CHRNet Disaster Management e-Textbook
Mass Casualty Management and Medical Surge

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Abstract:

A medical surge event may result from either a sudden or protracted event when the number of patients overwhelms the available health care capabilities. A medical surge event can be further characterized as one in which an excessive disparity exists between the patient load and the locally available health service capabilities. This disparity may involve personnel, facilities, equipment, supplies, communications, and evacuation means, which affect timely treatment.

While the health care system has continued to maintain its obligations to treat and protect patients, the system is generally under-prepared to deal efficiently and effectively with mass casualties from a catastrophic event. In fact, there is presently no legislated authority requiring the health system to maintain a surge capability in most Canadian Jurisdictions If the health system is to survive the impact of a catastrophic health emergency, aggressive action must be implemented to increase frontline capacity to deal with the minor injured/ill – those not requiring complex interventions - in a post-event situation and ultimately reduce the demand on critical (Code Red) acute care resources.

The hallmark of an effective and efficient surge capability includes: dual use – not disaster specific; modularity – building block approach; and scalability – tailored to need. While intended primarily for a disaster response role, an integrated disaster health service (IDHS) capability could be utilized in a variety of secondary roles; from providing pre-hospital treatment for minor injury during major events to providing alternate care facilities during a disease outbreak or

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temporarily replacing an Emergency Department during a renovation or service recovery event.

Notwithstanding the preceding rhetoric, the fact remains that the creation of an effective surge reduction capability will require both a legislated mandate and the integration of resources from all jurisdictional levels – federal, provincial/regional and municipal. This chapter provides both a *review* of key issues and challenges confronting the health system during events that exceed normal system capacity and capability and a *discussion* of innovations to created surge capacity through the effective management of existing resources.

After a mass casualty event, victims place great additional demands on the health system. This "medical surge" can have enormous implications for caring for not only those affected by the event, but for others who are unaffected but whom also require medical care. This article explores how medical surge can be managed and the importance of planning for increased surge capacity well in advance of a crisis in order to reduce post-disaster morbidity and mortality.

Table of Contents

Section 1: Introduction

Background

Public health threats and medical emergencies can ensue from a myriad of causes, such as disease epidemics, terrorist acts involving explosives, biological agents, toxic chemicals, radiological or nuclear devices; industrial or transportation accidents, and natural catastrophes.

The increasing threat of pandemic influenza, as well as recent events such as the terrorist bombings in Bali, London and Madrid, have increased concern about the health system's ability to meet the demands of such events. Emergency preparedness in health has reached a degree of complexity that requires new and innovative arrangements to address the full spectrum of threats, risks and concerns. Unfortunately, few jurisdictions have the capability to develop and maintain surplus capacity to deal with infrequent, large-scale health emergencies. The complexity of managing emergencies in the health sector can no longer be effectively addressed through traditional practices, such as rapid patient discharge and "hall admissions"

The specific frontline needs and resources of jurisdictions must be realistically considered to effectively plan for a sudden influx of patients into an already over stretched health care system. As few hospitals are capable of handling large numbers of traumatic casualties and given the sudden demand it would place on the health care system it would be prudent to address deficiencies in surge capacity now – not when crisis strikes. According to an American Hospital Association survey (Cracks in the Foundation, 2002), 62 percent of all hospitals and 79 percent of urban hospitals regularly operate at or over rated capacity – a similar situation exists in Canada. More than half of urban hospitals report that they have been on "diversion", diverting ambulances to other facilities for a portion of time. Overcrowded emergency departments are a clear and visible symptom of a destabilized health care environment, and raise clear and compelling questions as to whether any real surge capacity exists anywhere in the health system.

Mass Casualty Case Study – Halifax 1917

On December 6, 1917, a Belgian ship, the Imo, collided with the French munitions ship Mont Blanc in Halifax harbour, Nova Scotia, causing 35 tons of benzene to ignite on the top deck of the latter ship in a major fire. Fifteen minutes later, this fire ignited a cargo below decks to cause the largest nonnuclear man-made explosion in history.

There were 2,000 deaths, 9,000 injured, and 20,000 left homeless, in a city of only 50,000. Hospitals were overflowing in no time. Many people with relatively minor injuries were sent away to temporary wards and aid stations. Halifax had four public, four military and seven private hospitals. They ranged in size from a few dozen to 200 beds and they were soon overflowing. Doctors worked around the clock in the Victoria General Hospital's three operating rooms while stretchers crowded the sidewalks outside the building. Dozens of aid stations sprang up and local doctors performed surgeries on their kitchen tables.

The underlying causes of this overcrowding are well known – inadequate numbers of hospital beds, limited access to out-of hospital urgent care, unavailability of physician specialists, and major shortages of other key clinical personnel, particularly nurses. In many communities, accurate, standardized measurement of bed capacity has become an immediate need. Available hospital bed capacity is typically determined through a daily midnight census of occupied inpatient beds. Measuring bed capacity in this way fails to account for the inflow and outflow occurring throughout the hospital all day long and almost certainly overestimates available capacity. The United States Agency for Healthcare Research and Quality has embarked on a study to determine useful, relevant measures that could predict the imminent onset of emergency department overcrowding.

In order to effectively and efficiently prepare for and respond to possible incidents, the Public Health Agency of Canada (PHAC), Centre for Emergency Preparedness and Response (CEPR), in conjunction with provincial and territorial partners, has developed a National Framework for Health Emergency Management (2005). A requirement was also identified for a National Health Incident Management System (NHIMS) to enable provinces and territories to react quickly and effectively in the event of a complex health emergency[2]/disaster. Significant progress is also being made in the area of

[2] A complex health emergency refers to a situation in which patients suffer from a variety of conditions.

comprehensive health management, including the production or updating of a number of key emergency plans at both the federal and provincial/territory levels.

That said, one of the greatest challenges confronting the Canadian health system is the capability to respond in situations that simply exceed normal capacity. In many cases that excess workload may be relatively small in terms of the actual numbers; however, in a system chronically overcrowded[3] the consequences can be serious.

Erik Auf de Heide, an internationally respected emergency management authority, has stated that "disaster planning is an illusion unless it is based on valid assumptions about human behaviour, incorporates an inter-organizational perspective, is tied to resources, and is known and accepted by the participants" (Auf de Heide, 1989).

The purpose of this chapter is to review potential ways and means to reduce post-disaster system surge through an integrated approach to disaster health services. Such an approach will require innovation and the aggressive use of pre/out-of-hospital emergency care and surge health care facilities.

Catastrophic Health Events

A catastrophic health event[4], such as a naturally-occurring pandemic, a devastating environmental or geological event or a terrorist attack with chemical, biological or radiological weapons could cause an untold number of casualties. It is therefore imperative that the health system maintain a high level of preparedness to respond to a range of disasters.

As it is not possible to prevent all casualties in catastrophic events, strategic improvements in all-hazard planning can prepare response organizations to deliver appropriate care to the largest possible number of people and thus lessen the impact on limited health care resources. Equally critical is the requirement to guarantee the safety and security of health care responders throughout the patient care continuum.

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[3] Overcrowding is not defined by the number of patients in a facility, but rather on by the ability to provide care. It is a situation where the demand for emergency services exceeds the ability of a facility to provide quality care within acceptable time frames. Dr Grant Innis, Chair, Emergency Medicine, St Paul's Hospital Vancouver

[4] Any natural or manmade incident, including terrorism, that results in a number of ill or injured persons sufficient to overwhelm the capabilities of immediate local and regional emergency response and health care systems. Homeland Security Presidential Directive -21, October 2007

Medical Surge

Notwithstanding the looming possibility of an influenza pandemic the Canadian health care system faces the increasing probability of a major natural or man-made emergency or disaster. Such an event will severely challenge the ability of health care systems to adequately care for the resulting mass casualties. The ability of the system to rapidly respond to patient needs following a disaster is generally referred to as "surge capacity[5]". Surge capacity will be largely dependant on the "surge capability[6]" of the system to deal with victims with unusual or highly specialized medical needs.

Surge capability is generally characterized by an increased need for personnel (clinical and non-clinical), support functions (laboratories and radiological), physical space (beds, alternate care facilities) and logistical support (clinical and non-clinical supplies).

While generally associated with complex health emergencies, such as disease outbreaks or multiple casualty events, surge is an everyday reality and a health care challenge which is generally referred to by terms such as overcrowding (emergency departments) and wait-times (surgical services).

Surge Dynamics

The health care system, particularly hospitals, is routinely stressed by incidents such as:

- unplanned presentation of large numbers of patients, requiring care beyond the capacity of available staffing and equipment/supplies;
- presentation of patients with special care requirements demanding additional capability, such as care for chemical burns in hospitals that are not normally burn centres; and
- hazard or event related impacts that compromise the hospital's ability to provide patient care, for instance loss of electrical power or water.

It is important to recognize that incidents impacting routine operations may be brief in duration or prolonged over a period of days or weeks.

A recent US paper (Mass Medical Care with Scarce Resources: A Community Planning Guide, 2007), suggests that multiple casualty events (MCE) can be organized into two categories: those that result in an immediate or sudden

[5] A quantitative expression of an organization's ability to cope with an excessive patient load.
[6] An expression of an organization's inherent ability (skill-sets and resources) to provided required level of care/service

impact; and those that result in a protracted or sustained impact, as depicted at Figure 1.

The first category of MCE includes events such as explosions and earthquakes. These events result in an immediate impact characterized by large numbers of casualties at the outset of the event that generally taper off. In some cases there may be a second wave of casualties due to depleted pre-hospital resources or such factors as secondary exposure to natural elements and contagious diseases.

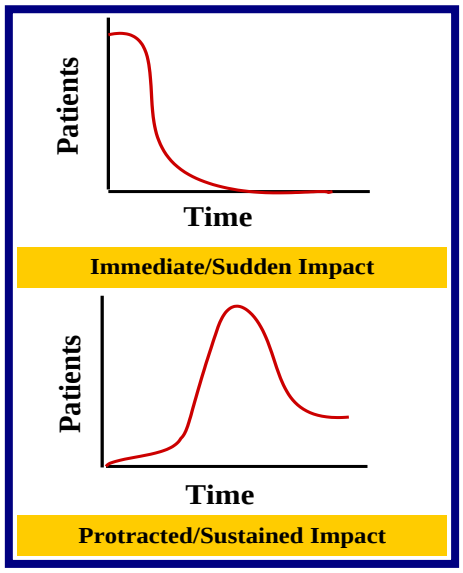


Figure 1: MCE Categories

The second MCE category features events such as a widespread exposure to a weaponized biological agent, such as anthrax or smallpox. Another example of this category is an influenza pandemic, in which there would be a gradual protracted increase in the number of people affected, rising to a potentially catastrophic number over time. In this type of MCE, the number of cases may decline due to treatment and prophylactic efforts only to increase due to reinfection with a different strain or as a result of an additional wave or waves of the disease. This type of event would necessitate a more sustained response, as the impact would be felt over a much longer period than the immediate-impact MCE.

Dr. Daniel Kollek (2005), a Canadian emergency physician and educator, describes two types of surge that occur in an Emergency Department setting:

- *sudden or spike surge* resulting from the sudden influx of patients following a specific, time-limited, non recurring event such as a major motor vehicle accident or hazardous material incident; and
- *prolonged surge* where the intake of patients is protracted over time and when it is harder, but not impossible, to predict when the demand will plateau or decrease. A prolonged surge is characteristic of an epidemic or pandemic event or seasonal issues such as heat waves.

Mass Casualty Case Study - Madrid 2004

On March 11, 2004, 10 terrorist explosions occurred almost simultaneously on commuter trains in Madrid killing 191 people instantly and injuring more than 2,000. That day, 966 patients were taken to 15 public community hospitals. More than 270 patients arrived at the closest facility between 0800 and 1030 hours. The closest hospital, which was in the process of evacuating, received over 200 patients in 2.5 hours, most of whom were self evacuees. The majority of casualties presented at the two largest public hospitals in Madrid: Hospital Gregorio Marañon (312 casualties) and Hospital Doce de Octubre (242 casualties).

The amount of resources mobilized to the care of the wounded was unprecedented in Spain with more than 70,000 health personnel involved, 291 ambulances for transport, 200 firemen and police vehicles. The health authority activated the emergency plan for disasters, which consists of fitting out all the operating theatres in the hospitals, postponement of all non-urgent scheduled operations and the call of duty of all available health staff.

Kollek further suggests that disasters may be classified as either "static" or "dynamic" events. Static events are ones where the cause of illness or injury ceases after a defined period of time and the number of patients is finite. On the other hand, dynamic events are ongoing situations where new patients present on a continuous or recurring episodic basis, causing prolonged surge. It should also be note that surge may be the result of a combination of spike and prolonged events where an initial spike is followed by a protracted demand for services.

The Madrid and London events demonstrated the impact that is created by detonating explosives among densely packed civilians. In an instant, an explosion can wreak havoc, producing numerous casualties with complex, technically challenging injuries not commonly seen following natural disasters such as floods, tornadoes, or hurricanes. Because many patients self-evacuate due to a perceived or actual absence of adequate out-of-hospital emergency care, hospitals near the scene can expect to receive a large influx of victims following an event. This rapid surge of victims typically occurs within the first few hours, exemplified by the Madrid bombings where the closest hospital received 272 patients in 2.5 hours (Gutierrez de Ceballos, Turegano, Perez., Sanz, Llorente, & Guerrero, 2005). On the other hand, surge resulting from a communicable disease outbreak or an environmental emergency, for example the 1995 Chicago heat wave, can last several days to weeks afterwards. The potential for large numbers of casualties and an immediate surge of patients from a sudden event may stress and limit the ability of emergency medical services (EMS), hospitals, and other

health care facilities to adequately care for the onslaught of critically injured victims.

