Chapter 6

Hospital Emergency Surge Capacity

By Daniel Kollek, MD, CCFP(EM)
Preface

This chapter deals with the ability of the healthcare system to receive and treat a number of patients that rapidly exceeds the system’s routine capacity. The term for this rise in patient volume is a “surge,” and the ability to modify the system to deal with this is “surge capacity.”

The chapter also defines the various forms of surges, the phases in preparing and responding to a surge, and provides guidelines for preparing a healthcare facility to deal with them. It also provides some recommendations with regard to general disaster preparedness.

Although this chapter focuses on surge capacity in hospitals, the reader should be cautioned that patients might present to other portals of entry such as walk-in clinics, family physicians, and rural nursing stations. Many of the principles for hospitals outlined below apply to other parts of the healthcare system. The reader should also note that this chapter is not a full outline of what is required in developing a disaster plan and is meant only to review the key points that might be relevant in a surge scenario.

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Section 1: Definitions

**Medical Disaster**: When destructive effects of an event overwhelm the ability of a given area or community to meet the demand for health care.

**Mass Casualty Incident**: A disaster in which healthcare delivery is overwhelmed by the large number of individuals requiring care.

**Surge Capacity**: The ability to handle massive, rapid overload of emergency services. This is broken into a variety of subsets (see Table 6-1).

### Table 6-1 Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Surge Capacity</td>
<td>Ability to manage a sudden unexpected increase in patient volume that would otherwise severely challenge or exceed the capacity of the current healthcare system.</td>
</tr>
<tr>
<td>Surge Capability</td>
<td>Ability of the healthcare system to manage patients who require specialized evaluations or intervention (e.g., contaminated, highly contagious, or burn victims).</td>
</tr>
<tr>
<td>Public Health Surge Capacity</td>
<td>Ability of the public health system to increase the capacity not only for patient care but also for epidemiologic investigations, risk communication, mass prophylaxis or vaccination, mass fatality management, mental health support, laboratory services, and other activities.</td>
</tr>
<tr>
<td>Facility-Based Surge Capacity</td>
<td>Actions taken at the healthcare facility level that augment services within the response structure of the healthcare facility. This may include responses that are external to the actual structure of the facility but are proximal to it (e.g., medical care provided in tents on the hospital ground). These responses are under the control of the Facility Incident Management System and primarily depend on the facilities’ operational plans.</td>
</tr>
<tr>
<td>Community-Based Surge Capacity</td>
<td>Actions taken at the community level to supplement healthcare responses. These may provide for triage and initial treatment, nonambulatory care overflow, redirection, or isolation (e.g., offsite “hospital” facility).</td>
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</tbody>
</table>
Section 2: Surge Timing

In considering surge capacity, it is important to recognize that there are, in fact, 2 kinds of surges that occur in an emergency setting.

- **Sudden or “spike” surge**: This is a sudden influx of patients secondary to a specific time-limited and nonrecurring event such as a major motor vehicle accident, a chemical spill, or a bomb explosion.

- **Prolonged surge**: in which the intake of new patients continues over time and when it is harder—although not impossible—to project when the demand will plateau or decrease. A prolonged surge is more typical of biological events such as an epidemic–pandemic influenza or seasonal issues such as the heat waves experienced in France.

The type of surge event can often be anticipated based on the type of disaster. For this purpose, it is useful to classify disasters as static or dynamic (see Table 6-2 for the complete Potential Injury Creating Event (PICE) classification).

- **Static events**: are events where the cause of the injury or illness ceases after a finite time period and the number of victims is finite. This will often cause a spike surge.

- **Dynamic events**: are ongoing situations where new patients are being recruited on a continuous or recurrent episodic basis causing a prolonged surge.

It is important to note that surges may be a combination of “spike” or “prolonged” or mixed, particularly in a prolonged event where there may be an initial spike followed by ongoing demands placed on the healthcare system.

Table 6-2: PICE Classification System

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Stage</th>
<th>Need for External Aid</th>
<th>Status of External Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td>Controlled</td>
<td>Local</td>
<td>0</td>
<td>None</td>
<td>Inactive</td>
</tr>
<tr>
<td>Dynamic</td>
<td>Disrupted</td>
<td>Regional</td>
<td>1</td>
<td>Small</td>
<td>Alert</td>
</tr>
<tr>
<td>Paralytic</td>
<td>National</td>
<td></td>
<td>2</td>
<td>Moderate</td>
<td>Standby</td>
</tr>
<tr>
<td>International</td>
<td></td>
<td>3</td>
<td>Large</td>
<td>Deployed</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Disaster Medicine online and Rosen (1999), Koenig (1996).

Section 3: Surge Phases

Similar to the classification of disaster management, the response to patient surges can be divided into phases. These would include the following:

- **Planning phase**: During this phase, the healthcare system has an opportunity to plan its response for when an event occurs. The disaster management cycle equivalent would be the *mitigation and planning phases*.

