SURGE CAPACITY OVERVIEW

This document deals with the ability of the health care 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 document defines the various forms of surges, the phases in preparing and responding to a surge and provides guidelines for preparing a health care facility to deal with them. It also makes some recommendations with regards to general disaster preparedness.

While this document 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 health care system. The reader should also note that this document is not a full outline of what is required in developing a disaster plan and meant only to review key points that might be relevant in a surge scenario.

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1 - DEFINITIONS AND PRESENT STATUS

1.1 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 health care delivery is overwhelmed by the large number of individuals requiring care.

Surge Capacity: the ability to handle massive and immediate overload of emergency services. This is broken into a variety of subsets (see table 1)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
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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 health care system.</td>
</tr>
<tr>
<td>Surge Capability</td>
<td>Ability of the health care system to manage patients who require specialized evaluations or intervention (for example, contaminated, highly contagious, or burn victims).</td>
</tr>
<tr>
<td>Public Health Surge Capacity</td>
<td>Ability of the public health system to increase 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 Surgery Capacity</td>
<td>Actions taken at the health care facility level that augment services within the response structure of the health care facility. This may include responses that are external to the actual structure of the facility but are proximal to it (for example, 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 health care responses. These may provide for triage and initial treatment, non-ambulatory care overflow, or isolation (e.g. offsite 'hospital' facility).</td>
</tr>
</tbody>
</table>

Table 1 - Surge Definitions

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1.2 Surge Timing

In considering surge capacity it is important to recognize that there are, in fact, two 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 non-recurring 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 - though not impossible- to project when the demand will plateau or decrease. A prolonged surge is more typical of biological events such as an influenza epidemic-pandemic, or seasonal issues such as the heat wave experienced in France a few summers ago.

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 2 for full 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 health care system.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Stage</th>
<th>Need for External Aid</th>
<th>Status of External Aid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Static</td>
<td>Controlled</td>
<td>Local</td>
<td>0</td>
</tr>
<tr>
<td>Dynamic</td>
<td>Disrupted</td>
<td>Regional</td>
<td>1</td>
</tr>
<tr>
<td>*</td>
<td>Paralytic</td>
<td>National</td>
<td>2</td>
</tr>
<tr>
<td>*</td>
<td>* International</td>
<td>3</td>
<td>Large</td>
</tr>
</tbody>
</table>

Table 2 PICE classification system

1.3 Surge Phases

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

- **Planning phase:** During this phase the health care 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.
- **Warning or pre-surge phase:** During this period of time, the health care 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 bio-event where there
is a lag between the index case and the epidemic peak) to only minutes (when patients present to the ED having been exposed to noxious substance such as the Tokyo Subway Sarin attack). During this phase the health care 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 of this would be the response phase.

  Intake: This is a period during which patients are actively presenting to the health care 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 prior to 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 health care system are ambulatory patients who self-extricated and self-evacuated. These patients are usually less ill or injured than those who could not leave the disaster site, though needing care nonetheless. They are followed by the second wave of patients who require pre-hospital/EMS support to bring them to treatment. It is important to avoid consuming all resources on the less ill prior to the arrival of the more acute patients.

  Treatment: 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: The health care system at this point returns itself to a pre-event 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.

1.4 Present status in Canada

The term surge “capacity” is somewhat of a misnomer in that it implies the health care system has some surplus capacity to accommodate increased patient loads. This is untrue. It’s important to recognize that hospitals across Canada - and particularly emergency departments - , have been functioning in a chronic surge capacity status. The overcrowding of emergency departments is probably the largest impediment in our health care system to deal with any surge event. Hallway patients and those waiting in emergency departments because of a shortage of space on 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 health care 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 non-disaster settings. The system of the British National Health Service (NHS), which is closer to ours in function than the health care delivery in the United States, has demonstrated that the problem of Emergency Department overcrowding can be successfully dealt with.
1.5 Command and Control during a surge

The organizational 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 document other than to mention that a structured and organized Incident Management System (IMS, also known as Incident Command System or ICS), is critical 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. There are other models such as the British major incident medical management and support (MIMMS) structure. Canada has elected to use IMS.

The specific roles filled by individuals in the IMS structure should be as close as possible their roles during normal operations. There should be at least two layers of redundancy in each position to allow for vacation, illness, isolation requirements etc.