In examining the potential duration and extent of an emergency there are two factors that require consideration in addressing surge capacity. Situations that persist over periods longer than 3-4 days should be expected to draw heavily on available resources, particularly on health professionals and supplies, to meet the needs.

Erik Auf der Heide (2002) states "The evidence shows that the least serious casualties tend to arrive to hospitals first, leaving hospitals unaware of more serious cases yet to come. When serious cases do arrive, all emergency department beds tend to be occupied. In a study of 29 disasters, the majority of casualties tended to be treated in a single hospital, even when numerous other hospitals were available to care for patients. Outside critical care medical help is rarely used. Although disasters can cause many serious injuries, most trauma victims in disasters have minor injuries, and many of these injuries occur during cleanup activities."

Many disaster casualties can be treated in a non-hospital setting; however, most disaster medical planning is aimed at major trauma hospitals. Non-hospital assets, such as: private physicians' offices and clinics; urgent care centers; outpatient surgeries; pharmacies; assisted living centers; nursing homes; dialysis, mental health and occupational health centers; and home health care providers need to be integrated into disaster plans.

He concludes that the old paradigm of disaster planning focused on the hospital, critical trauma, outside medical teams, casualty collection points and evacuation. The new paradigm focuses on mitigation (hazard protection for medical assets, such as physicians' offices and pharmacies), maximal use of local and non-hospital medical assets, mass care of minor injuries and large numbers of non-trauma cases.

Daily Surge versus Disaster Surge

Daily Emergency Department surge capacity, measured both by available staff and clinical space, is a concern for virtually all hospitals, many of whom operate at full capacity on a regular basis. The reality is that Canada has:

- the highest acute care occupancy rate (87%) among G-7 countries; ranks 2nd highest out of 21 OECD[7] countries;
- 25% fewer acute care beds per 1000 population than the OECD average (ranks 13th of 25); and
- 25% fewer physicians per 1000 population than the OECD average (23rd of 29). (Brimacombe & Bressler, 2005)

Most hospital emergency departments on receiving more patients than they can handle will choose to go on diversion and disperse less serious cases to other hospitals. However, in a recent survey, 24 percent of hospitals report never going on diversion, often because they are the only source of care or the only trauma centre in the area (Hospital Staffing and Surge Capacity During a Disaster Event, 2007). In this regard, emergency department overcrowding that results in widespread ambulance diversions is, one could argue, itself a community disaster, which should cause activation of a community/health region's health emergency plan.

Surge Capacity – the ability to manage increased patient care volume that otherwise would severely challenge or exceed the existing medical infrastructure

Surge Capability – the ability to manage patients requiring unusual or very specialized medical evaluation and intervention, often for uncommon medical conditions

Surge Capacity

Surge capacity is generally defined as the ability to expand care capabilities in response to sudden or more prolonged demand and is perhaps the most fundamental challenge for a health emergency preparedness program. Surge capacity encompasses potential patient beds; available space in which patients may be triaged, managed, vaccinated, decontaminated, or simply located; available personnel of all types; necessary medications, supplies and equipment;

[7] Organization for Economic Cooperation and Development (OECD)

and even the legal authority to deliver health care under situations which exceed authorized capacity.

Surge capacity has both point-in-time and longitudinal dimensions. That is, capacity that can be mobilized for a time-limited period to accommodate the needs resulting from an acute disaster will eventually be needed by those patients having more "routine" care requirements such as surgical procedures, cancer chemotherapy, or the delivery of a child. Thus, the capacity needed to manage longer-term situations, such as a disease outbreak, may eventually be in direct competition with the ongoing care needed by the people in the community. It is important that surge capacity, both in its point-in-time and longitudinal dimensions, be prospectively determined as part of the emergency planning process. There is also a basic need to define an agreed-upon set of units, or measures, of surge capacity at the provincial/territorial level. Such agreement is essential to the communication of needs within and across communities.

Surge Capability

Surge capability is the ability to rapidly expand the capacity of the existing health care system (long-term care facilities, community health agencies, acute care facilities, alternate care facilities and public health departments) in order to provide triage and subsequent medical care. This includes providing the clinically required level of care, within sufficient time to achieve recovery and minimize medical complications.

Emergency planners must recognize that medical resources are normally at or near capacity at any given time. The capability to manage routine workload surge will directly affect how hospitals will handle patient surges during a complex emergency or disaster. While both routine and disaster surge necessitate coordination of multiple issues, the latter will obviously require coping with these issues on a larger scale.

Capability mobilization requires the rapid expansion of existing capacity to meet the specific care requirements of an event and may include increased personnel (clinical and non-clinical), support functions (laboratories and radiological), physical space (beds, alternate care facilities) and logistical support (clinical and non-clinical equipment and supplies). The desired outcome being that the ill/injured resulting from the event are rapidly and appropriately cared for, while continuity of care is maintained for non-event related illness or injury.

Mass Casualty Incident Dynamics

A mass casualty incident (MCI) is a medical emergency that is associated with the production of a large number of human injuries. Figure 2 illustrates the chronology of such an event. MCIs can be categorised into three levels:

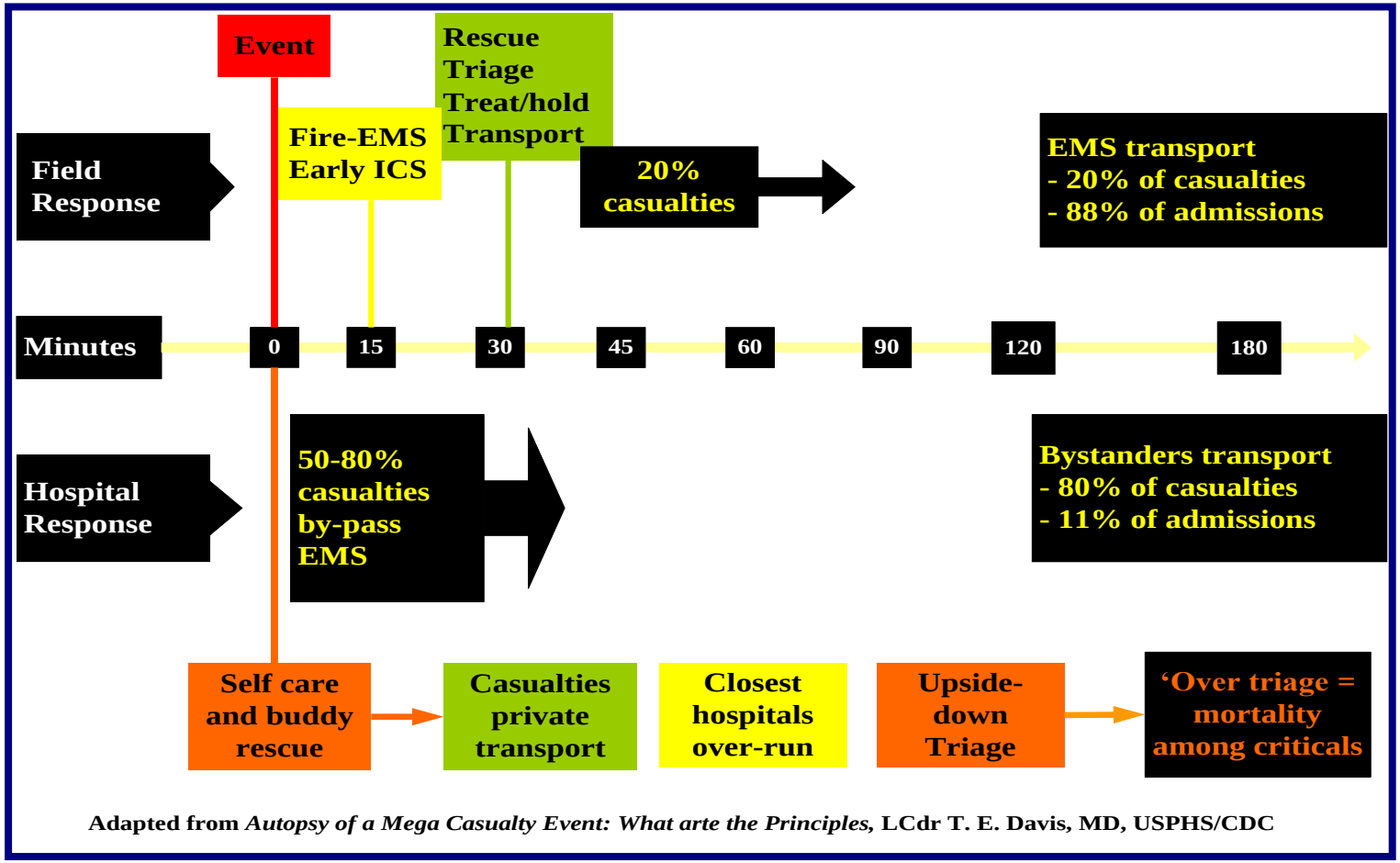
- Level 1 is an emergency that is manageable with local medical resources but which may require some alteration of normal care delivery;
- Level 2 is an incident with a significant number of casualties that exceeds the normally available medical response capabilities of the community. Mutual assistance may be required at Level 2;
- Level 3 is an event (disaster) that overwhelms the capacity of available local and regional resources and exceeds the capabilities of immediately available mutual assistance, necessitating a request for provincial or federal support.

While Level 1 and 2 MCIs are generally limited to a single incident scene, a Level 3 MCI is generally broader in scope with respect to both geography and the number/complexity of casualties. In a MCI the normal philosophy of emergency care is altered with respect to resuscitation, surgical procedures, and medical personnel scope of practice and hospital admission.

For example: the extent of resuscitation is modified so that severely injured patients who would normally receive the most intensive care possible would be triaged as dead or expected to die. Medically acceptable results are also altered – the sacrifice of a limb to save a life or less then optimal cosmetics, allowing wounds to heal without secondary intervention are plausible. Surgical priorities and timeliness may be altered as well. As a result, higher priority is given to casualties whose life threatening conditions have a high probability of survival, but result in a minimum expenditure of resources.

There may also be a requirement to alter the scope of practice to permit nurses, paramedics and other ancillary medical practitioners to assume a greater role in patient care, thus permitting specialist personnel to focus on the most complex cases. Lastly, casualties should only be evacuated and admitted to hospital when absolutely necessary – experience continues to reveal that up to 60% of casualties who suffer minor injuries can be treated and cared for out-of-hospital.

Figure 2: Mass Casualty Event Chronology



Adapted from *Autopsy of a Mega Casualty Event: What arte the Principles*, LCdr T. E. Davis, MD, USPHS/CDC

Section 2: Confronting the Challenge

Complex Emergencies and Disasters

There are a range of impacts a community can experience that increase in severity along a continuous scale (National Framework for Health Emergency Management: Guidelines for Program Development, 2005), At the front end of this continuum are the "everyday" accidents/routine emergencies that effect one or two people. As the seriousness increases, these mishaps become more complex and involve more people, as both victims and responders. When an event, like an earthquake or tornado, occurs it can cause severe damage within the community, including property destruction and personal injury. This type of wide-scale impact is toward the disaster end of the continuum where the consequences can be expected to overwhelm the community's capacity to respond.

Disasters not only impact our health, community, and economy they can devastate the environment and significantly disrupt our daily life. They may be the consequence of human intent (terrorism), the unintended result of human activity (industrial accidents), or natural occurrences. Most significant is the fact that *disasters occur at a local/regional level*, affecting a defined community that rapidly becomes overwhelmed.

Complex Emergencies			
Incident	**Location**	**Fatalities**	**Injured**
Terrorist attack World Trade Centre (911)	United States	2993	8700
Bomb in a nightclub	Bali	202	300
Multiple bomb attacks	Madrid	191	1900
Multiple bomb attacks	London	52	650
Tsunami	S.E. Asia	200,000+	unknown
Truck bombs	Istanbul	27	450
Spanish flu 1918/1919 pandemic	World wide	250,000 (UK)	unknown
SARS outbreak	30 countries	900 (global)	8000 (global)

Adapted from Mass Casualty Incidents – A Framework for Planning, UK Department of Health

The fundamental goals of disaster mitigation and preparedness are to understand and define the threat, limit vulnerabilities, prevent the occurrence

when possible, and minimize the effects and losses when they arise (Lettieri, 2006)

Hazard Identification

To effectively address the consequences of a complex emergency or disaster resulting in a surge event, it is necessary to identify potential hazards or stressors that could cause an unscheduled demand on the health system over and above the norm.

The National Framework notes that every aspect of health emergency management depends on accurate information about the hazards (Lettieri, 2006). It recommends that, for efficiency purposes, all potential hazards be examined at the same time, or within the same planning process, to ensure that the full range of threats are considered in a balanced way. Even though most hazards are characteristically different, they can result in the same or similar consequences. For example, loss of power, loss of water and disruptions in communications, could all result from a severe storm, an earthquake, a tornado, a wildfire and so on. Identifying potential consequences in this manner will allow for greater efficiency in defining possible surge requirements and identifying solutions.

Mass Casualties

Mass casualties may result from any type of event. The term "mass casualties" can apply to any number of casualties produced in a relatively short period of time that overwhelms available capabilities. Furthermore, a mass casualty situation is one in which an excessive disparity exists between the patient load and the locally available resources. This disparity may involve personnel, facilities, equipment, supplies, communications, and evacuation means, which effect timely treatment. When mass casualties occur, patients already in the health system may also have to be managed according to mass casualty protocols[8] until the overall situation is resolved.