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**Warning or presurge phase:** During this period of time, the healthcare system is aware of the upcoming need to process a large number of patients and activate its plan. This phase can range from months in advance (in the event of a known bioevent where there is a lag between the index case and the epidemic peak) to only minutes (when patients present to the emergency department (ED) having been exposed to noxious substance such as the Tokyo subway Sarin attack). During this phase, the healthcare system deploys its resources as per the appropriate disaster plan.

The **intake and treatment phases:** This is the actual period of patient care. The disaster management cycle equivalent to this would be the *response phase.*

**Intake phase:** This is a period during which patients are actively presenting to the healthcare system in need of treatment. The intake phase of a surge event will vary in its duration based on the type of event that has occurred as outlined above. It is during this phase that patients are triaged into treatment streams and decontaminated if necessary before registration.

In a surge, particularly a sudden surge, patients do not present randomly. When a large number of injuries occur, the first wave of patients presenting to the healthcare system are patients who have self-extricated, self-evacuated, and are able to walk. These patients are usually less ill or injured—needing care nonetheless. They are followed by the second wave of patients who require prehospital/EMS support to bring them to treatment. It is important to avoid consuming all resources on the less ill before the arrival of the more acute patients. This “reverse triage” occurred in London during the July 7, 2007 bombings when many of the priority 3 patients arrived before the priority 1 and 2 patients who had long extrication times.

**Treatment phase:** This is when patients are treated for their illness or injury. This phase would include acute care treatment as well as long-term, chronic, and rehabilitative treatment.

**The recovery phase:** At this point, having dealt with the surge, the healthcare system returns to a “neutral” status and prepares for its next surge. This phase must include a reflective and evaluative component to integrate whatever lessons may have been learned from the disaster into future plans. This is the same term used in the disaster management cycle.

These phases are not exclusive and will often overlap. Intake will continue during early treatment, planning and organization can continue during this time, and future planning can occur throughout the event.

### Table 6-3: Surge Phases in the Disaster Cycle

<table>
<thead>
<tr>
<th>Disaster Management Cycle</th>
<th>Surge Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation</td>
<td>May take place as part of recovery and planning phases</td>
</tr>
<tr>
<td>Planning</td>
<td>Planning phase</td>
</tr>
<tr>
<td>Response</td>
<td>Intake and treatment phase</td>
</tr>
<tr>
<td>Recovery</td>
<td>Recovery phase</td>
</tr>
</tbody>
</table>

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Section 4: Present Status

The term surge “capacity” is somewhat of a misnomer, in that it implies the healthcare system has some surplus capacity to accommodate increased patient loads. This is untrue. It is important to recognize that hospitals across Canada, and particularly emergency departments, have been functioning in a chronic surge capacity status. This challenge does not only occur in Canada but is also present in many other developing and developed nations.

The overcrowding of emergency departments is probably the largest impediment in our healthcare system to deal with any surge event. Hallway patients and those waiting in emergency departments because of a shortage of space in wards are effectively occupying the “extra” capacity required should there be a sudden surge of new patients. Dealing with this issue must receive high priority in any healthcare system that wishes to prepare itself for disaster.

Solving the problem of overcrowded emergency departments would improve hospital flow-through and function—a huge benefit in nondisaster settings. The system of the British National Health Service (NHS), which is closer to ours in function than the healthcare delivery in the United States, has demonstrated that the problem of ED overcrowding can be successfully dealt with.

Key Strategies in Dealing with Surge Events

The strategies below are arranged by the phases in which they apply. As mentioned earlier, there is much overlap and the classification has been occasionally arbitrary. Unless otherwise specified, the following strategies are applicable to both spike surge events and prolonged surges.

Section 5: Command and Control During a Surge

The command and control aspect of responding to a surge event is part of a much larger topic of incident management. I will not dwell on this in this chapter other than to mention that a structured and organized Incident Management System (IMS, also known as Incident Command System [ICS]), is a critical component in responding to any kind of disaster. This has, in fact, been recognized by a variety of authorities and is gradually becoming accepted across Canada. More details on IMS can be found in Chapter 4.

Section 6: Risk Assessment

Facilities cannot plan unless they know what they are planning for; yet, there is currently no published Canadian tool designed to review the impact or likelihood of disasters for Canadian hospital risk assessment. In view of the large variability of disasters and the large variability of risk faced by different hospitals, this lack poses a significant problem. The Centre for Excellence in Emergency Preparedness has designed a risk assessment tool that can be found in Chapter 2.

Whatever plan a hospital develops, it is critical that an initial environmental risk scan is carried out and an annual review conducted to ensure the hospital functions.
Disaster Preparedness for Healthcare Facilities

plan stays relevant to the risks at hand. Table 6-4 outlines risks by category. The hospital has to formally review the probability of each type of potential disaster, what the impact of that occurrence would be, and what preparedness plan is in place to meet that event.