2 - 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 occasionally been arbitrary. Unless otherwise specified, the following strategies are applicable to both spike surge events and prolonged surges.

2.1 PLANNING PHASE

2.1.1 RISK ASSESSMENT

There is presently 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 tool which is attached to the materials in this package. Whatever plan a hospital uses, it is critical that the first step is an environmental risk scan and that an annual review is conducted to ensure the hospital plan stays relevant to the risks at hand. Table 3 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>
<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>
</tbody>
</table>

Table 3 Hazard list divided by categories – adapted from AHA documentation
2.1.2 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 and equipment. 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 requirement projection tool, the best alternative is to perform a formal risk analysis to identify potentially likely or high-impact disasters. Once a list has been generated of scenarios that require planning, each scenario can be reviewed by content experts who can assist in determining the resources required.

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 amounts stocked (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 non-acute 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 varies, dependent on 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 health care system with a delayed peak of resource consumption and may be bi or multi-modal (have more than one peak with waves of infection)

4. The availability of intake beds at a specific facility will depend on
   a. The number of empty staffed beds in the institution (usually a near-zero amount)
   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. This capability will vary enormously between communities across Canada.

2.1.3 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. While almost all hospitals in Canada have plans, 10% have not reviewed their plan within recent
memory, of those that have, the majority have not reviewed them within the past year, and more than 50% have not carried out a full practice exercise in over three years.

In developing a plan it is useful to apply a readiness assessment tool. This is a questionnaire that assesses response capability by asking if the facility has specific resources available. One such tool is included in your package.

2.1.3.1 Common Misconceptions
There are common erroneous assumptions in planning for disaster related surges. These assumptions are:

1. **Victims will arrive via the EMS system.**
   The Tokyo Sarin attack is an excellent example of what actually occurs in a disaster “spike” surge. Of the 640 patients at one hospital, 541 came without the 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 non-designated facility can be safely transported to the appropriate site.**
   It is highly unlikely that during a mass casualty incident patients would be transferable 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, the appropriate hospital may be on the opposite side of the disaster area or the hospital may itself be the disaster area. Also, as is often the case in smaller communities, there may not be any neighbouring facilities.

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

2.1.3.2 Bed Management
In any scenarios involving large numbers of casualties there must be a plan for where to put the patients. If a large number of non-ambulatory patients is anticipated, the accommodation must enable these patients to lie down. If the absolute number of patients exceeds the number of 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. The key concern - whatever the solution – is that the appropriate materiel is stored in a safe place and in proximity to its deployment point.

In any sudden influx of patients an effort needs to be made to rapidly clear the Emergency Department. This is important because the Emergency Department will be the Triage and Resuscitative area for the most severely injured patients who do not go directly to the OR.

In all plans consideration must be given to accommodating the needs of vulnerable populations such as the elderly, children, the disabled and the mentally ill.

Last, all plans must include the ability to track patients and provide access to their health records through the relocation and discharge process.
The steps involved in maximizing the number of beds available are as follows:

1) **Stopping all elective activity**

   Immediately advise 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 be done for all patients who are safe to leave and these patients should be immediately moved (along with appropriate documentation) to a discharge area so as to clear the ward bed for the incoming casualties. This would 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, since some of the patients will be non ambulatory, require food, medication etc. until they leave.

3) **Transferring non-dischargeable patients to other care environments**, such as other hospitals away from the disaster area.

   This requires a prior negotiation of a mutual aid agreement with the receiving facilities that would include defining the process of transporting patients, supplies & health records and a process for following the orders given by one facilities staff in another facility where they may not have privileges.

   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. Once again, if other agencies are involved in transport the arrangements need to be negotiated ahead of time.

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. Do they need their present level of care? Can they be cared for elsewhere within the facility? (see point 6)

5) **Expanding inpatient units.**

   Each in-patient unit needs to have a plan that will allow it to increase its capacity by adding beds to existing rooms or to hallways. There needs to be a pre-determined number of patients “above capacity” that can go to 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 needs to be defined ahead of time. For hallway beds there must be a provision for power, medical gasses, waste management, patient/location identification and privacy.