Mass Casualty Management Challenges

- Self-evacuees
- Less severe casualties arrive first
- Hospitals closest to event become overwhelmed
- Timing of casualty arrival unpredictable

When casualties are produced in numbers that exceed rated capabilities of health service resources, impacted facilities will need to alter the standards and

[8] Triage and patient management process to be used in the event of mass casualty/trauma event of any type, particularly which causes or may potentially cause a disruption of normal hospital operations and delivery of patient care services.

scope of services that they normally provide. These alterations should be with the objective of providing the greatest good for the greatest number to ensure that treatment is directed first toward patients who have the best chance of survival. Therefore, simple lifesaving procedures that can be rapidly performed should be given the highest priority – life must take precedence over limb and functional repair over cosmetic concern.

Casualty Distribution

- 250 dead at scene
- 750 seek medical care
  - 188 admitted
  - 47 to ICU per 1000 injured

Rule of 85/15% has applied to all disasters thus far including NYC 9-1-1

- At least 50% arrive self-referred
- On average, 67% of patients in any given disaster are cared for at the hospital nearest the event (range 41-97%)
- Redistribution from the hospital closest to the incident scene to other facilities may be as (or more) important than transport from the scene

Key Considerations

Human Behaviour

Evidence shows that the least serious casualties tend to arrive at hospitals first, leaving hospital staff unaware of more serious cases yet to come. When serious cases do arrive, all emergency department beds tend to be occupied. In a study of 29 disasters, the majority of casualties tended to be treated in a single hospital, even when numerous other hospitals were available to care for patients (Auf de Heide, 2002). Outside critical care medical help is rarely used. Although disasters can cause many serious injuries, most trauma victims in disasters have minor injuries, and many of these injuries occur during cleanup activities.

In a typical MCI severe injuries are sustained by only about 10-15% of survivors (Hirshberg, Holcomb, & Mattox, 2001). Furthermore, most "self-triage" casualties have minor injuries and can be treated on an outpatient basis and remain in/at the hospital less than one day. Most casualties are soft tissue injuries, which are often considered a non-trauma condition. While most (50-80%) disaster casualties can be treated in a non-hospital setting, medical planning is primarily aimed at major trauma care within a hospital setting. Non-hospital assets, such as

private physicians' offices, clinics, urgent care centers, outpatient surgery centers, pharmacies, assisted living centers, nursing homes, dialysis centers, mental health centers, home health care providers and occupational health centers need to be integrated into disaster plans.

Consideration must also be given to the psychological effects of a disaster. It is estimated that for every one physical casualty caused by a terrorism incident, there are four to twenty psychological victims (Warwick, 2002). As an example, the September 11 attack has been described as a "mental health catastrophe." In just one of the hospitals proximate to the attack in New York City, St. Vincent's Catholic Medical Center, staff in the psychiatric department provided counseling and support to more than 7,000 people and received more than 10,000 calls to their help line during the first two weeks following the disaster. Similarly, following Tokyo's sarin attack, 80% of hospital presentations were psychological.

A further consideration should be the "worried well," made up of individuals who believe they are unhealthy but whose physical examination and lab tests are normal. In a terrorism context, these are people who seek medical attention in the wake of a biological, chemical or nuclear attack who are not in fact ill but are concerned they might be.

The worried well include those who have heard about the event and think their symptoms match those of the disaster victims, but in fact have minor injuries and do not require significant care. While there is essentially nothing medically wrong with such individuals from a standpoint of "mental health" or psychosocial intervention, they still require assistance. From a surge perspective, the worried well can create a significant workload issue for hospital staff and identify as a "bottle-neck" in post-disaster casualty management.

Another frequent gap in mass casualty planning is the impact of large numbers of "walk-in" patients on the outcome of those most critically injured. As with over triage[9], the "walking wounded" can have a variable, but potentially significant, impact on the relationship between resource consumption and mortality. Less severely injured self evacuees typically arrive before EMS transports and consume available emergency department resources thus degrading the quality and timeliness of care for more critical patients.

System Surge

As was discussed in Section 1, surge capability is characterized by an increased need for personnel (clinical and non-clinical), support functions (laboratories and radiological), physical space (beds, alternate care facilities) and logistical support

[9] Triage is the process of sorting casualties into groups according to their need and available resources

(clinical and non-clinical supplies) in a coordinated fashion. While generally associated with complex health emergencies such as disease outbreaks and multiple casualty events, the reality of surge is a daily health care challenge that is generally referred to using terms such as overcrowding (emergency departments) and wait-times (surgical services).

The health care system, particularly acute care hospitals, is routinely stressed by incidents such as:

- unplanned presentation of large numbers of patients, requiring care beyond the capacity of available staffing and equipment/supplies;
- presentation of patients with special care requirements demanding additional capability, such as care for chemical burns in hospitals that are not normally burn centres; and
- hazard or event related impacts that compromise the hospital's ability to provide patient care, including the loss of electrical power or water, for example.

There are generally two types of surge that can impact a hospital:

- sudden or spike, surge resulting from the sudden influx of patients following a specific time-limited non recurring event such as a major motor vehicle accident or hazardous material incident; and
- prolonged surge where the intake of patients is protracted over time and when it is harder, but not impossible to predict when the demand will plateau or decrease. A prolonged surge is characteristic of an epidemic or pandemic event, or seasonal issues such as heat waves.

The bottom-line is that while casualty numbers strain capacity, high demand (specialized intervention/evaluation) strains overall capability (Auf de Heide, 2002).

Meeting the challenge of managing post disaster surge will require the mobilization of both traditional and non-traditional health service providers. Therefore, a decentralized approach to providing basic medical care may be the most effective use of resources. In this regard, the conceptual model, which will discussed in Section 4, will draw upon community health and social service resources outside the purview of the health authorities. Envisaged partners in the model would include, but not be limited to: local emergency medical/ambulance services, private practitioners (physician, nurses, and occupational/emergency first aiders) and clinics, and community health and social services agencies.

Patient management during disaster response operations is organised into a continuum of care (Annex A) extending from the incident site, through emergency

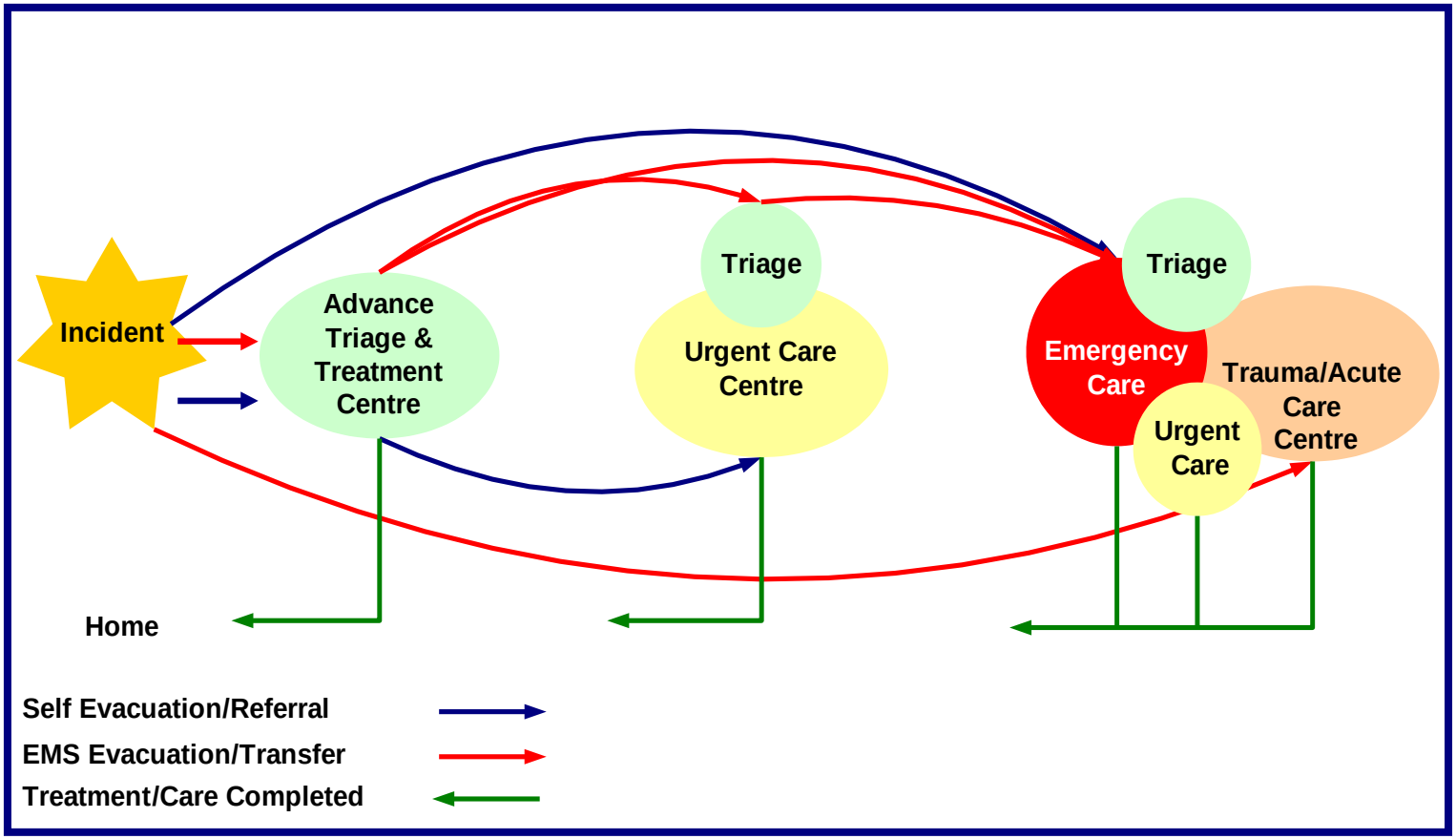
and acute care services, up to and including full recovery (Figure 3). The initial pre-hospital care includes: first aid, initial medical and psychosocial intervention, and emergency medical and sustaining care. Disaster health services during the pre-hospital phase will be largely dependent on first aiders (all levels, medical first responders, paramedics, and other private sector health care providers), including physicians, nurses, and mental health counsellors. Triage at the scene will determine the type of care required as injuries from explosions, fire, flying debris and toxic substances produce problems which transcend usual disciplinary boundaries (Edwards, 1989). Furthermore, continuous integrated triage will ensure patients are treated and returned home in a timely and efficient manner with only those requiring complex intervention proceeding to subsequent levels of care.

Planners and on-site managers must remain cognisant of the fact that every person who is transported and/or evacuated without sufficient reason imposes an unnecessary burden on the health services. The result is a need to commit additional space in evacuation vehicles, beds in treatment facilities, and trained health care providers. Furthermore, continuous triage is essential to ensure casualties are only evacuated or referred to the level of care that their condition warrants and the operational situation dictates.

System Vulnerability and Business Continuity

Given the recognized, all-hazard vulnerability of the health system, it is imperative that health planners address the issue of continuity of operations during events which may impact service delivery. It is essential that critical health care programs and services be rendered secure against potential hazards. Effective business continuity and recovery plans must be developed and understood to ensure that the health system is able to provide uninterrupted service in situations where both the physical infrastructure and human resource capacity are compromised - thus preventing a surge situation developing.

Figure 3: Survivor Care Continuum



Business continuity is an essential component of comprehensive emergency intended to ensure plans are in place, exercised and updated, to enable the continuation of pre-defined mission critical and key business priority health services at an optimal level, including:

- comprehensive plans and procedures for implementing and monitoring business continuity and recovery activities;
- specific security plans and procedures to move up to heightened security levels in the event of an emergency or increased threat condition; and
- current lists of key resources required for the recovery and resumption of essential services, including personnel, facilities, critical infrastructure and assets information, materials and office equipment/furniture, information technology assets (hardware and software) and communications.

While emergency response planning deals with how an organization will cope with the victims of a disaster, business continuity deals with how the organization handles the impact of the disaster on its systems and resources. Business continuity is an ongoing process which ensures the necessary steps are taken to identify potential impacts, maintain viable recovery strategies and plans and ensure the continuity of health services

Particular attention should be paid to contingency plans for both the maintenance of essential support of community care clients and the relocation of acute and residential care patients outside the potential impact area as was the case in New Orleans following Hurricane Katrina. In addition, continuity of operations planning must acknowledge the potential for workforce degradation as a result of the physical and psychosocial impact of an event on health care professionals, para-professionals, other health care providers and support staff.

System Capacity

A major challenge confronting the health system in a complex emergency or disaster situation is the capacity. The fact that facilities are already at or near capacity for emergency and trauma services, suffer from a lack of on-call specialists and nurses, are forced to accommodate competing health care priorities and are plagued with incompatibilities in communications systems are just a few of the issues that need to be addressed. Virtually all provincial and territorial health systems are operating at or near system limits. With respect to surge capacity, any significant event or health emergency could potentially overwhelm these systems. As depicted in Figure 4, casualties in excess of 50 would exceed the response capacity of most, if not all, local Canadian health systems and any capacity beyond that is speculative. Recognizing that a gap exists for the potential

exposure of the health system to public scorn should make the development of an effective and nationally available surge mitigation and management strategy a priority consideration for federal/provincial/territorial health planners.