Table 6-4: Hazard List Divided by Categories

<table>
<thead>
<tr>
<th>Natural Disasters</th>
<th>Technological Disasters</th>
<th>Man-Made Disasters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Thunderstorm</td>
<td>Electrical Failure</td>
<td>MCI—Trauma</td>
</tr>
<tr>
<td>Snowfall</td>
<td>Generator Failure</td>
<td>MCI—Medical</td>
</tr>
<tr>
<td>Blizzard</td>
<td>Transportation Failure</td>
<td>MCI—Hazmat</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>Fuel Shortage</td>
<td>Hazmat—External</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Natural Gas Failure</td>
<td>Terrorism—Chemical</td>
</tr>
<tr>
<td>Tidal Wave</td>
<td>Water Failure</td>
<td>Terrorism—Biological</td>
</tr>
<tr>
<td>Drought</td>
<td>Sewage Failure</td>
<td>Terrorism—Radiological</td>
</tr>
<tr>
<td>Flood—External</td>
<td>Steam Failure</td>
<td>VIP Situation</td>
</tr>
<tr>
<td>Wild Fire</td>
<td>Structural Damage</td>
<td>Infant Abduction</td>
</tr>
<tr>
<td>Landslide</td>
<td>Fire alarm Failure</td>
<td>Hostage Situation</td>
</tr>
<tr>
<td>Volcano</td>
<td>Communications Failure</td>
<td>Civil Disturbance</td>
</tr>
<tr>
<td>Epidemic</td>
<td>Medical Gas Failure</td>
<td>Labor Action</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Medical Vacuum Failure</td>
<td>Forensic Admission</td>
</tr>
<tr>
<td>Infestation</td>
<td>Information Systems Failure</td>
<td>Bomb Threat</td>
</tr>
<tr>
<td>Hurricane</td>
<td>Fire—Internal</td>
<td></td>
</tr>
<tr>
<td>Tornado</td>
<td>Flood—Internal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hazmat Exposure—Internal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Failure</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: MCI, mass casualty incident.
Adapted from AHA documentation.

Section 7: Impact Assessment

Because of the nature of surge events, surge planning needs to incorporate a projection of required resources. The most critical of these are beds, staff, equipment, and supplies. The need for each of these would be a function of
the nature of the event and the capacity of the system (see below for specific comments). In the absence of a critically appraised resource projection tool, the best alternative is to perform a formal risk analysis, identifying potential likelihood of high-impact disasters. Once a list of potential scenarios that require planning has been generated, each scenario can be reviewed with the local content experts.

There are a few assumptions that can be made about the pattern of resource consumption in a surge:

1. **The nature of the resources consumed** will depend on the clinical impact of the disaster. For example:
   a. Patients admitted to an acute care facility for an infectious disease may require individual or cohort isolation.
   b. Patients from a contaminated event will require decontamination at the hospital.
   c. Specific illnesses will require specific medications, possibly in doses that far exceed the usual (i.e., atropine in nerve gas exposure).

2. **Patient length of stay (LOS)** will vary depending on the type of pathology caused by the event. For example:
   a. Mass trauma patients will require large numbers of hospital beds initially but, after definitive care has been delivered, may be transferable to nonacute facilities if such exist.
   b. Patients admitted to an acute care facility for an infectious disease may require a longer LOS.
   c. Some chemical or radiological exposure may require very little initial bed use (after decontamination) but may require long-term clinic use and significant public health tracking.

3. **The speed, timing, and duration of resource use** vary, depending on the event type.
   a. Trauma or chemical mass casualty incidents (MCIs) will create a sudden but limited unimodal surge of patients with a very short preparation time at the local (primary) receiving facility.
   b. Biologic events will gradually increase demands on the healthcare system with a delayed peak of resource consumption and may be bi- or multimodal (have more than 1 peak with waves of infection).

4. **The availability of intake beds** at a specific facility will depend on the following:
   a. The number of empty staffed beds in the institution.
   b. The number of closed beds in the institution that could be opened if staffing was available.
   c. The ability to discharge existing patients or transfer them to alternate-care environments.
   d. The ability to create previously nonexistent “surge” beds (see Section 8.2).
e. The availability of nearby facilities (not necessarily hospitals) to receive overflow patients or to intake patients in the event of an evacuation. This requires that an evacuation/overflow plan exist and that prior negotiation with receiving facilities has taken place (see Section 8.2.7).

**Section 8: Planning**

Once risk and impact have been assessed, it is possible to proceed with disaster planning. Hospitals must have a plan of response to any disaster that is either likely or of high impact. Although almost all hospitals in Canada have plans, 10%–30% have not reviewed their plans, of those that have, the majority has not reviewed them within the past year, and more than 50% have not carried out a full practice exercise in over 3 years.8

**Section 8.1: Common Misconceptions**

There are common erroneous assumptions in planning for disaster-related surges.9 These assumptions are as follows:

1. ** Victims will arrive via the Emergency Medical Services (EMS) system.**
   The Tokyo Sarin attack is an excellent example of what actually occurs in a disaster “spike” surge. Of the 640 patients at a hospital, 541 came without EMS; they came independently—by cab, by car, or carried by their friends.

