system at the surge facility is not operational, the local fire department should be notified. Facilities workers need to conduct various activities to enhance facility structure, including water restoration, HVAC system repair, establishment of negative pressure rooms, restoration of communications systems, and partitioning off areas that will not be used. Workers should ensure adequate generator fuel supply and order additional fuel if needed. Moving companies should empty out desks or other items. Once the move out is completed, a cleaning company should conduct a thorough facility cleaning.⁸

Structural Integrity

Once facility structure is intact, planners will need to identify sources for staffing the facility. Qualified, available healthcare providers can be obtained through federal government resources such as disaster medical assistance teams and Public Health Service Commissioned Corps.⁸ Planners can look towards the Department of Defense's Modular Emergency Medical Stem (MEMS) for help in determining the number of staff needed at the surge facility. MEMS utilizes the incident command system and establishes a network for accessing patient care personnel.² State governments can also be a viable source for qualified staffing by providing public health department staff members. Other non-government sources, such as mutual aid agreements, temporary staffing agencies, and health professions schools can supply staff members if needed. Volunteer programs can be tapped as a source of both clinical and non-

clinical staff. The American Red Cross, AmeriCorps, and SeniorCorps are all excellent sources for medical personnel and volunteers. In addition to obtaining qualified staff, planners must address licensing and credentialing issues and institute a badge/ID system before staff members report to the facility.⁸

Security Forces

The security taskforce will have staffing and equipment needs. Certain formal arrangements should be secured with a radio communications vendor for portable radio communications. A security equipment vendor can provide monitoring and access control equipment, including remote door controls, card readers, and cameras. Card readers should be placed at all entrances not staffed by security. These card readers must be programmed to identify staff photo-ID badges.⁸ A contract with a satellite telephone vendor is crucial. Satellite phones can be rented if the facility lacks the funds to purchase such a system outright. Arrangements can be made with partner organizations for use of their security staff. If additional staff is needed, security firms can be contacted. Planners will need to specify response time, staffing level, uniform requirements, weapons, training, and security protocols in advance. Other security concerns include the installation of temporary chain-link fencing around the facility and the availability of traffic control devices. Local police and military personnel should be aware of surge facility plans and be briefed on possible situations and appropriate responses.⁸

Existing Supply Arrangements and the Strategic National Stockpile

Procuring the appropriate equipment and supplies takes considerable advance planning. Significant decisions include whether to buy or lease critical items and if items should be pre-ordered or placed on a standby purchase order. Inventory decisions include how much should be stored and how often items should be restocked.⁸ Surge facilities can acquire medications and

supplies through the Centers for Disease Control and Prevention's Strategic National Stockpile (SNS). The SNS, despite its extensive cache of medications, supplies, and surgical items, may not reach the designated area for several days following an extreme emergency.² According to the 2006 Trust for America's Health report, only seven states have enough preparation to efficiently distribute materials from the SNS.⁹ Even more troublesome is the fact that not a single state reported knowledge of the exact process behind the arrival of SNS supplies.⁵ The SNS, while an invaluable resource, lacks clear definition and distribution protocols.⁵ Therefore, planners should take measures to establish relationships with local suppliers in advance to supplement supplies. Ideally, a surge facility should have enough supplies to cover each patient for at least three days.²

Transportation to and from the Site

Shuttered hospitals slated for surge use will require their own patient transport services to receive patients from the tertiary medical center and also to discharge patients. Once the surge facility is ready to receive patients, patients will be transferred from the tertiary centers, mostly within the first few days. Surge hospitals have a continued need for patient transport beyond the initial days as additional patients may be transferred or discharged. Advance contracts should be established with private ambulance services. Hospitals acquiring ownership of the surge facility will most likely have existing contracts in place. Planners must take into consideration that private ambulance staff will need respiratory protection in the event of a bioterrorism incident. Also, planners should determine whether a particular ambulance company has contractual agreements in place with other facilities as this will affect their availability. Surge facility planners should coordinate with the transit authority and local emergency planning committee to ensure bus transportation during disaster situations. Plans should also reflect the availability of