System capacity in the wake of a public health emergency is an issue that requires attention. In the various post-SARS studies (Naylor Report, the Walker Report and Campbell Commission), this need for flexibility or "surge capacity" was cited as being vitally important in responding appropriately to public health and other emergencies impacting the health system. In recent years, hospitals have lost much of their ability to deal with extraordinary demands for services, with bed occupancy rates running well above the recommended 85%, and often as high as 95-96% (Inspiring Health Care Innovation: Policy Ideas for Ontario's Health Care System, 2002). Not surprisingly, this review found that there is little "redundancy" in the Canadian health care system, particularly in emergency care. Therefore, ongoing planning at the local and successive levels of government must ensure that there is a capacity to provide for a "surge" in the event of unexpected pressures or demand (see figure 5). Furthermore, few contingency plans exist that address how resources (health professionals, laboratory support, supplies, information and expertise) could be exchanged among jurisdictions as part of a pan-Canadian approach in dealing with surge issues. It would be useful to identify the required surge capacity in the two principal components of the health care system – health care and public health. Provisions for surge capacity in the health care system should take into account needs such as: pre-hospital triage and treatment, in-hospital acute care, post-hospital care and support, and provision of mental health care and support to response agencies as well as to victims. Provisions for surge capacity in the public health system should address issues such as: ongoing monitoring of community health status with respect to established baselines, effective epidemiological surveillance including laboratory support for time-sensitive detection and identification of hazardous agents, and ensuring effective, accessible and quality personal and population-based health services to respond to a threat or event.

Figure 4: Flexible Response

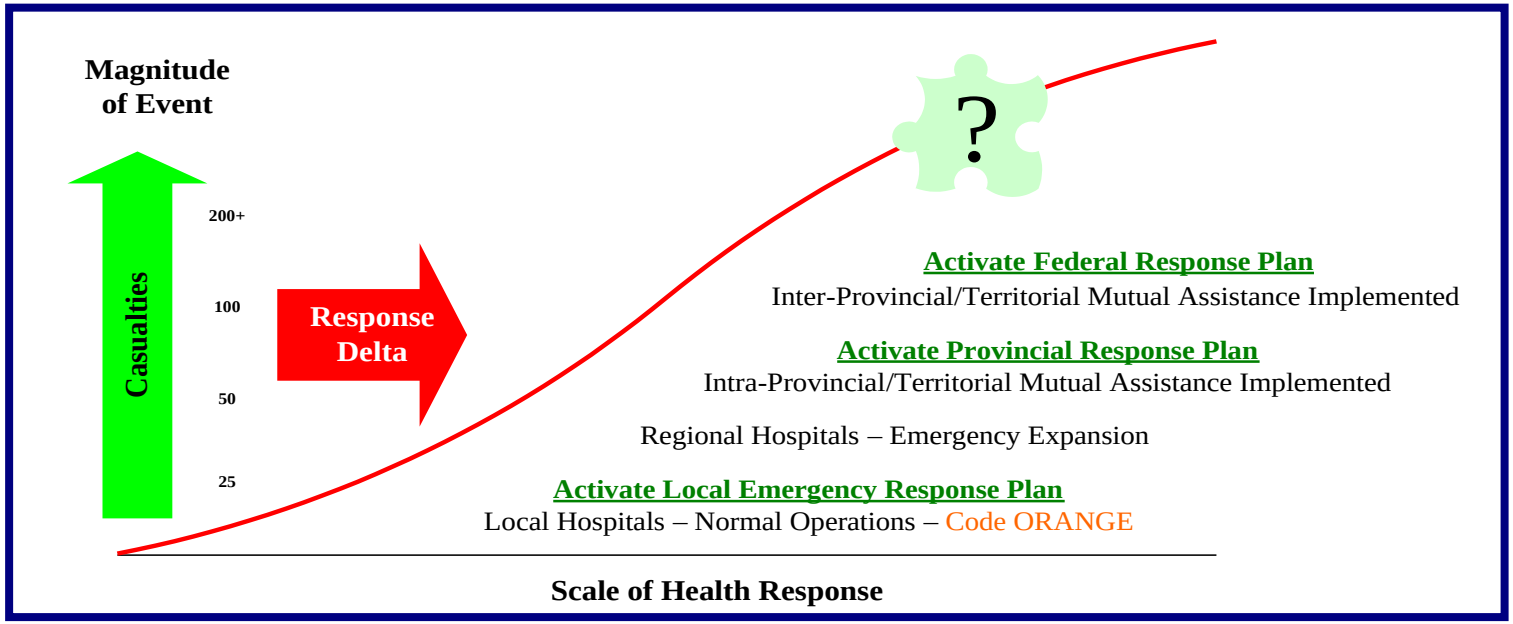
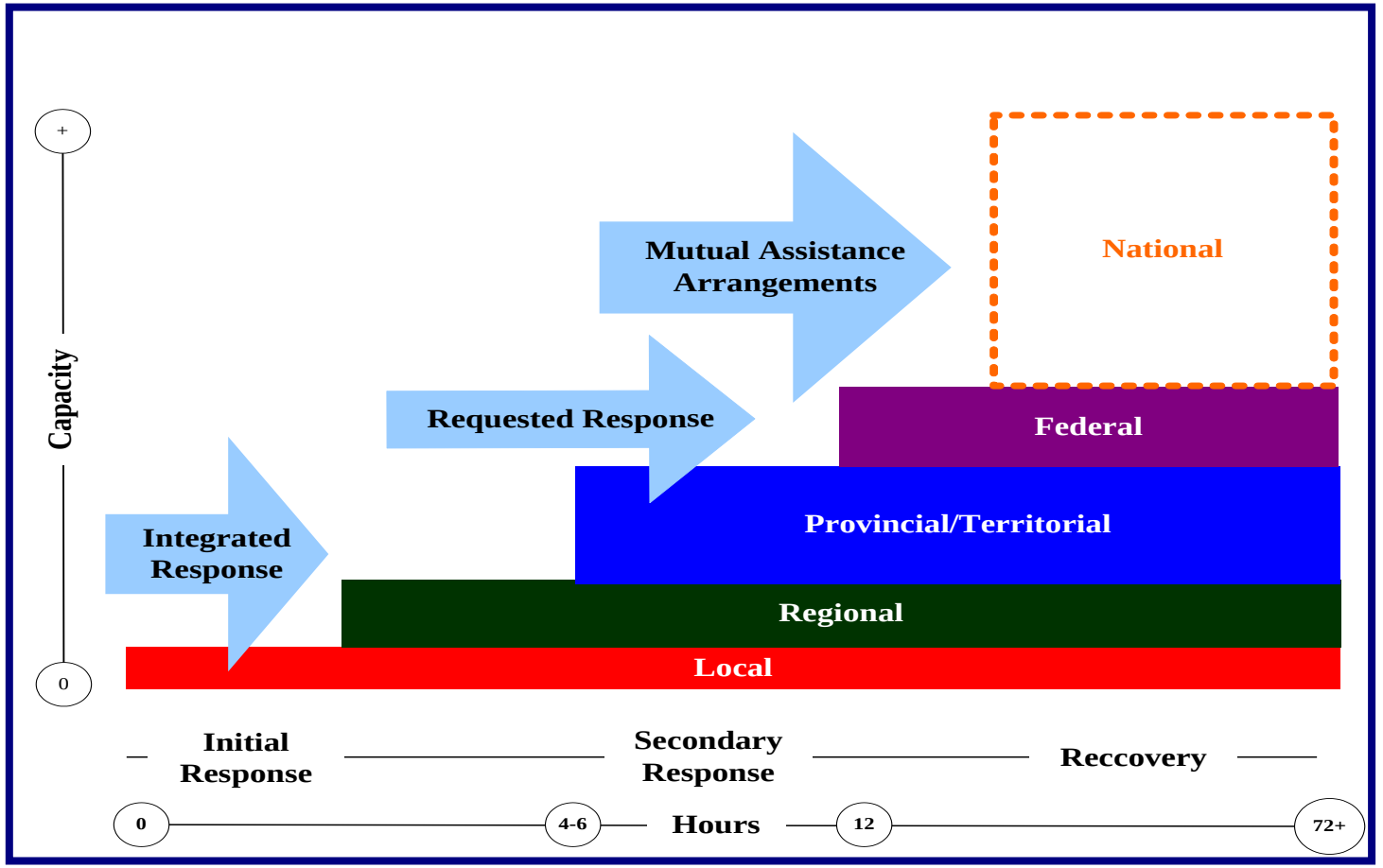


Figure 5: Disaster Response Capacity



Time and Space

Resuscitation and stabilization of patients must be performed within the first hours of trauma management in order to reduce morbidity and mortality rates. Planning should take into account that resuscitation and stabilization may require immediate life saving intervention as well as intensive care procedures. However, it must also be appreciated that a proportion of those resuscitated will deteriorate or remain unstable. Hence, emergency and urgent care should be provided as close to the incident site as possible. Additional surgery necessary to save limbs or prevent potentially disabling complications should be available as soon as possible after the health-affecting event. The interval between injury/onset of illness and initial definitive treatment is critical to the probability of patient recovery.

As wounds may be contaminated, leaving the patient prone to life threatening infection, a requirement exists for the early surgical removal of dead tissue (debridement), a procedure not to be confused with "life-saving" surgery. The time limit for completion of debridement is six hours from time of injury (Bowen, 1998). That notwithstanding, all trauma/post-surgical patients will require hospital level intervention as soon as possible. Time is a critical factor in patient survival and recovery. Hence, time and space will be a major consideration in determining the type and location of emergency response assets, including initial surgical intervention. The sooner intervention is provided the greater will be the number of survivors, and the less will be the degree of disability.

Psychological Trauma and the Worried Well

A major challenge for emergency managers in a mass casualty event will be the management of those victims with no obvious physical injuries who present at medical facilities feeling they may have been impacted. This will be particularly significant in a CBRNE event where the cause and immediate affects may not have any immediate physical manifestations. In the context of such events, the term "worried well" has been used to describe those who present with health concerns but display no physical injury. It is estimated that for every one physical casualty caused by a terrorism incident, there are four to twenty psychological victims (Warwick, 2002). The 911 attack has been described as a "mental health catastrophe". In just one of the hospitals proximate to the attack in New York City – St. Vincent's Catholic Medical Center – staff in the psychiatric department provided counselling and support to more than 7,000 people and received more than 10,000 calls to their help line during the first two weeks following the disaster.

The worried well are generally identified as those who have heard about the event and think their symptoms match those of the disaster victims but likely have at worst minor injuries not requiring significant care. While there is essentially nothing medically wrong with them from a standpoint of "mental health" or psychosocial intervention, they need assistance. The individuals from a surge perspective could create a significant workload issue and be the source of a "bottle-neck" in post-disaster casualty management. Unfortunately use of the term "worried well with its negative connotation of the absence of a problem or an unwarranted concern can contribute to a misdiagnosis, the ongoing minimization of the very real psychosocial effects of a disaster and the need to assess those who appear to be "well" and to proactively address response symptoms (personal communication, Robin Cox, 2008)

In both the US 911 related anthrax letters cases and the Tokyo Aum sarin attack, most of those tagged "worried well" were acting with surprising rationality. In those cases analyzed individuals were responding to a lack of accurate information prompting them to make a rational health decision (one we would encourage them to make in most circumstances) to respond proactively by seeking medical attention where there was concern.

Psychosocial Case Study - Tokyo 1995

Part of what overwhelmed the medical system following the Sarin attack on the Tokyo subway was a category of affected people called the "worried well." The worried well included both exposed and unexposed individuals who sought — but did not really require — medical care. Some may have been exposed to the attack but were not physically affected. Others may have heard about the attack and were concerned for their welfare even though they had not been exposed to the chemical. Still others exhibited psychosomatic symptoms that led them to believe they were in danger. Some people associated pre-existing conditions with symptoms described by sarin victims, such as eye pain or nausea.

People who did not exhibit symptoms of exposure — easily over one half of the patients seen at St. Luke's alone — represent the worried well that clogged the system and postponed treatment of affected individuals. Because the source of the attack and the symptoms of patients were unknown, physicians were unable to distinguish exposed patients in need of medical intervention from the thousands of worried well that flooded hospitals all around Tokyo.

In the Tokyo attack many of those categorized as "worried well" were indeed exposed, experienced symptoms of exposure and were encouraged to seek medical attention but the reception they received was not always positive or welcoming. Some were dismissed and then went on later to develop symptoms and ailments associated with the untreated exposure – they may indeed have been worried, but not well. A follow up study of those with minimal exposure to the agent and who were treated as outpatients experienced significant compromises to their nervous system including declines in memory functionAccurate assessment and early intervention will permit the health systems to respond more effectively to the psychosocial effects of disasters and large-scale emergencies. Planning in this regard should include strategies for anticipating and addressing the surge in demand on medical systems following an event; more accurate triage and assessment of those who are currently lumped together in the category "worried well" to avoid misdiagnosis or under-diagnosis of mental health symptoms; and early intervention with acute psychological/behavioural responses in order to mitigate potential long-term mental health problems, such as post traumatic stress. As no classification system is perfect, a more clinically accurate designation of these "patients" would likely improve the health system response and minimize the impact of these "patients" on the health response to complex emergencies. While there is no industry wide consensus on an alternative term or even the need for it, however, some new terms are now making their way into health emergency planning:

- *Low Risk Patients (LRP)* – those who may have been exposure to the event (whether to CBRN agents or traumatic material such as dead bodies, gruesome scenes) but in the context of triaging do not need immediate treatment but have been assessed with a brief history and 'rule-outs' to determine where the patient was in relation to the incident and the likelihood of direct exposure. (Stone, 2007)
- *Psychological Casualties (PC)* – those who have been assessed as not being LRP but who are clearly exhibiting symptoms of distress and/or acute stress response and may require or benefit from psychological intervention (Shultz, Espinel, Hick, Galea, Shaw, & Miller, 2006)
- *Minimally Exposed Persons (MEP)* – those who have been minimally exposed (physically or psychologically) indirectly through the media or otherwise (e.g., family members who were involved but survived without serious injury) who do not fit the former two categories but who may benefit from some general psycho-educational outreach and/or support (e.g. on what to expect, signs-of/managing stress, & enhancing resilience).