2. ** Patients will only go to designated hospitals.**
   Because patients do not know the disaster plan and most arrive independent of EMS, the tendency is for them to go to the nearest hospital or the hospital with which they have the most familiarity or comfort.

3. ** Victims at a nondesignated facility can be safely transported to the appropriate site.**
   It is highly unlikely that during an MCI, patients can be transferred from one hospital to another. There may be a lack of access to ambulances that are still dealing with patients incoming from the site, road access may be unavailable, or the appropriate hospital is on the other side of the disaster area. Even more crucial, the hospital may itself be the disaster area.

4. ** Victims will be decontaminated on scene before arrival at the hospital.**
   In a 6-year review of 72 major contaminated incidents in the United States, not a single patient was decontaminated before arriving at the hospital. In most cases, patients who are ambulatory will leave before the decontamination crew arrives; and patients who are nonambulatory may be decontaminated if contamination has been recognized.

**Section 8.2: Bed Management**

With any scenarios involving large numbers of patients, there must be a plan for where to put these patients. If a large number of nonambulatory patients is
anticipated, the accommodation required must enable these patients to lie down. If the absolute number of patients exceeds the number of existing beds, then beds must be added to the system. These do not need to be full hospital beds, and solutions can range from folding canvas stretchers to using collapsible bed frames with foam mattresses. Whatever the solution, the appropriate material should be stored in a safe place and in proximity to its deployment point.

An effort needs to be made rapidly to clear the ED. This is important because the ED will be the triage and resuscitative area for the most severely injured patients who do not go directly to the operating room (OR).

The steps involved in maximizing the number of beds available are as follows:

1. **Stopping all elective activity.**
   
   Immediately advising the appropriate hospital authorities to cancel elective procedures and elective admissions. This would involve discharging patients booked for elective procedures that have not yet occurred and advising all patients coming in for elective procedures that their procedure has been deferred until further notice.

2. **Expediting patient discharge.**

   Expedited discharge needs to occur for all patients for whom this is safe, and patients cleared to leave should be immediately moved (along with appropriate documentation) to a discharge area to clear the ward bed for the incoming casualties. The discharge area should be a location where they would not interfere with the clinical care being delivered and where the picking up of these patients will not interfere with incoming patient traffic flow. The discharge area should be able to handle a variety of levels of care, as some of the discharged patients may be nonambulatory, be appropriately staffed, and have access to telephone and the hospital’s computer system.

   An up-to-date tracking system is essential to prevent “lost” patients. St. Mary’s Hospital in London, England, cleared 100 acute beds in the first hour of the July 7, 2007 London bombings. ⁰

3. **Transferring nondischargeable patients to other care environments, such as hospitals away from the disaster.**

   Note that in the case of a sudden surge, it is possible that patient transfer capabilities will be severely strained. Planners may not be able to rely on ambulance transfers from one facility to another. In such a situation (and if the medical condition of the patient allows), it may be reasonable to consider alternative transfer modes such as taxis, buses, or transfer by family.

4. **Assessing patients who cannot be discharged or transferred to other sites.**

   This review would consider the patient’s need for a ward bed as opposed to a chair or a clinic setting within the hospital. Can they be cared for elsewhere within the facility? (See point 6 for further details.)

5. **Expanding inpatient units.**

   Each inpatient unit needs to have a plan that will allow it to increase its capacity by adding beds to an existing environment or beds to hallways.
There needs to be a predetermined number that can go from the ED to the wards (e.g., a ward may accept 2–4 extra beds). The location of the added beds and the allocation of care staff to those beds need to be defined ahead of time.

6. Creating new inpatient units within the hospital.

Consider inpatient flow, moving ward patients who cannot be discharged or transferred into hallways to make ward beds available for incoming patients. Israeli hospitals have bed caches that can be deployed to corridors and lobbies already equipped with “hardwired” oxygen and power outlets. There is dedicated staff that, in a disaster, will shift from its usual work location to a new patient care area. In a very short period, a hospital can establish a series of new “wards”—staffed and equipped. The hospital makes the decision to relocate known, stable patients to these makeshift areas, clearing the usual wards for intake, or to intake directly to the “new” wards—or a combination of the above.

7. Establishing nontraditional treatment areas away from the hospital.

A good example of this is in Moscow where, according to interviews with the city planners, the city can add anywhere from 5000 to 9000 beds within a matter of hours. This is done by deploying hospitals that are stored in subway stations, taking advantage of their large corridor areas and the natural shelter they provide in all weather. Doctors and support staff at specific hospitals are designated to respond to a specific station in their sector of the city. Some equipment is securely stored in the station (this includes hardware, but no medications). In the event of a deployment, the physicians take medication and equipment that is prepackaged and relocate to the station; staff on-site in the station deploys beds and other hardware. This has been repeatedly drilled and it is apparently extremely smooth. It is coordinated with the civil defense authorities, and the claim is that approximately 50% of the stations can have some form of hospital deployed in them. Another option is using hotels or community centers.

Section 8.3: Staffing

The 2 key issues in staffing during a disaster include staff availability and staff training.