6) **Creating new inpatient units within the hospital**

   Consider internal patient flow, moving ward patients who cannot be discharged into alternate areas to make ward beds available to incoming patients. Israeli hospitals have
bed caches that can be deployed to corridors and lobbies already equipped with “hardwired” oxygen and power outlets. There are dedicated staff that, in a disaster, will shift from their usual work location to a new patient care areas. In a very short time period, a hospital can establish a series of new “wards” - staffed and equipped.

Plans in the United States include the conversion of outpatient procedure beds into inpatient beds using a similar process\textsuperscript{23}.

The hospital makes the decision either 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) **Establish non-traditional treatment areas away from the hospital.**

These could be local long term care facilities, rehab facilities, auditoria, schools, armories etc. Every Health care facility needs to perform a local scan to identify potential support and develop a protocol for activating and closing down the site, patient transfer (see 2.1.3.2.6), staffing (see 2.1.3.4) and the provision of care. Transfer to another site might involve transfer of care to another organization (such as St. John’s Ambulance or the Victorian Order of Nurses) and there needs to be a process of information transfer as well as a clear definition of what care the staff of these organizations are able to deliver.

A good example of an even less traditional venue is found in Moscow where, according to interviews with the city planners, the city can add anywhere from 5,000 to 9,000 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 relocates to the station; staff on site in the station deploys beds and other hardware. This has been repeatedly practiced and it is apparently works well. The hospital deployment 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\textsuperscript{19}.

**2.1.3.3 Staffing**

There are two key issues in staffing during a disaster: staff availability and staff training.

**Availability**

It is important to identify key staff positions (as opposed to key individuals) in all responding organisations and health care facilities and to develop a staffing plan that would include;

1. A fan-out procedure to call in staff as well as an update process to keep the procedure current (e.g. making sure contact information is kept current)
2. A list of roles that must be filled and their priorities.

In any Human Resources plan the first step is to define the tasks that need to filled and then, stemming from this, to define the Human Resources needs. Once the tasks have been defined then it is possible to delegate them out to individuals who might normally not fulfill those roles but would be able to do so in an emergency. Building a Human Resources plan starting with tasks will provide more flexibility than building it based on present roles filled by individuals.
3. A shift schedule to relieve staff and avoid exhaustion (both of the individual and of the organization)
4. A process for accreditation or medical staff across facilities in the event of the need to provide or accept mutual aid
5. A plan to relocate staff within and between facilities including orientation and safety briefing as required
6. Daycare for the children of hospital staff as well as children of victims if appropriate
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
8. A communications plan allowing staff to call home at scheduled times while preserving the integrity of the hospital communications.
9. A process for the safe integration of volunteers and their allocation to appropriate tasks. This requires:
   a. A dedicated Volunteer Coordinator,
   b. A formal orientation program for volunteers,
   c. A review by insurers and legal staff to make sure that volunteers are not putting themselves or the hospital at risk, and
   d. Well-defined tasks that the volunteers can be oriented to ahead of time or rapidly upon deployment.
10. A training schedule with at least one exercise every year.
11. Pre-negotiations with any agency providing temporary or casual Human Resources support, be it nursing, physicians, lab technicians, transportation, maintenance or others. In these negotiations it is important to ascertain that this agency does not have multiple commitments to other organizations that in a disaster would out-strip its resources.
12. Pre-planning with all other support groups that may be involved in a disaster situation such as: Red Cross, CCAC, Meals on Wheels, etc.
13. Allocating resources for the staff and volunteers to allow them to work longer hours. This would include food, accommodation, bathing facilities, ability to communicate with their families with a certain degree of privacy, ability to store medications and personal items safely, and support in the home of the Staff worker (such as child support, support for the elderly, and support for pets). Note that Human Resources do not stand alone. With added Staff there will be an added consumption of both supplies and energy. It is important that a supply chain is secured.
14. Pre-negotiations with Unions (if applicable) so that the plan of action during a disaster will not be blocked by labour union regulations. It must be made very clear to the Unions that these negotiations are purely for the event of a formally declared disaster and not related to any other ongoing negotiations between the employer and the Union. This may involve:
   1. Negotiating with multiple labour unions if Staff have to cross between sites that belong to different bargaining groups
   2. Negotiating the arrangements for additional time worked or time worked at a task outside of the usual job definition,
   3. Clarifying insurance coverage for time worked at a task outside of the usual job definition.