Other Factors

Human Resources

While bed availability is most often identified as the cause of Emergency Department over-crowding, it is the lack of staff required to provide patient care rather than the lack of physical beds that is the most common cause of overcrowding. Similarly, the availability of adequate staff (capacity) with the appropriate skills (capability) is unquestionably the most, significant constraint on expanding capacity.

To meet the human resources demands of disaster surge it is essential that organizations have appropriate Business Continuity Plans in place. However, such plans must recognise that many health care professionals often have commitments to multiple hospitals in a region, which could result in a serious shortfall of staffing when surge capacity is needed.

These plans should also recognise the fact that staff (or their families) may well be victims of the incident, particularly if it is in the locality. This could potentially have a considerable impact on staff attendance and this must be considered when planning. Plans must also consider that staff, regardless of level, may find it difficult to focus on the response (including leading the response) until they are reassured that their family and friends are safe and well. Consideration should also be given to the need for counselling support for staff involved in a response from an early stage.

While funding dictates the amount of staff available to provide patient care the same can be said for most other hospital services. Hospital services are, by and large, funded on the basis of human resources and thus, staff availability dictates workload. If all services were funded for full 24/7 operation, and if required skill sets were available, chronic over-crowding and excessive wait-times would be the exception rather then the rule. The human resource situation may be further impacted by the terms of collective agreements and employment standards, which dictate conditions of work from defined work-sites to restrictions on recall and allowable overtime. Recognizing that most services are operating at marginal staffing levels, even moderate, short-term surges in demand will remain a significant but not necessarily insurmountable challenge.

While individual health service entities have some degree of flexibility in addressing the human resource challenge within their span of authority, mobility barriers and other impediments continue to exist that hinder the rapid reassignment of health care practitioners between jurisdictions. Arrangements that bridge jurisdictional regulatory/licensing barriers are essential to the development of surge capacity in a sector with scarce resources.

A cross jurisdictional capacity to meet the human resource demands of disaster surge will require an effective means of identifying professional resources readily available for relocation/reassignment in an emergency. The creation of such capacity may also require legislative and regulatory mechanisms that allow resources to be shared across jurisdictions and health professionals to act outside their licensing jurisdiction and possibly their spectrum of practice.

Ethics and Clinical Practice

Virtually all surge events will require a reassessment of the scope of practice and standard of care provided by impacted health care organizations. During mass casualty events, such as epidemics or other disasters that result in large numbers of victims, the demand for care will likely exceed available resources. In such situations, it may be necessary to abandon individual patient-based outcomes in favour of an approach that saves the most lives. In other words, clinicians will need to balance the obligation to save the greatest possible number of lives against that of the obligation to care for each single patient. To the fullest extent possible, any shift in provider obligation from individual responsibility to population outcome should, however, continue to adhere to the principles of ethical practice (Guidelines for Healthcare Surge during Emergencies: Population Rights, 2006*).*

As most hospitals are unequipped to handle a sudden surge of highly complex injuries following a catastrophic event there will likely be shortages of health care resources that will necessitate altered standards of care and possibly the suspension of some procedures.

Changes in the usual standards of care will undoubtedly be required to save the most lives in a mass casualty event. Protocols for triage will need to be flexible enough to change as the size of a mass casualty event grows and will depend on both the nature of the event and the speed with which it occurs.

Health Economics

The financial climate chronically forced health care providers to adopt cost effective, business-like management practices, including minimal staffing and "just-in-time" equipment and supply purchases. While this approach has allowed the health sector to survive financially, it has generally lowered surge capacity, restricted specialty capability in many jurisdictions and eliminated ancillary staff dedicated to training and preparedness duties. The end result is a decrease in overall preparedness in that staff are now required to assume more individual responsibility.

Just-in-time inventory management has virtually eliminated supply reserves beyond seven days and has created a situation were distributors are also drawing upon the same manufacturing base to service multiple jurisdictions. For example, most hospitals currently maintain the minimum on-site inventory of sterile supplies, vital equipment, and pharmaceuticals to meet immediate requirements. This severely limits what is available at any one moment to be used during a mass casualty or surge event. Furthermore, re-supply and "back-up" mechanisms are often shared by a number of local and regional health organizations all of which potentially count the same capability as their individual surge capacity.

Another issue is the fact that there is presently no process, either provincial/territorial or national, to reimburse health care organizations for the incremental and extraordinary costs incurred to develop, maintain and mobilize the resources necessary to respond to an extreme event. Preparedness planning is time-intensive and costly. Complicating the situation further is the possibility that during an event, circumstances may prevent the completion of documentation needed for providers to be fully compensated for services through patient billing, which is of particular concern to the private health sector.

Unfortunately due to a general lack of awareness on the part of governments regarding health system preparedness, there are relatively few, if any, programs that provide funding assistance other then for direct patient care and in some jurisdictions, health promotion.

Section 3: Strategies & Initiatives

Responsibility for responding to emergencies and disasters, both natural and man-made, begins at the local level. – Emergency Management Mantra

General

Patient management is a continuous process of health care that increases in complexity based on capability and availability of resources to address specific clinical needs. While optimal patient management should never be compromised unless dictated by the operational situation, it may be necessary to achieve a balance between many conflicting factors, including: treatment and evacuation requirements; resource availability; and the environmental and operational conditions. There are fundamental differences in patient management during a mass casualty situation as compared to routine practice due to the demands for care and the availability of resources. These differences must be recognized and form the

basis of developing concepts, standardising procedures, material and equipment, and assessing human resource requirements.

The effectiveness of the health system will be measured by its ability to maintain its operational integrity while minimising the mortality and morbidity of disaster victims. Therefore, the health care sector must develop community-wide response plans that integrate its capacities into a single, organized response.

Mass Casualty Case Study - London 2005

On the morning of July 7, 2005, four bombs were detonated on the London public transportation system requiring a major mobilization of ambulance services. All told, four suicide bombers had left approximately 700 persons injured. Fifty-six of them (8.0 percent) were dead — a proportion identical to that after the train bombing in Madrid in March 2004, when 191 (8.0 percent) of the 2253 injured persons died. In both attacks, most who died did so at the scene.

A total of 101 ambulances, involving 258 paramedical staff and 56 management staff, responded within one hour. In spite of the confusion generated in the first 1-2 hours, all casualties were cleared from all sites within 4 hours.

A total of 350 patients were transported to hospital with 103 admitted for at least 24 hours. The fact that all 18 emergency surgeons who are assigned to helicopter ambulance services were having a general meeting at the time permitted rapid deployment of teams of emergency surgeons to the actual site by helicopter. Significant triage and first life-saving measures were provided on site.

Process

Risk and Vulnerably Assessment

Adequate preparedness for a surge event requires an objective assessment of risks, an analysis of needs, and the development of appropriate response systems. A component of the risk assessment is vulnerability analysis, a process to determine the impact a hazardous event may have on the community/sector. An adequate response capability is specifically designed to meet the projected health care needs determined by the vulnerability analysis. In contrast, the concept of reasonable preparedness is defined as response capabilities established within the limits of available resources, including funding. (Barbera, Macintyre, & DeAtley, 2001)

When analyzing the mass casualty needs of an incident involving the deliberate release of chemical, biological, or radiation agents, a clear disparity exists between "reasonable" versus "adequate" health care response capabilities. Some of the vulnerabilities that exist during such events include[10]:

- patients who pose a potential threat to health care workers and facilities unless appropriately managed;
- patient conditions requiring unusual and expensive capabilities for adequate management, such as decontamination systems, isolation wards, ventilation requirements, and special medications; and
- health care facilities that could themselves be primary or secondary targets, markedly increasing security requirements.

What to consider

- Triage Protocol
- General Responsibilities
- Tagging And Identification
- Transportation Resources
- Alternate Care Sites
- Credentialing Practitioners
- Crisis Resource Centers

While some US jurisdictions have legislated surge capacity requirements based on arbitrary fixed ratios[11], such as maintaining capability to increase capacity by "x percent", a realistic determination of required surge capacity must consider a number of factors, including a comprehensive risk and vulnerability analysis (RVA).

Preparedness Planning

The health system's ability to rapidly expand its services beyond that of normal operating levels in response to a public health emergency is largely dependent upon the mobilization of all available health care resources, both traditional and non-traditional. In this regard, it is necessary to plan for the integration of all available facilities, equipment and personnel into disaster response plans, particularly at the community level.

[10] See Annex E Supplementary Reading for more information on CBRN casualty management

[11] The US federal Health Resources and Services Administration (HRSA) has established benchmarks for surge capacity staffing to be implemented at the state level. Specifically, states must create a response system that allows for: triage, treatment, and disposition of 500 adult and paediatric patients per one million population who suffer from acute illness or trauma requiring hospitalization from a biological, chemical, radiological, or explosive terrorist incident; immediate deployment of 250 or more additional patient care personnel per million in urban areas; and immediate deployment of 125 or more additional patient care personnel per million in rural areas.

There are few options available when confronted by an unanticipated surge event. An organization can either mobilize the required capability or shift the workload to another facility(s) with the needed capacity. That said, a potential strategy in managing surge would be to mitigate negative impacts through initiatives that defuse the situation before it becomes an issue. A strategy based on an integrated health services approach has the potential to address the provision of initial/pre-hospital medical care and "out-of-hospital" sustaining care for the minor ill and injured in a post disaster situation.

The first step in addressing health care surge should be the implementation of a management system with an established methodology for implementing the medical and health response, as well as the development and maintenance of preparedness programs. Such a system should include provisions that assign key response functions and advocate a management-by-objectives approach. In this way, the system would provide a framework for coordination and integration across the various levels of response. A conceptual framework is provided at Annex B.

Leadership Engagement

Effective disaster health services planning is complex and, as such, requires dedicated resources as well as a strong commitment by senior management in order to minimize the impact of disasters on the health of residents within their jurisdiction.

The role of health leaders during a surge event will vary depending on the jurisdiction and level of authority and accountability. Leaders at all levels of government will need to operate both independently and in harmony with one another. Because of the critical importance of inter-sectoral, inter-professional and integrated planning, all must play roles as collaborators and communicators. Managing both strategy and operations across all levels of government and jurisdictional boundaries is no small task. This is further complicated by the necessity of developing alliances between and among health care organizations, unions, providers, and private sector companies who have different and sometimes incongruent perspectives and needs.

Health leaders will need to address the following issues during a surge event:

- deployment of staff and the use of people from other institutions or jurisdictions;
- health care provider health and safety;
- storage, distribution and security of supplies;
- societal disruption;

- ethics of access to health care services and mandatory report to work policies;
- organizational risk management and liability;
- governance support for the planning process as well as accountability for plans; and
- how to acquire the best available research and establish systems for knowledge transfer.

Sustainable Funding

Public policy must recognize that health sector preparedness for mass and/or specialty casualty scenarios is a public safety function, similar to fire and police services and requires sustained, directed funding sources.

To effectively strengthen the resilience of Canada's health system it will require a national health emergency financial assistance program that focuses on capability building, including hospital surge capacity and community preparedness for health emergencies. Furthermore, it will be essential to establish realistic benchmarks and effective guidelines, with built-in accountability systems. These should accompany the program to ensure an adequate level of preparedness efforts on the part of grant recipients.

Standardization and Interoperability

Disaster health services must be fully integrated and interoperable at all government levels. To the extent possible, planners must address enhanced portability and sustainability between the emergency response and acute care systems through identification, availability and use of standardized equipment and protocols for communications, personal protection and agent detection, as well as for medical and operational emergency preparedness throughout the duration of an emergency event.

Standardization

Compatibility – "My System (or procedure) does not interfere with yours".
Interoperability – "My system (or equipment) can talk to yours".
Commonality – "We utilise the same doctrine, procedures, or equipment".

It should be noted that Canada currently subscribes to standardization of patient management by ratifying and implementing formal agreements through international forums, such as the North Atlantic Treaty Organisation (NATO). The Emergency War Surgery Handbook, a widely used disaster medicine reference, is an example of an international effort to achieve consistency in casualty care.

Mutual Assistance

As most communities would be overwhelmed by a major mass casualty event, health planners must prepare for the possibility that outside assistance may be delayed or may not arrive at all within the critical hours post-event.

Naylor and others have clearly articulated the need for multi-jurisdictional collaboration in public health (Learning from SARS: Renewal of Public Health in Canada, 2003). It has become evident, particularly during a complex emergency/disaster such as Hurricane Katrina, that multilateral approaches are often the most efficient means to address gaps in health system capacity. In this regard, pre-negotiated arrangements between entities will greatly expedite the provision of assistance.

It should be noted that intra-health authority/region mutual assistance arrangements are as, and possibly more, essential as inter-jurisdictional arrangements.

Human Resource Management

Virtually all surge management strategies will have a "human resources" component and are thus dependant on certain enablers being in place prior to an event. Items that merit consideration include:

- *Collective agreements.* Do collective agreements permit the increase in hours of work and relocation and/or reassignment of staff between geographic work areas during a surge event?
- *Liability indemnification/protection*. Are auxiliary/augmentation staffs covered under the organization's liability protection program?
- *Compensation and benefits*. Are there provisions for appropriate compensation and benefits for all staff?
- *Scope of Practice.* Are there provisions to extend scope of practice?

Whether man-made or natural, disasters have demonstrated significant challenges with regard to government policy with regard to medical liability, standards of care and license reciprocity to enable volunteer health professionals to participate in disaster response. Only when the human resource issues are addressed will it be possible to begin considering the development of mitigation and management strategies.

The development of a nationally integrated, fully interoperable, technologically based system(s) for the rapid identification and mobilization of appropriately educated, duly licensed and certified, disaster-credentialed and privileged, and collectively indemnified health care professionals to jurisdictions where an health emergency exists should be considered a priority.