Availability

It is important to identify key staff positions in all responding organizations and healthcare facilities and to develop a staffing plan that would include the following:

1. A fan-out procedure to call in staff as well as an update process to keep contact information up-to-date. This is also known as a “cascade call-out” and should be preset in the switchboard. In addition, each clinical area needs a list of staff contact details with an idea of ETA so that the nearest staff can be contacted first. Another option could be mass calling software or an autodialing package if this is available to the facility.

2. A list of roles that must be filled and their priorities.
3. A shift schedule to relieve the staff and avoid exhaustion (both of the individual and the organization).

4. A process for accreditation of medical staff across facilities within a region in the event of mutual aid.¹¹

5. A plan to relocate staff within and between facilities including orientation and safety briefing as required.¹¹

6. Daycare for the children of hospital staff and children of victims if appropriate.¹²

7. Sleeping quarters, toilet facilities, and food for staff who cannot go home or would not be able to return for further duty if they did.¹²

8. A communication plan allowing staff to call home at scheduled times while preserving the integrity of the hospital switchboard. The prevalence of mobile phones may make this unnecessary, however the mobile phone system might not be functioning well in a mass casualty incident.

9. A process for the safe integration of volunteers and their allocation to appropriate tasks.

10. A training schedule with at least 1 exercise every year.⁷,¹³–¹⁵

Training

In ideal disaster plans, staff would perform tasks with which they are familiar and that are close to their usual (nondisaster) roles. Having said that, in a disaster scenario hospital, the staff will likely be treating patients at a different rate to which they are accustomed. They may be assigned to unfamiliar teams and using unfamiliar equipment. It is critical that they learn to adapt to working in these new situations and that they learn their new routines until following them becomes automatic. Disaster staff must know how to continue to work wearing any necessary personal protective equipment (PPE), specifically if they are dealing with a contaminated disaster. If the staff are not trained to work in a contaminated environment, or if they do not know how to put on, take off, and maintain their equipment, morbidity and potential mortality among staff are likely, in addition to not being able to provide adequate care. Wearing protective equipment may muffle speech, and so staff wearing protective clothing need some effective method of communication with which they are already familiar to enabling them to perform complex tasks such as decontamination or intubation. Training may need to be expanded to the security staff who may be involved in crowd control.

Section 8.4: Equipment

It is essential that required equipment be stored in a safe place. Items stored in public environments for a long period are not secure; disaster equipment must be kept locked.

Supplies need to be stored close to where they will be deployed. It is unsafe to rely on “just-in-time” supply delivery in a disaster scenario, because the facility may not have access to the supply dump or the transportation capability to deliver supplies. The motto in disaster planning is not “just in time” but “just in case.”¹⁶

A restocking or supply rotation plan needs to exist for supplies that may expire or “stale date.”
Supplies need to be *appropriate* for the anticipated population and must take into account the local demographics. For example, if a large pediatric population is expected, the equipment must include pediatric supplies such as Broselow tapes and kits. For more details, see Chapter 8.

All equipment has to be laid out for use in a standardized fashion. For example, if designated intubation stations are part of the disaster response plan, all intubation trays need to be identical so that staff, when deployed, can easily find the item they require regardless of which intubation station they are deployed to. Generally speaking, the more one can standardize throughout the disaster plan, the smoother things will run. The less problem solving people will have to do, the less they need to adapt from location to location. There is already recognition of this in today’s medical environment in that we have standardized kits for procedures such as central line kits, chest tube trays, and so on.

A common problem in the present hospital environment is that most procedural trays look the same and are wrapped in the same color towel or cloth wrapping, requiring the reading of labels every time to pick out the appropriate tray for the procedure. This may be difficult in a disaster scenario because of time, lighting, or decreased visibility due to PPE. To quickly identify the package contents, they should be listed in large letters on the outside and, ideally, kits should be color coded for easy recognition (intubation tray in blue, thoracotomy tray in red, etc.). Beware that this does not become confused with Broselow kits that are also color coded. A “stack” system for supplies is helpful, so cages full of relevant stock can be pulled out to use for resus/minor/major areas, and so on.

To ensure interoperability, it is important to integrate equipment with responders from other facilities and with first responders. In London, England, the regional health authorities have mandated that hospitals purchase equipment from a certain list so that any hospital can provide mutual aid and equipment to other hospitals in a disaster scenario. In Israel, in the past, ambulance crews delivering a patient in a disaster scenario could drop off a patient with his/her stretcher, and because the equipment was compatible, they could leave their stretcher and replenish their equipment from the hospital stores, allowing them to avoid transferring the patient to another bed, and quickly return to the scene and pick up the next patient.

### Section 8.5: Defining Patient Flow Route with a Forward Triage Point

In an MCI, large numbers of patients will present to the hospital attempting to access care or seek out loved ones through a variety of entrances. This can disrupt care and lead to chaos in the building. In the event that the disaster is contaminated, uncontrolled traffic can put patients, caregivers, and the public at risk. It is important to control all access to the building, as well as maintaining separate areas for decontamination and treatment (“hot” and “cold” zones).