Training
In a disaster scenario hospital staff will be treating patients at a different rate to which they are accustomed. They may be assigned to unfamiliar teams and be 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 using them becomes automatic. Disaster staff must know how to continue to work wearing any necessary protective equipment, specifically if they are dealing with a contaminated disaster. If 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 is likely, in addition to not being able to provide adequate care. Wearing protective equipment muffles speech, and so staff wearing protective clothing need some effective method of communication with which they are already familiar to enable them to perform complex tasks
such as decontamination or intubation. All staff should be as cross-trained for varied tasks as much as possible, so that staff could fulfill multiple or non-traditional roles in the event that the situation dictates this.

2.1.3.4 Equipment

It is essential that required equipment be stored in a safe place. Items stored in public environments for a long period of time 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 there may not be access to the supply dump or the transportation capability. The motto in disaster planning is not “just in time” but “just in case”.

Supplies need to be appropriate for the anticipated population, and must take into account local demographics. For example, if a large pediatric population is expected, equipment must include pediatric supplies such as Broselow tapes and kits.

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 the staff - when deployed – can easily find the item they require. 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 etc.

A common problem in the present hospital environment is that most procedural trays look the same and are wrapped in the same colour 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 package contents, it is worthwhile listing contents in large letters on the outside and, ideally kits should be colour coded for easy recognition (intubation tray blue, thoracotomy red etc) in order to quickly identify the contents of a package. Beware that this does not get confused with Broselow kits that are also colour -coded.

To ensure inter-operability, it is important that equipment used by staff from facilities that may need to co-operate in a disaster and by first responders be compatible or, better yet, exchangeable. This minimizes the need for training on multiple types of equipment and simplifies restocking procedures. 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 leave a patient at the hospital on the same stretcher used in the ambulance and, since the equipment was compatible, replenish their equipment from the hospital stores, allowing them to quickly return to the scene and pick up the next patient.

2.1.3.5 Defining patient flow route with a forward triage point

In a mass casualty incident, 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 – see 2.1.3.7).
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 two key ground rules in flowing patients efficiently are;**

1. **Flow is always uni-directional** and
2. **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 patient flow-through and prevent patients returning to the triage area where they will cause confusion, clog the system, impair statistics, lead to multiple registrations and possibly contaminate the care area.

In a contaminated disaster patients who have already been cleaned off should never return to the contaminated area. If, despite precautions, this occurs then they need to be fully decontaminated again. These patients pose the risk that, if re-contaminated, 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.

In order to facilitate patient flowthrough:

1. **It is critical to provide good signage.**
   a. Signs should be printed ahead of time, be large, very clear and in the languages of the population you are going to be servicing.
   b. The signs should be able to stand alone or have a pre-arranged place where they can be put without the need for tape, Velcro or special tools.
   c. Every sign should have its own pre-defined location marked on a deployment map and also painted 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, determine the sign number and its location on a deployment map, go to that sign’s location on the map, verify that the correct number is there and place the sign accordingly. Attention should be paid to the possibility of misplacing signs with arrows that may be in the right location but facing the wrong direction.

   It is always preferable to have fixed signage where possible. This saves time and work and decreases the possibility of error.

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 (i.e. Forward Triage Officer) as opposed to their name or titles (i.e. Department Chief).
   b. Identification methods must be such that the hospital staff cannot be confused with other people who will be responding from the scene (ie paramedics, fire, police etc).

   Hospital badges, while commonly used, will not be adequate in a large mass casualty incident. It is better to have vests in a reflective and very obvious colour, or a series of colours 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 colour code can see a vest labeled “intubator”, “Triage Officer”, “physician”, “nurse”, and so on.
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.

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

Planners must consider either a public address system (ideally with a portable microphone, or a bullhorn) or some other method that will allow them to coordinate the crowds 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 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 staff and time to deploy, whereas hard-wired lighting can be turned on with the flick of a switch, is stable and secure. Provision must be made for power failure.

5. Place the triage point(s) as far forward as possible

Patients arriving at the hospital will vary in their acuity. While 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 to areas that will consume fewer resources.