Education and Training

There is an urgent need to define the knowledge, skills, attitudes and proficiencies needed by health care and allied professionals for the management of patients during both day-to-day emergencies and catastrophic mass casualty events. Organizations responsible for or engaged in the education, training and continuing education of health and allied professionals must define and incorporate disaster preparedness and emergency care competencies into discipline-specific educational curricula at the undergraduate, graduate and postgraduate levels.

Regulatory and other health professional bodies should be encouraged to embrace comprehensive, standardized and competency-based disaster education and training programs, such as Disaster Life Support[12] and the Disaster Extreme Event Preparedness (DEEP)[13] programs, for health emergency responders. Such programs should:

- use an all-hazards approach;
- cover the full spectrum from prevention and mitigation to response and recovery;
- provide specific information to address psychosocial, ethical and legal issues, and the needs of particular at-risk populations (such as, children, disabled, frail elderly);
- use a common vocabulary (such as, glossary of terms and definitions) to provide consistent information across disciplines;
- provide emergency responders with a fundamental mutual understanding and working knowledge of their integrated roles and responsibilities at a disaster scene; and
- allow for pan-Canadian portability.

[12] The American Medical Association has developed a National Disaster Life Support Program
[13] Developed by the University of Miami, Miller School of Medicine

Public Awareness and Risk Communications

Public understanding and acceptance of disaster health service plans is essential to their successful implementation, thus messages should be consistent and timely at all stages. Therefore, the health system must actively collaborate with the media and policymakers to accurately inform and educate the public about the potential risks and available coping strategies associated with disasters. Such information should be provided both pre- and post-event to enhance individual and community resiliency.

Clear communication with the public is essential before, during, and after a mass casualty event to manage anxiety and educate the public about the impact of an event, who to call for information, where to go for care, and what to expect. In this regard, the public should be brought into the discussion during the early stages of planning so that citizens develop a clear understanding of concepts being considered, such as the suspension of elective services or the rationing of resources.

Health related messages should be delivered through public media by a local health official, preferably a physician, whom the public perceives as having knowledge of the event and the area. It may also be appropriate to engage a representative of the provincial/territorial Ministry of Health depending on the nature of the event and the level of communication necessary. Regardless, spokespersons at all levels, local, provincial/territorial and federal, should coordinate their messages.

Additionally, it may be necessary to adapt the mode of communication according to the type of information to be communicated, the target audience for which it is intended, and the operating condition of media outlets, which may be directly affected by the event. Examples that illustrate this point could be the use languages other than English or alternatives to usual media outlets in the affected area.

Public Health

In addition to health care services, the Public Health (PH) sector must have contingency plans that cover the following:

- rapid enhancement of the surveillance system;
- information system support for contact tracing;
- training and redeployment of staff with field epidemiology, contact tracing and outbreak control expertise;

- extended laboratory capacity in collaboration with universities, local and international organisations; and
- availability of designated quarantine and isolation centres.

PH services should engage private practitioners and para-medical organisations regarding their potential involvement to provide backup services during an outbreak. There is also a need to engage non-government organisations which provide essential support for patients who are chronically ill and who may be further disadvantaged in a disaster situation.

Practice

There are a number of enabling practices that merit consideration in preparing for any category of surge event – sudden impact or protracted. These enabling strategies include:

Patient Management

Patient management is a dynamic decision-making process that must be applied throughout all levels of medical care. It does little good to move patients from one point to another if the receiving point is not prepared to handle them. During disaster response it is organised into a continuum of care extending from the incident site, through emergency and acute care services, up to and including full recovery.

There are fundamental differences in patient management during a mass casualty situation as compared to routine practice due to the demands for care and the availability of resources. These differences must be recognized and form the basis of developing concepts, standardising procedures, material and equipment, and assessing human resource requirements. It should be noted that Canada currently subscribes to patient management standards through ratifying and implementing formal agreements established by international forums, such as the North Atlantic Treaty Organisation (NATO). The Emergency War Surgery Handbook, a widely used disaster medicine reference, is an example of an international effort to achieve consistency in casualty care.

The first, and probably most important, step is the implementation of a continuous integrated triage process. Triage, or sorting, implies the evaluation and classification of casualties for purposes of treatment and evacuation. It is based on the principle of accomplishing the greatest good for the greatest number of casualties, particularly in catastrophic health and mass casualty events. The critical decision concern: the need for resuscitation and emergency surgery; and the futility of surgery when the intrinsic lethality of certain injury is clearly overwhelming. Triage also involves the establishment of priorities for treatment and evacuation.

The START (Simple Triage and Rapid Treatment) system[14], widely used in Canada, is an initial assessment tool and should not be used for extended patient holding areas. Once patients are received into treatment and holding areas, a more thorough assessment and triage process should be performed. START relies on making a rapid assessment - based on three assessment criteria: respiration, pulse and mental status - of every patient, determining which of four categories patients should be in and visibly identifying the categories for responders who will treat the patients.

Triage Categories

- Green (Minor) walking wounded who need prompt care within 12 – 24 hours
- Yellow (Delayed) not mobile due to mental or traumatic injuries and need to evacuated within 2 hours
- Red (Immediate) requires immediate evacuation due to life threatening injuries.
- Black (Deceased) victims who died or are expected to die.

The next most important step is the activation of a patient regulating process to coordinate the movement of patients from the site of injury or onset of disease through the successive levels of the care continuum to medical facility that can provide the appropriate treatment and care. Prompt movement of patients to the required level of professional care is necessary to avoid increased morbidity and mortality.

Casualties from a catastrophic incident may require transport, regulating, and tracking from the site to treatment facilities providing definitive care that are located in the surrounding community, the surrounding region, or possibly in other parts of the country. A system that can be used during a mass casualty or

[14] Developed by Hoag Hospital and the Newport Beach Fire Department (Newport Beach, CA),

evacuation incident for the purposes of locating, tracking, and regulating patients and evacuees, as well as provide decision support to persons and organizations with responsibility for patient and evacuee movement and care, health care and transportation resource allocation, and incident management.

A disaster patient management and regulating system is intended to link, but not replace, existing public-private systems and to serve as a solution in those localities where access to such systems is not currently enabled. As such, these systems need to be designed for flexibility and interoperability with pre-existing systems in the public and private domain over a defined geographic area. The need to integrate siloed systems, so that they can inform decision makers on sources/destinations, critical personal information and evacuee status is emphasized by experience from prior disasters

Resource Management

The availability of required resources in terms of both capability and capacity is critical to the success of any response plan. Emergency management and incident response activities require carefully managed resources (personnel, facilities, equipment, and/or supplies) to meet incident needs. In this regard, it is essential that up-to-date inventories be developed and maintained to enable emergency responders to locate specific resources based upon mission requirements, capability of resources, and response time

Resource management should be flexible and scalable in order to support any incident and be adaptable to changes. Efficient and effective deployment of resources requires that resource management concepts and principles be used in all phases of emergency management and incident response.

The resource management process can be separated into two parts: resource management as an element of preparedness and resource management during an incident. The preparedness activities (resource typing, credentialing, and inventorying) are conducted on a continual basis to help ensure that resources are ready to be mobilized when called to an incident. Resource management during an incident is a finite process, as shown in the below figure, with a distinct beginning and ending specific to the needs of the particular incident

On-line resources, such as the Emergency Preparedness Resource Inventory (EPRI) provide tools allowing local or regional planners to assemble an inventory of critical resources that would be useful in responding to a catastrophic health emergency (Emergency Preparedness Resource Inventory: A Tool for Local, Regional, and State Planners, 2005).

Volunteer Engagement

Disaster situations often involve the mobilization of large numbers of health care personnel raising questions about the "practice of medicine" and scope of practice in jurisdictions where an individual is not licensed. Ensuring proper licensure and credentialing has legal implications both for health professionals and facilities utilizing their services. The public will also expect that the best available treatments be offered in circumstances where the short-term lack of emergency and critical care services requires the application of alternative standards of care.

Altered Standards of Care

In planning for a mass casualty or other catastrophic health event, the aim should be to keep the health care system functioning and to deliver an acceptable quality of care to preserve as many lives as possible. Adhering to this principle will involve: allocating scarce resources in order to save the most lives, developing a basis for the allocation of resources that is fair, open, transparent, accountable, and well understood by both professionals and the public, and ensuring, to the extent possible, a safe environment for the provision of care, and placing a high priority on infection control measures and other containment processes.

The rights of individuals must be protected to the greatest extent possible and reasonable under the circumstances, particularly when determining the basis on which scarce resources will be allocated, when considering limiting personal freedom through quarantine or isolation measures as well as the conditions for release, and when privacy and confidentiality may need to be breached.

Task Shifting

Task shifting is the name now given to a process of delegation whereby tasks are moved, where appropriate, to less specialized health workers. By reorganizing the workforce in this way, task shifting can make more efficient use of the human resources currently available. For example, when doctors are in short supply, a qualified nurse could often prescribe and dispense antiretroviral therapy. Further, community workers can potentially deliver a wide range of HIV services, thus freeing the time of qualified nurses. Training a new community health worker takes between one week and one year depending on the competencies required. This compares with three or four years of training required for a nurse to fully qualify.

Contingency Supply Stocks

A large scale natural disaster or an act of terrorism targeting the civilian population will require rapid access to large quantities of pharmaceuticals and medical supplies. Such quantities may not be readily available unless special stockpiles are created. In addition, having a stockpile of supplies on hand can help staff members to respond immediately to a disaster rather than spending valuable time gathering resources from various locations. As no one can anticipate exactly where an event will occur and realistically few local health facilities have the resources to maintain sufficient stockpiles on their own, consideration should be given to the creation of regional stockpiles with strategically located caches. These caches of pharmaceuticals, antidotes, and medical supplies should be specifically designed for rapid access by local responders.

Sudden Impact Event

In sudden impact situations the consequences are generally short-term and coping is within the realm of possibility depending on the casualty load. Most health care facilities have and frequently active "Code Orange" plans to deal with the sudden workload surge resulting from a multiple casualty incident (MCI). A "Code Orange" is essentially the mobilization and effective management of integral on-site resources.

There are a range of short-term strategies that may be applied to increase capacity and/or capability where resource shortages can be expected to be resolved relatively quickly (within hours or days). Annex C lists some potential short-term strategies identified by the United States Agency for Health care Research and Quality (Mass Medical Care with Scarce Resources: A Community Planning Guide, 2007).

Effective surge mitigation and/or management requires a proactive approach to prevent facility over-crowding and gridlock through continuous triage and out-of-hospital treatment of those patients not requiring complex interventions. Through a integrated approach in planning and capability development it may be possible to significantly mitigate the negative impacts of a surge event on the health system.

Disaster Reality

- 50-80% of casualties by-pass EMS
- EMS transports 20% casualties but 88% of admissions
- Bystanders transport 80% of casualties but only 11% of admissions

To maximize the potential capacity available in the community, planners should consider the establishment of a process to transition community health care resources from an organization-focused approach to an emergency response one that encompasses the full community. Realistically, however, this will only be achieved if local health authorities are provided the required funding and other resources and held accountable for overseeing the planning, assessment and maintenance of the preparedness program.

Planning should include developing integrated plans to set up and provide facilities - preferably away from acute hospital sites - to assist in the triage, diagnosis, treatment and support of those patients who are not obviously seriously ill or injured. Planners should also consider options to maintain patients in the community and limit or avoid referrals to acute hospitals as far as possible. Plans should also consider the extent to which community staff and general medical practitioners could be deployed to supplement acute services if that is required

The objective of a community based, integrated approach to surge management/mass casualty care is to increase frontline capacity to deal with the minor injured/ill in a post-event situation. When fully activated, this approach has the potential to significantly reduce the surge impact on hospitals. Unfortunately, few jurisdictions have adopted an integrated approach to emergency/disaster health services that bridges the gap between public and private health care providers in dealing with the health impacts of emergencies and disasters.

Disaster Health Service

Where the capability and resources exist and can be mobilized, it is suggested that consideration be given to the creation of a comprehensive disaster health services (DHS) organization (Annex D). As community based rapid response capability the DHS integrates all available public and private sector health care resources, including associated care providers. Ideally, the DHS would have sufficient supplies and equipment to sustain themselves for a period of 72 hours, while providing medical care at one or more fixed or temporary care sites. In a disaster situation, responsibilities would include patient triaging, providing high-quality emergency/pre-hospital care and preparing patients for evacuation.

While a DHS would be an effective approach for the management of casualties not requiring critical care the reality is that many of those capable of self evacuation will have done so before the capability became operational. That aside, adopting a DHS approach and educating the public accordingly has the potential to significantly help in reducing post-disaster hospital gridlock.

In other types of situations, the disaster health service could provide primary medical care/triage and/or sub-acute sustaining care to reduce demand on the acute care system. Such a scenario might include assisting with mass

chemoprophylaxis (a mass vaccination program). Under the rare circumstance where disaster victims are evacuated to a different locale to receive definitive medical care, DHS resources may be activated to support patient reception and disposition of patients to hospitals. The DHS provides a "treatment bridge" between the event site and the acute care sector. It is intended to reduce the initial surge impact on the acute care sector or more effectively manage the surge and supplement the local health care system until other provincial/territorial resources can be mobilized, or the situation is resolved. The aim of this systems approach to disaster health services is to admit to hospital only the most seriously ill or injured.

Protracted/Sustained Impact Event

While the impact of sudden surge events, characterized by multiple traumatic injuries, is generally limited in time and scope, the impact of epidemic or pandemic events will be protracted for weeks or months and may produce one or more surge waves. While both sudden and protracted events require the health system to maintain routine health services, the impact of a protracted event on the health system will require both innovation and flexibility on the part of health planners.