wheelchair van services as secured through advance communication.⁸

Legal and Regulatory Issues

Several legal and regulatory issues surround the operation of an off-site surge facility. Public health regulations may be applicable depending on the operator of the facility, especially if the surge hospital is a satellite of the tertiary facility. Many issues will require guidance or coordination at the state and federal level, including liability coverage, narcotics handling, patient records, receiving reimbursement for staff time and incurred expenses, and matters concerning both licensed and unlicensed volunteers.¹ During emergency situations, The Emergency Medical Treatment and Active Labor Act (EMTALA) can be waived and cooperative agreements can be honored to deliver certain patients to designated facilities. A waiver of EMTALA allows the immediate transfer of critical victims from the surge facility to a predetermined facility.² The Emergency Management Assistance Compact (EMAC) allows states to distribute aid across state lines in any disaster situation. Under EMAC, licensed physicians can travel across state lines to provide aid and their credentials will be honored upon arrival. EMAC covers liability and worker compensation to lessen the financial and legal issues of responding states.^{2,3,4,5}

Isolated and Developing Populations

Regarding populations in isolated areas or the developing world, it is important that a plan be in place which *focuses on local resources and need sets*. This will allow for the population to utilize existing resources and manage the interim period between the incident and the response. Surge facilities in the area represent the best case for housing large numbers of casualties and can range from a local school, church, or an area that can be cleared out to house a population for short periods. These areas will need to have access to sewage disposal away from

the facility, water treatment (this can be as simple as an area for boiling) and, when possible, access to food and medical supplies from within the community. It is also advantageous to have a predefined list within the community of available facilities. It is important for the local community to identify regional hazards (e.g. tsunamis, earthquakes, floods, and snowstorms) and facilities that would more than likely not be affected by the incident. The combination of taking into account pre-existing resources and allowing the community to model its plan based on local resources and incident history presents the best combination mitigation techniques available for situations where resources are overwhelmed.

Conclusion

Effective operation of surge facilities requires advance planning, coordination of resources, efficient communications, and clear leadership. Surge hospitals carry inherent operational challenges and cannot be opened without detailed, thorough planning. The Joint Commission on Accreditation of Healthcare Organizations recognizes the need for a set of standards to ensure the safety and quality of surge facility operation and plans on working with facilities to institute these standards with minimal cost.^{2,3,4,5} Healthcare facilities need to work together with community planners to develop a single, organized response to increase system-wide surge capacity. Those facilities that fail to plan in advance will find themselves without options for surge hospital use. Nothing will truly test surge facility planning more so than the mass casualty event itself. Plans may look thorough and detailed on paper, but the developing situation will most likely present a different reality with unanticipated stressors. Thus, it is crucial that facilities assess surge facility resources in advance and perhaps incorporate surge facility use into disaster drills.

The combination of forethought, utilization of GIS in planning and the ultimate

development of a plan based on the available data represents a paradigm shift in decision making. Other concepts for developing more useful and reliable data and planning tools for surge facilities and facilities of opportunity include:

- *Surge-Sheds* – determine in advance which hospitals feed into which surge facilities and which surge facilities are related to facilities of opportunity;
- *Surge Facility Wiki Map* – develop an on-line, collaborative effort to catalog and map surge facilities and facilities of opportunity by various registered editors and overseen by registered or approved reviewers;
- *Surge Facility Map Service* – publish a map service that can be consumed in a standard web site;

The additional information sets available to the planner (e.g. water shed information, topographical analysis, historical data) through GIS based systems presents a wide range of opportunities by which the modern planner can determine what is best for his or her facility. Therefore decision making changes from a mere art form into a rigor-based science dependent on clear data provided by the GIS system.

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