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 emergency department, the E.D. will rapidly become crowded and dysfunctional. Whereas if triage occurs in the parking lot, minor patients can be diverted to the hospital lobby keeping the E.D. free for those patients requiring resuscitation.

The same rule applies to scene response. In Moscow, a doctor is on-scene at the disaster and decides what 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 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 site.

There may be more than one triage point, initially sorting patients into ambulatory ("minor" or green tagged patients) and non ambulatory then, at a second triage point, further subdividing the non ambulatory into “delayed” (yellow tag), immediate (red tag) or expectant/deceased (black tag)

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 prior to 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. This is far from ideal, particularly if contamination is involved.

2.1.3.6 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 will be staffed by health care staff with an appropriate skill set. For example, the acute care resuscitative area will be staffed by senior physicians, anaesthetists and a higher nurse to patient ratio, whereas the ambulatory/minor injury section may be only staffed by clerical staff and, in a teaching hospital, junior residents and medical students.

Each treatment area must have defined and fixed protocols. The purpose of this fixed protocol methodology is to ensure that every patient in an area gets the same initial treatment and that treatment is not delayed waiting for a physician. The nurses would be authorized to initiate care and investigations using preset protocols and as the physicians catch up the patient treatment plan can be adjusted to match individual requirements.

There are patterns of injury in mass casualty incidents 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 then re-triage periodically. This will be different from an area designated for sicker, non-ambulatory, 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.

The only area with significant variability should the resuscitation area, where each patient will be treated individually based on the cause for his or her critical condition. That said, in a disaster situation most patients requiring resuscitation will likely receive only palliation.

2.1.3.7 Prepare a decontamination plan

In the event that patients from the disaster have been contaminated with a noxious substance, decontamination has to take place prior to 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 do⁶. In the US, by comparison (Pre 9/11 data), 44% of 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 contamination¹⁵.

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 emergency department and not within the building wherever that is possible. If it is within the building 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 non-ambulatory patients, and should be able to function in all relevant weather conditions. Consider areas that would not normally be 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
Patients that cannot walk need to be decontaminated on a stretcher or backboard. There are a variety of tools for this, from the roller system (reminiscent of beer stores) to decontamination beds that are designed for the patient and the bed to be washed down simultaneously. Either way, 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 non-contaminated 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 of exercising different kinds of processes and minimize the amount of documentation required in preparing Disaster Plans for hospitals.

2.1.3.8 Organise the data flow

In the Tokyo Sarin Disaster, 640 patients presented themselves to St. Luke’s Hospital during more than 90 minutes. Of those, 541 came independent of the EMS system. Even if it took only one 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 a mass casualty incident. In preparing for a mass casualty incident charts must be pre-printed and pre-registered in the facility’s computer system. The number of charts required will depend on the facilities risk assessment. The pre-printed charts and the pre-registration ensure that the patients exist (as anonymous entries) in the computer system with lab work pre-ordered, specimen stickers available, armbands are pre-printed and so on and so forth. Provisions must exist for computer and/or power failure.

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 pre-morbid status, medications, drug allergies and some history of the present illness (what injuries the patient actually suffered).

Only later, and when time allows, do 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 OHIP number, and so on.

In regional plans, it may be worthwhile allocating distinct number sets to specific hospitals so as to prevent duplication and to allow regional planners to immediately identify which hospital a patient came from on the basis of their ID number.

2.1.3.9 Communications

Any disaster plan must define roles (see 1.5) and a communications plan between the individuals in these roles. Communications plans can be broadly defined as internal (communicating within the organization or facility), external (communications with other agencies (see table 4) and facilities) and public (communications with the public including concerned relatives, potential patients, provision of general advice and provision of information to the media). IMS structure (see 1.5) specifies the appointment of a media relations officer.

2.1.3.10 Other plan components

In addition to the usual disaster plan components it is important to include;

1. Identification of partners such as the Red Cross, Salvation Army and local industry that can assist in a disaster (see table 4).
2. Identification and plans to co-operate with other health care facilities (including but not limited to hospitals) and the prehospital emergency response teams.