Alternate Care Facilities

All health care organizations should have contingency plans for the rapid activation and operation of a temporary "alternate care" facility(s) where treatment and care can be rendered without compromising the main facility. In this regard, health planners should engage their local government contacts to assist in finding suitable facilities sufficient to meet the needs of the health authority, who would directly negotiate and pay for the use of such facilities. The intent of setting up the alternate care facility is to demonstrate to impacted communities that the health care system will continue to take care of the ill and injured.

In areas with a potential high risk of a natural disaster, the planning and construction of new structures, such as libraries, civic centres, or community centres, the local government should consider the requirement for a dual-use concept in construction plans.

Section 4: Mass Casualty Response Model

Mass Casualty Management

Mass Casualty Protocol

- Do the greatest good for the greatest number
- Make the best use of personnel, equipment and resources
- Do NOT relocate the disaster

In the event of a conflict, the MCI protocol supersedes all others

The basis of mass casualty patient management is the ability to:

- provide effective first aid treatment and life-sustaining procedures immediately following injury or the onset of illness;
- protect patients from complications, including protection from environmental and weapons effects;
- document personal particulars of each patient and basic details of the illness or injuries sustained and treatments given;
- treat injuries as early as possible, returning as many patients home as possible;
- evacuate patients as rapidly as possible, from the point of injury or onset of illness, to a place of comparative safety where initial primary care and/or secondary primary care facilities exist;
- evacuate patients following stabilization to acute (definitive) and tertiary (convalescent or rehabilitative) care facilities as appropriate; and
- provide definitive, long term nursing/convalescent rehabilitative care, and other specialist services as required by a patient's condition.

Sudden Impact

To maximize the emergency response potential available in the community, planners should consider the establishment of a process to transition community health care resources from an organization-focused approach to a model that encompasses the full community.

Realistically, this will only be achieved if local health authorities are provided the required funding and resources, while being held accountable for overseeing the planning, assessment and maintenance of the preparedness program.

The objective of disaster health services approach to surge management/mass casualty care is to increase frontline capacity to deal with the

minor injured/ill in a post-event situation. When fully activated, this approach has the potential to significantly reduce the surge impact on hospitals.

First/Self Aid

First/self aid is the emergency or life-saving care given to an ill, sick, or injured person when a health care provider is not immediately available. First aid includes the application of measures (restore breathing and heartbeat, to stop bleeding, and to intervene against shock and infection), to prevent a casualty's condition from becoming worse, and the use of proper methods in moving a casualty to a point of relative safety to await care and evacuation by medically trained personnel. The capacity of individuals to cope in a post disaster situation will be significantly enhanced by adherence to a familiar process for accessing health care and information.

Existing organizations, such as Neighbourhood/Block Watch, should be engaged at this level with support being provided from individual, family, neighbourhood and community resources, such as the 72 hour self-sufficiency kits recommended by emergency management practitioners.

Victims able to evacuate the danger area should be directed what to do and where to go using bull-horns or other mass communication devices. To reduce the volume of patients seeking assistance at health care facilities, it is essential that individuals not requiring hospital level care be directed to an appropriate emergency treatment centre or walk-in clinic.

Initial Medical and Psychosocial Intervention

Initial medical and psychosocial intervention should be initiated as soon as possible after injury or onset of illness. This is the initial care and triage provided by trained[15] personnel, usually by paramedics and/or general practitioners.

This includes the skilful application of examination techniques, performance of emergency or life-saving measures, and continual observation and care to ensure that the airway remains open, that bleeding has been controlled, and that shock, infection and further injury are prevented. Initial medical care may include basic intravenous and prophylactic therapies applied by non-medical personnel, such as St John Ambulance first responders, and includes the arrangement for evacuation.

[15] Minimum life-saving skills and knowledge to perform patient care

While this level of support falls within the Emergency Health Services mandate, effective support will require the full mobilization of public and private sector resources. Some of these resources include general practice physicians, nurses, first aiders and other care givers, including non-traditional or alternative care practitioners, that could act as an extension of community health care.

Generally for pre-event planning, communities will designate and identify major general practice clinics Disaster Assistance Clinics (DAC) for the use as primary triage and treatment sites in their all-hazard response plan. A cache of response (medical) supplies should be pre-positioned within or in close proximity to each DAC to complement neighbourhood response resources. The DAC should be promoted as an established component of local health infrastructure to gain public acceptance as part of their community health culture.

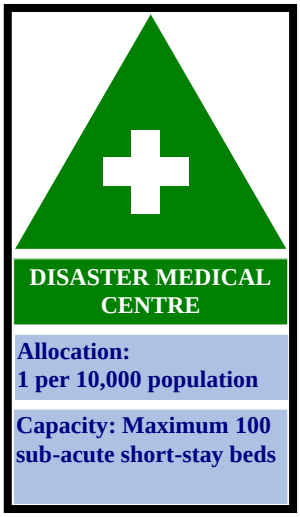
Emergency and Life Sustaining Care

The next level in the casualty care continuum focuses on emergency life saving/sustaining care provided at a community Emergency Treatment Centre (ETC). As a pre-hospital urgent/emergency care facility, the ETC provides advance trauma life support (stabilisation) within the capability and capacity of the specific facility, which may vary from jurisdiction to jurisdiction. Typical care would include: maintenance of cardio-respiratory function, control of haemorrhage, alleviation of shock through vascular volume replacement, relief of pain, control of body temperature, application of more secure dressings and splints, and protection from complications, including environmental effects. While this level of support generally falls within the Emergency Health Services (EHS) pre-hospital care mandate, timely and effective support may require the mobilization of the full spectrum of public and private sector medical resources, both professional and para-professionals, including retired practitioners.

The ETC will utilize a deployable equipment assembly and ideally be based on an established community health facility which has been designated and identified as a disaster ETC. Similar to the DAC, the ETC should be promoted as an established component of local health infrastructure and in order to gain public acceptance as part of their community health culture, similar to other existing emergency capabilities.

In addition to a disaster response role, the ETC can also function, either independently or in conjunction with other health resources to provide pre-hospital minor treatment during major special events.

Sub-Acute Treatment and Sustaining Care



The final pre-hospital level of care is sub-acute treatment and sustaining care which may involve short-term in-patient care. The conceptual facility providing this level of care is the Disaster Medical Centre (DMC). The DMC is resourced to treat a range of non-life threatening injuries and ensure earlier efforts toward stabilisation of patients requiring more extensive care are not compromised. The DMC capabilities include the application of clinical judgement and skill by a team of physicians and other health care practitioners with access to a broad range of equipment and supplies and functions similar to a community Urgent Care Centre. In-patient care is limited to: observation, hydration, pain management, and antibiotic/antiviral therapy as there is only limited capability for mechanical interventions. It is at this level arrangements are made to transfer patients who require a more comprehensive scope of care to an appropriate definitive care facility. The DMC function is the pivotal span in the "treatment bridge" between the primary and definitive levels of care.

In addition to a disaster response role, DMC functional components could also operate, either independently or in conjunction with other health resources to temporarily replace or augment a hospital emergency or surgical capability during a renovation or other service interruption event.

NOTE: Those victims who also require acute or critical medical treatment for other conditions such as heart attack, traumatic injuries, or severe exacerbations of chronic conditions, such as diabetes mellitus, should be transported to an acute care centre where required specialized resources are available.

Rapid Response Team (RRT)

RRTs are specialized teams that enable a cost effective means of addressing capability gaps between facilities within an organization or geographic jurisdiction. While most hospitals have Cardiac Resuscitation Teams, few community health services have shared Triage Teams. It is important that organizations examine their resources and culture when establishing a RRT to

build on existing relationships and practice patterns. Ideally team structure should maximize members' capabilities both as responders and educators.

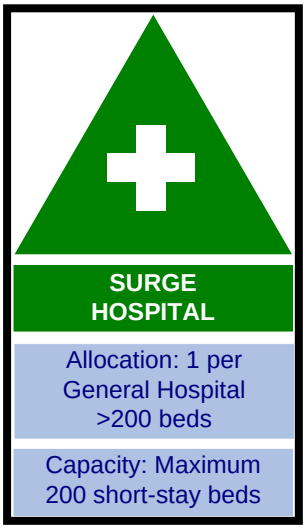
Effort should be made to engage and utilize health professionals in formally organized and trained emergency response teams, such as Rapid Intervention Trauma and Outbreak Management Teams, to supplement existing resources within provincial/territorial boundaries and across jurisdictional lines. Health care organizations should promote such efforts and provide information to interested members on how to become more involved in local disaster health services initiatives.

A Rapid Intervention Trauma Team (RITT), comprised of 20-40 people, is designed as a rapidly deployable capability for immediately respond to a disaster scene and provide care. The team is scalable in size, allowing for different functional configurations. The team could typically be on the scene within hours and is self-sufficient for 24 hours. Their role is essentially to go in, stabilize the medical situation and save as many lives as possible. The RITT could easily be described as "the SWAT team of disaster health services."

Protracted/Sustained Impact

Characterized by multiple traumatic injuries, the impact of sudden surge events is generally limited in time and scope. As an example, the impact of epidemic or pandemic events will be protracted lasting weeks or months and may produce one or more surge waves. While both events require the health system to maintain routine health services, the impact of a sustained event on the health system will require both innovation and flexibility on the part of health planners.

Surge Hospital



One strategy to effectively respond to the health and medical needs arising from a prolonged incident is to activate and mobilize pre-planned surge facilities. In this regard, all health care organizations should have contingency plans for the rapid activation and operation of an alternate care site or "Surge Hospital" outside their normal health operations where hospital medical staff can continue to provide care for non-acute patients.

Health planners should engage their local government to assist in finding suitable facilities sufficient to meet the needs of the health authority, who ultimately negotiate and pay for the use of such facilities. The intent of setting up an alternate care facility is to demonstrate to impacted

communities that the health system will continue to take care of the ill and injured.

Restricting the type of patients treated at these centres serves two purposes. First, it allows a streamlined approach to patient care by recognizing most patients will require similar treatment that follows pre-established critical pathways or clinical practice guidelines. Second, in situations where isolation is desirable but impractical, it facilitates cohorting patients with similar infections/exposures in one location limiting exposure of non-infected persons to the disease.

9/11 Surge Hospitals

Surge hospital can increase the medical capacity of current health systems, meeting the needs of a sharp increase in patient population. An example of this effort was the September 11, 2001 attack on the Pentagon in which "ER ONE", a surge hospital set up two miles from the capitol building effectively increased the ability of local hospitals in the District of Columbia to handle over 5 times the typical capacity.

An example of surge management from September 11th, 2001 in New York was based on the two major hospitals closest to the World Trade Center: the New York University Downtown Hospital, a medium-sized public hospital, and the Bellevue Hospital, a large public hospital. As the events unfolded, New York's hospitals including eighteen state designated trauma centers seven of which were designated level 1 trauma, peripheral special care units and private hospitals all activated their disaster plans. The plans oversaw area triage in the Chelsea piers, shops, hotel lobbies, and stores and evacuations through the East and Hudson Rivers to get to Staten Island and New Jersey

As with all disasters, responding medical personnel must be trained to understand that their natural instinct to deliver as much care as needed for each patient is not optimal and may be counter-productive. In this regard, predefined criteria for the delivery of care (standing admission orders) and guidelines for discharges will provide the framework to assist medical personnel in applying a reduced care delivery model.

Positioning a hospital near the site of every potential disaster is impossible, yet a patient with serious injury needs to be transported to surgery within the *"Golden Hours*[16]*"* after the injury occurs for the best chances of survival. Health care planners have developed a number of innovative ways to confront surge at the hospital level. These solutions include opening "mothballed" hospitals or closed wards in an existing facility, temporarily using functionally compatible buildings in the community, transporting mobile medical facilities to the site and using the above mentioned types of temporary facilities to augment hospital capacity.

Incident Command System Key Concepts

- Unity of Command
- Common Terminology
- Management by Objective
- Flexible/Modular Organization
- Span-of-control

In areas with a potential high risk of a natural disaster, the planning and construction of new structures, such as libraries, civic centres, or community centres, should consider the requirement for a dual-use concept in construction plans.

Command and Control

A critical step in addressing health care surge is the implementation of an incident/emergency management system that establishes a methodology for managing medical and health response, as well as the development and maintenance of preparedness programs.

Recognizing that many different organizations participate in the response to a disaster it is imperative that a common organizational structure and organizational language be adopted to allow response agencies to work together effectively. The basic need is for an effective integrated response is that it is managed through a recognized incident command (ICS) or unified command (UC)[17] system. The unpredictability and complexity of disasters requires an emergency management system that recognizes the need for fluidity of authority to adjust to changing needs and that there may be multiple, but unified authorities managing the event.

[16] That period after injury during which life and death is decided. The appropriate interventions during this period can yield good clinical outcomes with modest resource implications.

[17] Incident Command System/Unified Command (ICS/UC) is an efficient on-site tool to manage all emergency response incidents, and UC is a necessary tool for managing multi-jurisdictional responses. For more information go to http://training.fema.gov/EMIWeb/IS/IS100a.asp

Two incident management systems that are intended specifically for the health and emergency social services sectors are the "Hospital Emergency Incident Command System" (HEICS) and the "Medical and Health Incident Management" (MaHIM) (Hospital Emergency Incident Command System, n.d.). HEICS applies the principles of the Incident Command System to the hospital setting. MaHIM describes an overarching system for organizing and managing the many diverse medical and public health entities involved in mass casualty response" (Barbera & Macintyre, 2002). Most provinces and territories in Canada use an incident management system that is based on the Incident Command System (ICS). British Columbia for example, uses a multi-level emergency management system similar to what has been proposed above. Healthcare facilities use HEICS while regional health authorities use the British Columbia Emergency Response Management System (BCERMS) which is based on ICS.