The role of the security staff is crucial in guiding patients. Patients arriving will not know the building layout. The same applies to support staff from other hospitals or first responders from the public sector. Thus, it is critical to organize the flow of patients and staff.

The 2 key ground rules in flowing patients efficiently are as follows:

1. Flow is *always* unidirectional.
2. Initial triage should be as far forward as possible.
Patients must flow from the triage/arrival area to the appropriate treatment area (see below) and from there, hopefully, to discharge. It is important that this forward motion be maintained to maximize a patient flow through and to prevent patients “recycling” to the triage area where they will cause confusion, clog the system, impair statistics, lead to multiple registrations, and possibly contaminate the care area.

The decontamination process, if required, should take place between first (minimal) triage and treatment areas. Patients who have already been cleaned off should never return to the contaminated area, and if this occurs, they need to be fully decontaminated again. These patients pose the risk that if recontaminated, they bypass the showers (with the claim that they have already been washed) and spread the contamination to the hospital. Thus, particularly in a contaminated disaster, the flow of patients must always be in one direction only. The same also applies to staff who may be unfamiliar with plans or layout of the area.

To facilitate patient flow through:

1. It is critical to provide good signage.
   a. Signs could be printed ahead of time, be large, very clear, and in the languages of the local population.
   b. The signs should be able to stand-alone or have a prearranged place where they can be put without the need for tape, Velcro, or special tools.
   c. Every sign should have its own predefined location marked on a deployment map and also on the ground/wall at the signs location. In the event of activating of the plan, staff simply go to the sign storage area, pick up a sign, go to that sign’s predetermined location on the map, verify that the location is current, and place the sign accordingly. Attention should be paid to the risk of misplacing signs with arrows that may be in the right location but facing the wrong direction.

2. All staff have to be very clearly identified.
   a. Individuals need to be identified by the role they will be playing in the disaster plan.
   b. Identification methods must be such that the hospital staff cannot be confused with other people who will be responding from the scene (i.e., paramedics, fire, police, etc).

   Hospital badges, although commonly used, will not be adequate in a large MCI. It is better to have vests in a reflective and very obvious color, or a series of colors identifying the various roles of the individual responders. It is useful to have the individual’s role written on the vest so that people unfamiliar with the color code can see a vest labeled “intubator,” “physician,” “nurse,” and so on and know to whom they are talking.

3. Mark the patient’s route in some obvious fashion on the wall or the floor.
   In many Israeli hospitals, lines or arrows on the floor act as guides for people to follow. This is important for a variety of reasons. First, the triage officer will not need to explain the route (which can be difficult if wearing a gas mask) but simply advise patients to “follow this yellow line until the next staff stops..."
you.” Second, this will decrease confusion when there are language issues or complex instructions. Third, this will make it obvious where the different areas are because they are physically demarcated in the field.

4. Operations must be able to continue despite both noise and darkness.

Planners must consider either a public address system (ideally with at least one portable microphone or a bullhorn) or some other method that will allow them to coordinate the crowd and be heard. Caregivers also need to be able to light up the area very powerfully so as to be able to operate at night and while wearing equipment that might interfere with vision (such as a Stryker hood or a gas mask). As far as lighting is concerned, this should be built-in and not mobile. Mobile equipment gets lost, breaks down, and requires batteries to be kept charged as well as staff and time to deploy, whereas hard-wired lighting can be turned on with the flick of a switch and is stable and secure. This assumes that the hospital has a secure electrical supply. Battery backup is still useful, however a built in system is important.

5. Place the triage point(s) as far forward as possible so as to triage the patients to the correct areas of care as early as possible. Ideally, initial triage should be distant from the actual care areas of the hospital.

Patients arriving at the hospital will vary in their acuity. Although some may be triaged in the field, the first presenting patients (those who self-extricated and self-evacuated) will likely arrive independent of EMS and will not have been triaged at the scene of the event. Patients need to be directed to different areas based on their triage level reserving the acute care areas for the sicker patients and separating the stream of patients who are less acute (or the “worried well”) to areas that will consume fewer resources.

There should be more than 1 triage point, initially sorting patients into ambulatory (“minor” or green-tagged patients) and nonambulatory then, at a second triage point, further subdividing the nonambulatory into “delayed” (yellow tag), immediate (red tag), or expectant/deceased (black tag). This also allows for reassessment of the patients. For further information, please refer to Chapter 5.

The sooner patients are divided into treatment streams, the easier it is to direct them to the appropriate treatment areas of the hospital. For example, if all victims present to the ED, then that area will rapidly become crowded and dysfunctional. However, if triage occurs in the parking lot, minor patients can be diverted to an alternate area such as the hospital lobby keeping the ED free for those patients requiring resuscitation (see Figure 6-1).