3. Identification of key staff and volunteers in all responding organisations and health care facilities and developing 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. Establishing an exercise schedule, both table top and full-scale, that involve all responding agencies. Full drills should take place at least once yearly to avoid the situation in which the executive level has been trained but the front line responders have not. Drills should be used to identify process issues that impede care and should be critiqued.
Table 4 – agencies and organizations that can be of support in a disaster

<table>
<thead>
<tr>
<th>Agency or Organization</th>
<th>Agency or Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal/Provincial Health authorities</td>
<td>Federal/Provincial Laboratory (if separate from agency)</td>
</tr>
<tr>
<td>City/county government elected officials</td>
<td>County Attorney</td>
</tr>
<tr>
<td>Locally headquartered provincial legislator</td>
<td>Local Board of Health</td>
</tr>
<tr>
<td>Federal/Provincial Emergency Management Agency</td>
<td>Local Emergency Management Agency</td>
</tr>
<tr>
<td>Metropolitan Medical Response System (MMRS)</td>
<td>911 dispatch</td>
</tr>
<tr>
<td>Local law enforcement</td>
<td>RCMP local/regional contact</td>
</tr>
<tr>
<td>Fire Department/HazMat</td>
<td>Occupational health and safety agencies</td>
</tr>
<tr>
<td>Local Mental Health Authority</td>
<td>Home health care provider agencies</td>
</tr>
<tr>
<td>Managed care organizations</td>
<td>Nursing homes/assisted living facilities</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Local Hospital Association</td>
</tr>
<tr>
<td>Private laboratories</td>
<td>Community indigent health centers</td>
</tr>
<tr>
<td>Urgent medical care centers</td>
<td>Local Physician Association</td>
</tr>
<tr>
<td>Local Veterinarian Association</td>
<td>Local Pharmacy Association</td>
</tr>
<tr>
<td>Red Cross</td>
<td>Salvation Army</td>
</tr>
<tr>
<td>Department of Human/Social Services</td>
<td>Medical Examiner/Coroner</td>
</tr>
<tr>
<td>Funeral directors</td>
<td>Universities/colleges/public health schools</td>
</tr>
<tr>
<td>Education system</td>
<td>Poison Control</td>
</tr>
<tr>
<td>Environmental protection agencies</td>
<td>Public transportation systems</td>
</tr>
<tr>
<td>Public works/sanitation/utilities</td>
<td>Correctional institutions</td>
</tr>
<tr>
<td>Tribal government representatives</td>
<td>Representatives of foreign states/county/provinces along international borders</td>
</tr>
<tr>
<td>Public health agencies in neighboring jurisdictions</td>
<td>Inter-faith councils</td>
</tr>
</tbody>
</table>
2.2 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 might be extended by improving:

- syndromic surveillance
- diagnostic surveillance
- Transmission of relevant risk assessment information to front lines
- improved interface between EMS/Police/Fire and health care facilities

The warning phase is the time in which the hospital can initiate the plan created in the planning phase. Depending on the disaster the warning phase would be the time for:

1. Preparing as many beds as possible
2. Maximising available staff for immediate care and staff relief
3. Establishing triage point(s)
4. Activating treatment areas
5. Initiating the Incident Management System and establishing an operations centre (it is the assumption that the hospital already has a disaster plan in place with the appropriate colour codes and IMS structures. Reviewing of these would be beyond the scope of this document).

2.3 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 collection 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.

2.4 RECOVERY PHASE

The recovery phase is beyond the scope of this document.

3 RECOMMENDATIONS

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

1. Establish national standards of disaster response driven by best evidence and derived by front line responders
2. Link accreditation of hospitals with their meeting the aforementioned standards.
3. Establish a mandated training cycle for all health care facilities as part of accreditation
4. Attempt to maximise the warning phase in a disaster scenario by improving:
   4.1. syndromic surveillance
   4.2. diagnostic surveillance
   4.3. Transmission of relevant risk assessment information to front lines
   4.4. improved interface between EMS/Police/Fire and health care facilities
5. Formalise front line co-operation with other countries facing similar issues and with similar health care systems on the topics of
   5.1. ED and hospital design
   5.2. EMS role and function
   5.3. Training and exercises
6. Mount a public education campaign on appropriate use of the Emergency department and its function is a disaster
4. SUMMARY

This document dealt with the ability of the health care 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 document defined the various forms of surges, the phases in preparing and responding to a surge and provided guidelines for preparing a health care facility to deal with them. It also made some recommendations with regards to general disaster preparedness.
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