![Figure 6-1: Triage and patient flow.](image-url)
The same rule applies to scene response. In Moscow, a doctor is on scene at the disaster and decides which hospital will receive the patient. This is an interesting idea when compared to the Canadian scenario in which an ambulance dispatcher makes a decision at a distance from the actual event and based on second-hand information provided to him or her by the EMS crew. It must be recognised that this forward triage model refers only to patients arriving by EMS from a specific event. The equivalent in a pandemic situation would be to designate off-site assessment areas and use the media to direct patients to present there for initial assessment. Patients presenting to another site not designated for intake would, assuming this is clinically safe and operationally feasible, be redirected to the appropriate intake site.

6. Use all possible accesses to the hospital.

The triage officer should ideally be outside the hospital where the ambulances and ambulatory patients are arriving and direct the crews to drop the patients off at different areas, thus dividing the patients up into streams of treatment before entering the building. This will prevent crowding and confusion to any one area in the hospital. Obviously there are weather considerations to be kept in mind. It is harder to do this in the depths of winter; if the triage point is unsheltered, one may have to take all patients into one area within the hospital and divide them up later, which is far from ideal.

Section 8.6: Establish Dedicated Treatment Areas for Patients of Specific Triage Levels

It is important to have separate areas within the hospital for the treatment of different types of patients. Each of these areas should be staffed with healthcare staff with an appropriate skill set. For example, the acute care resuscitative area should be staffed with senior physicians, anesthetists, and a higher nurse to patient ratio, whereas the ambulatory/minor injury area may be only staffed with clerical staff, and in a teaching hospital, junior residents and medical students.

Each treatment area must have defined and fixed investigation and treatment protocols. The purpose of this fixed protocol methodology is to ensure that every patient coming in gets the same initial treatment and that treatment is not delayed waiting for a physician. The nurses would be authorized to initiate care using medical directives and, as the physicians catch up, the individual patient treatment plan can be fine-tuned.

There are patterns of injury in MCIs that lend themselves to care maps. For example, if an area is designated for walking wounded and minor injuries, this could be staffed by more junior staff with the instructions to perform basic first aid and minor procedures, provide analgesia, discharge wherever possible, temporize with the other patients, and reassess periodically. This will be different from an area designated for sicker, nonambulatory, patients where the protocol may include establishing intravenous access and drawing specific bloodwork, which would be the same for all patients from the scene of the disaster regardless of their history. Note that, although patient care supersedes criminal investigations, it may be helpful to have procedures in place to determine chain of evidence for samples collection.
The only area with significant variability in care plans should be the resuscitation area, where each patient will be treated individually based on the cause for his or her critical condition. Having said that, in a disaster situation, some patients who under normal conditions would have been provided resuscitation may receive only palliation, if it is decided the patient is not salvageable with the resources available at the time.

**Section 8.7: Prepare a Decontamination Plan**

In the event that patients from the disaster have been contaminated with a noxious substance, decontamination has to take place before entering the hospital. In Canada, 57% of hospitals state that they do not have a decontamination area, 5% do not know if they have one, and only 31% of hospitals report that they do.8

In the United States, by comparison (pre 9/11 data), 44% of the US facilities in one survey had the ability to receive any chemically exposed patient, 39% had no designated decontamination facilities, and 30% had no protocol for handling chemical contamination.17

In every decontamination plan, there has to be a *decontamination area*. This is an area where the patients can be washed, ideally after undressing, and provided with uncontaminated clothes to wear. The decontamination area should be outside the ED and not within the building wherever that is possible. If it is within the building, then there should be a method of isolating and evacuating the air and fluid runoff so as to avoid contaminating the rest of the facility.

Decontamination areas must be able to accommodate both ambulatory and nonambulatory patients and should be able to function in all relevant weather conditions. Consider areas that would not be normally used for patient care, such as service corridors, and so on, where patients could enter at one end, discard their clothes, walk through built-in showers, and exit at the other end to receive clean clothes. This has been the plan for several years in some hospitals in Washington.

Patients who cannot walk need to be decontaminated on a stretcher or backboard. There are a variety of tools for this, from “roller” systems to decontamination beds that are designed for the patient and the bed to be hosed down simultaneously. Whatever option the facility chooses, it is important to have the equipment and train the staff to operate that equipment.

*What is most important is that the intake process of patients in a contaminated or noncontaminated disaster should be the same with the added step of decontamination if required.* Keeping these processes as similar as possible will minimize confusion, allow for training staff on one set of emergency guidelines only, avoid the need and cost for exercising different kinds of processes, and minimize the amount of documentation required in preparing disaster plans for hospitals. Further details on dealing with a contaminated disaster can be found in Chapter 12.

**Section 8.8: Organize the Data Flow**

In the Tokyo Sarin Disaster, 640 patients presented themselves to St. Luke’s Hospital within 90 minutes. Of those, 541 came independent of the EMS system. Even if it took only 1 minute to register each patient, intake would have taken more than 10 hours. *It is not possible to use the normal process of registration in an MCI.* In preparing for an MCI, a number of charts must be preprinted and

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preregistered in the facility’s computer system. The number of charts required will depend on the facilities’ risk assessment. The preprinted charts and the preregistration ensure that the patients exist (as anonymous entries) in the computer system with laboratory work preordered, specimen stickers available, armbands are preprinted, and so on.

On arrival to the treatment area, the patient is allocated a number from the bank of preprinted charts, and this number is their hospital Unique Number (UN#) throughout their visit.

The only medical history that should be elicited from the patient on arrival is their premorbid status, medications, drug allergies, and some history of the present illness (what injuries the patient actually suffered). The mnemonic for this is AMPLÉ—Allergies, Medications, Past History, Last meal, and the history of the Event.

Only later, and when time allows, should the clerical staff return to the patient and collect the other demographic data (name, address, etc.) and “marry” this data with the UN# disaster chart. This clerical work can be deferred if the registration staff is still overloaded by incoming patients. It is important to recognize that there are going to be a variety of labels on these patients including, hospital armbands, triage tags, and their own personal identifiers such as provincial insurance number, and so on.

In regional plans, it may be worthwhile allocating distinct numbers used by each of the hospitals within the region to prevent duplication and to allow central planners to use the UN# to identify immediately which hospital a patient came from. This would be more relevant in smaller communities where there may be 2 hospitals intaking patients from the same disaster and it would help to avoid confusion if there is only 1 chart with a certain number or prefix immediately identifiable as originating from hospital A as opposed to hospital B.

**Section 8.9: Other Plan Components**

In addition to the usual disaster plan components, it is important to include the following:

1. Identification of partners such as the Red Cross, Salvation Army, and local industry that can assist in a disaster.\(^7\)

2. Identification and plans to cooperate with other healthcare facilities (including but not limited to hospitals)\(^7,11\) and the prehospital emergency response teams.\(^12,18\)

3. Identification of key staff and volunteers in all responding organizations and healthcare facilities and development of a staffing plan (see below).

4. Outlining supply and waste disposal plans.

5. Defining alternate treatment and housing areas in case the hospital is the disaster site.\(^7\)

6. Specifying an explicit chain of command\(^6,13\) and communication process\(^12\) (see Chapter 5).

7. Establishing an exercise schedule, both tabletop and full scale, that involve all responding agencies\(^7,13\). Full drills should take place at least once yearly to avoid the situation in which the executive level has been trained but the frontline responders have not\(^13–15\). Drills should be used to identify process issues that impede care and should be critiqued.
Section 9 Warning Phase

Time between the warning of an impending event and the arrival of patients is variable. Good coordination with the public health authorities and other groups that can provide early warning (such as fire, police, and EMS) can maximize the duration of this phase and provide added preparation time to the hospital. The warning phase can be extended by improving:

a. Syndromic surveillance
b. Diagnostic surveillance
c. Transmission of relevant risk assessment information to frontlines
d. Interface between EMS/police/fire and healthcare facilities

The warning phase is the time in which the hospital can initiate the plan created in the planning phase. The steps should be undertaken as soon as possible and can continue even after patients have arrived with the goals of:

1. Preparing as many beds as possible
2. Maximizing available staff for immediate care and staff relief
3. Establishing triage point(s)
4. Activating treatment areas
5. Initiating the IMS and establishing an operations center (it is the assumption that the hospital already has a disaster plan in place with the appropriate color codes and IMS structures [see Chapter 4]).

Section 10: Response Phase

The response phase will be the delivery of items outlined in the planning section of this document, as well as data collection and tracking of financial data (as per the IMS model). All these help to improve future response and provide an accounting and costing at the end of the disaster.

Section 11: Recovery Phase

The recovery phase is beyond the scope of this document.

Section 12: Recommendations

There are a variety of recommendations that flow out of the research done in preparing this chapter. These are as follows:

1. Establish national standards of disaster response driven by best evidence and derived by frontline responders.
2. Link accreditation of hospitals with meeting the aforementioned standards.
3. Establish a mandated training cycle for all healthcare facilities as part of accreditation.

4. Attempt to maximize the warning phase in a disaster scenario by improving:
   a. Syndromic surveillance
   b. Diagnostic surveillance
   c. Transmission of relevant risk assessment information to frontlines
   d. Improved interface between EMS/police/fire and healthcare facilities

5. Formalize frontline cooperation with other countries facing similar issues and with similar healthcare systems on the topics of
   a. ED and hospital design
   b. EMS role and function
   c. Training and exercises

6. Mount a public education campaign on appropriate use of the ED and its function in a disaster.

7. Promote volunteering in the healthcare sector.

Section 13: Summary

This chapter dealt with the ability of the healthcare system to receive and treat a number of patients that rapidly exceeds the system’s routine capacity. The term for this rise in patient volume is a “surge” and the ability to modify the system to deal with this is “surge capacity.”

This chapter also defines the various forms of surges, the phases in preparing and responding to a surge, and provides guidelines for preparing a healthcare facility to deal with them. It has also made some recommendations with regard to general disaster preparedness.

References


10. Personal communication with Dr. Patricia Ward, casualty officer, St. Mary’s Hospital London, U.K.