Section 5: Systems & Programs

Operational Systems

There are a number of systems, equipment modules and configurations in use in Canada and the United States for health planners to consider in developing the best model for a particular jurisdiction.

Emergency Medical Assistance Team (EMAT) – Ontario

EMAT is a 20-bed, acute-care field unit, with its own medical equipment and supplies, a communications centre, electricity and water. It can be sent anywhere in the province in crisis situations to provide acute care to patients for a limited period of time. EMAT is staffed by a volunteer, on-call support team of healthcare professionals which includes physicians, paramedics, nurses and respiratory therapists.

EMAT provides a staging and triage base for the evaluation and management of patients prior to them being transported to a hospital. It can also isolate patients who have infectious diseases in a tent that filters the air at a level greater than national standards. EMAT can be self-sufficient operationally for 72-hours without needing outside resources. It can travel for 3,200 kilometres before refueling.

Emergency Medical Assistance Task Force (EMATF) – Calgary

The EMATF involves the management, planning and coordination of staff, vehicles and equipment during a major disaster situation. The program includes a mobile rescue command unit (MRCU) and several specialized vehicles including a 53-foot, Featherlite NASCAR-style trailer, which can support 40 EMS personnel for a 10-day period, independent of any local infrastructure support.

The Medical Rescue Command (MRC) vehicle, a mobile command post and equipment vehicle built on a five-ton International chassis, carries portable tents and other equipment that can be quickly deployed to manage approximately 100 casualties. Two medical rescue support (MRS) vehicles, based on an F-550 chassis, can deal with up to 60 casualties per unit. EMATF can be deployed in the event of a temporary loss of access to health facilities, due to a disease outbreak or other critical situation. The EMATF goal is to activate within two hours of a decision to deploy, and may be used in Calgary, the neighbouring health region or possibly outside Alberta.

Carolina's MED 1 – North Carolina

MED 1 is a one-of-a-kind prototype mobile hospital. The mobile emergency department consists of two 53-foot tractor trailers. The patient-care trailer features three slide-out pods: One provides a two-bed shock-resuscitation and surgical unit; the other a 12-bed critical- and emergency-care unit, both with a full complement of monitors, equipment and tools. An attached awning system can shelter up to 130 more beds outside. MED-1 also boasts diagnostic and laboratory resources, enough medications for 72 hours, a complete communications infrastructure and its own power source.

The unit is staffed by physicians, nurses and associated personnel from Carolinas Medical Center, a Level 1 trauma center, and paramedics from the Mecklenburg Emergency Medical Services Agency, assisted by tactically trained

and federally deputized law enforcement personnel. Staff members are expected to rotate in and out every week or so.

The Vancouver 2010 Olympic and Paralympics Winter Games Olympic Committee (VANOC) will co-locate a Mobile Medical Unit (MMU) similar to the Carolina's MED-1 with the Whistler Athletes' Village Polyclinic. The MMU will be capable of life, limb and organ saving interventions should patient condition or other factors preclude evacuation to a major trauma centre.

Mobile Field Hospital (MFH) – California

Three vendor managed, turn-key Mobile Field Hospitals (MFH) are stored in secure strategic locations in southern, northern and central California allowing a rapid delivery by ground, air or sea to an affected area. Each 23,000-square-foot MFH contains 200 beds and can provide services ranging from emergency/triage to intensive care. The mobile hospital contains operating rooms, two 10-bed intensive care units and radiology, pharmacy and laboratory units. Support equipment includes a power generation system, HVAC systems, electrical distribution systems, and specialized mobile medical equipment including ventilators, monitors, diagnostic equipment and portable oxygen delivery systems.

The hospitals are scalable in size, allowing for different configurations. In the event of a catastrophic event, multiple field hospitals can be assembled to fit together. When combined, the three MFHs can provide 600 patient beds, treatment space for 60 emergency care patients, three operating rooms, along with medical equipment and support services as needed to restore or replace available hospital beds at the scene of a disaster or public health emergency.

Canadian Federal Programs

The following paragraphs describe a number of federal programs that should be considered as potential enablers when considering the development of a model IDHS system.

Joint Emergency Preparedness Program

Public Safety Canada (PS) administers the Joint Emergency Preparedness Program (JEPP), which was created to help ensure that all levels of government

across Canada are equally prepared to respond to emergencies. The JEPP provides funding and support to emergency preparedness and critical infrastructure protection projects and initiatives. Projects are jointly financed by federal, provincial and territorial governments, with the aim to reduce injuries and loss of human life, property damage, and to assure the continuation of critical services in an emergency. For example, funds from the program have been used for training, the purchase of emergency response equipment, emergency planning and capacity building.

JEPP projects are proposed annually by the provincial and territorial governments and selected for funding based on national and regional priorities. The federal share of project costs depends on the nature of the project, other projects under consideration and the amount of funds available. The federal contribution becomes payable only after the project has been completed and the invoices for costs incurred have been paid and submitted by the provincial or territorial governments for reimbursement. Currently, approximately $5 million is made available for emergency preparedness and critical infrastructure protection projects every year.

National Emergency Stockpile System

The Public Health Agency of Canada's (PHAC) National Emergency Stockpile System (NESS) is a collection of disaster oriented medical supplies that are packed for long term storage and arranged into different units based on specific response functions. These supplies are intended to supplement the health sector's response to large emergencies and disasters. Pre-positioned supplies are available for immediate use at the discretion of provinces/territories while the Public Health Agency of Canada also holds a national inventory of supplies for use across the country as needed. While some pharmaceuticals are held in the NESS Central Warehouse most of the pharmaceutical stockpile is held for the Agency by the manufacturers as obligated stock. Manufacturers are able to regularly rotate the stock, utilizing their client supply chain, ensuring that up-to-date drugs are accessible when required.

The pre-positioned NESS equipment modules include:

- *Emergency Hospital (EH).* The EH is a self-contained 200 bed + 72 stretcher transportable facility that can provide acute, short term care of up to 200 patients (19 tonnes). The EH requires 30,000 sq ft. accommodation in an

existing structure (e.g. school, sports arena). These units are positioned throughout the country and can be deployed on short notice (within 24 hours) in either two 48' trailers, one rail boxcar, or one C130 Hercules aircraft and are designed to be set up in existing buildings.

- *Advance Treatment Centre (ATC).* The ATC supports field triage of victims/evacuees with supplies for early medical stabilization and transport of up to 500 casualties before refill and the transport of patients to health facilities. The unit is transported in one - 5 ton (14') truck box. NOTE: A NESS Strategic Review has recommended that ATCs be phased out and replaced by Mini-Clinics.
- *Casualty Collection Unit (CCU).* The CCU supports immediate first aid and movement of patients with initial supplies for 500 casualties and can be transported in one 12' truck box.
- *Mini-Clinic (MC).* The MC is designed to supplement health care facilities. In emergency response situations that overwhelm existing public health systems, the clinic would be located adjacent to the impacted facility(s) in order to triage and treat the less seriously injured casualties. The clinic has the capability to support the first aid treatment of minor injuries to the stabilization of seriously injured casualties until they can be moved to a more definitive medical facility. The unit can provide: first aid; maintenance of free airway; control of haemorrhage and shock; pain management; and infection control. Available equipment and supplies include: First Aid supplies, medical supplies and equipment (catheters, suturing material, electric sterilizer, etc.); intubation supplies and equipment (airways, suction apparatus, hand and battery operated, etc.); intravenous solutions and supplies; bulk supplies (pharmaceuticals, dressings, orthopaedic material, etc).

National Office of Health Emergency Response Teams

PHAC has established the National Office of Health Emergency Response Teams (NOHERT) to field multi-disciplinary Health Emergency Response Teams (HERT) comprised of volunteers from a number of health disciplines, including epidemiologists, physicians, nurses, psycho-social and emergency social services professionals as well as specialty teams for chemical, biological, radiological, nuclear and explosive (CBRNE) response. It is planned that teams, together with appropriate equipment, will be located throughout the country to support provinces and territories when requested or to respond to multiple complex emergencies on a national scale. Significant progress has been made in the development of a Concept of Operations and Training and Equipment Management manuals and the procurement of shelters and associated infrastructure equipment.

Annex A: Health Care Continuum

Patient management in disasters is generally organised into a continuum of care extending from the incident site to a facility where comprehensive medical care can be received. The continuum comprises the following levels of care expressed in terms of its specific response role.

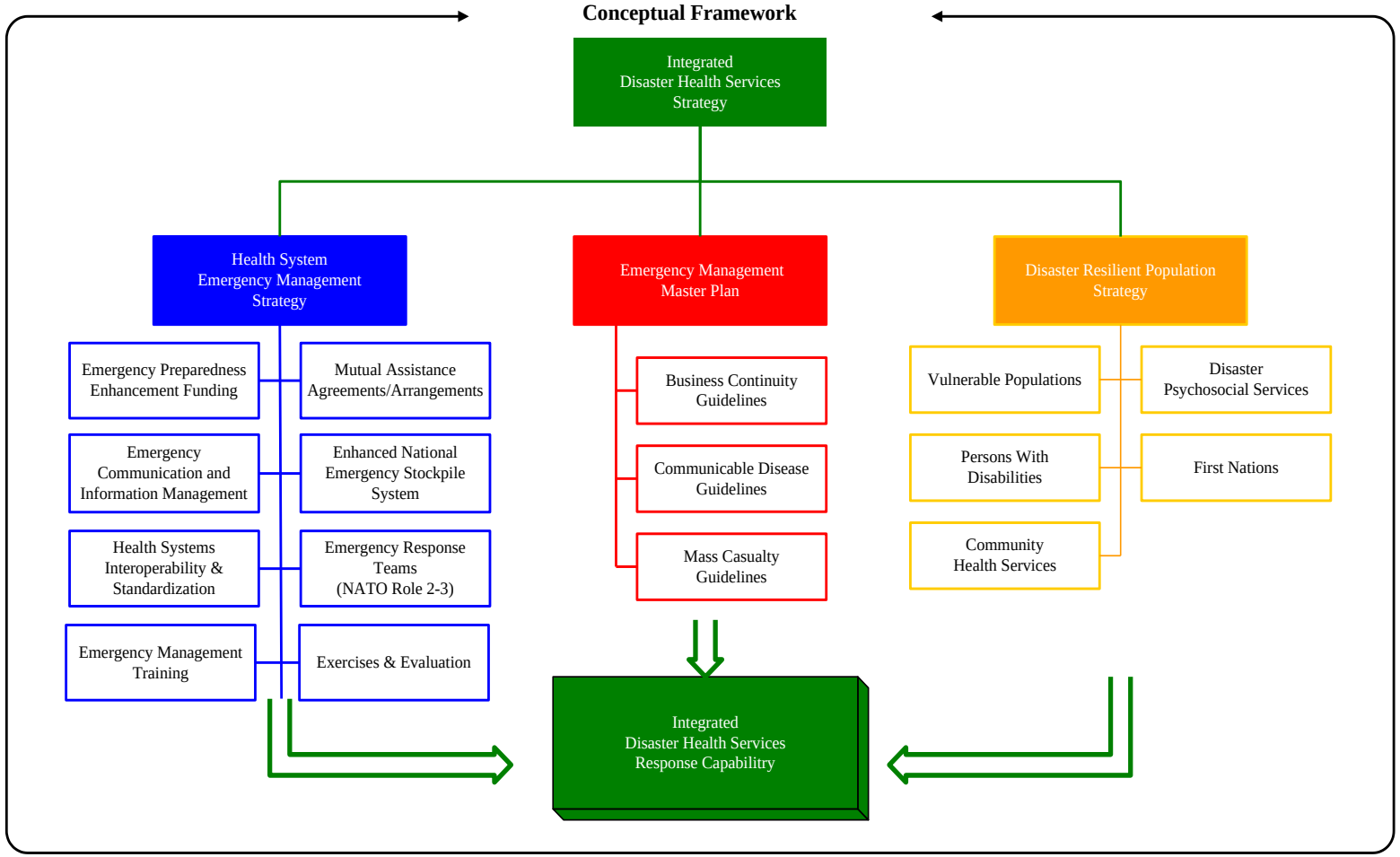
Level 1 includes locating casualties, providing them with first aid and emergency medical care, evacuating them from the site of injury to a safer location, sorting casualties according to treatment precedence, and stabilising and preparing patients for evacuation to the next level of care, if required.

Level 2 emphasises efficient and rapid evacuation of stabilised patients from supported elements, and en route sustaining care. Emergency lifesaving resuscitative procedures may be performed. Medical re-supply may be provided to Level1 facilities. Level 2 capabilities may be augmented to include capacities for emergency surgery, intensive care, essential postoperative care, blood replacement, diagnostic services, and psychosocial services.

Level 3 emphasises resuscitation, initial surgery, post-operative care, and short-term surgical and medical in-patient care. Diagnostic services such as x-ray and laboratory, and limited scope internal medicine and psychiatric services are available. Other ancillary capabilities may include the provision of psychosocial services. Level 3 capabilities may be augmented with specialist surgical capabilities, advanced and specialist diagnostic capabilities (CT scan, arthroscopy, sophisticated laboratory tests, etc.), major medical, dental, and nursing specialities, and environmental health capabilities.

Level 4 includes re-constructive surgery, definitive-care hospitalisation, rehabilitation, storage and distribution of national medical stocks inclusive of blood, blood products and intravenous fluids, and major repair or replacement of medical equipment.

Annex B: Integrated Disaster Health Service



Annex C: Short-term Capacity Enhancement Strategy

Short-term strategies usually do not require a systematic assessment of the standard of care being provided and as such may include the following:

Increase space capacity with:

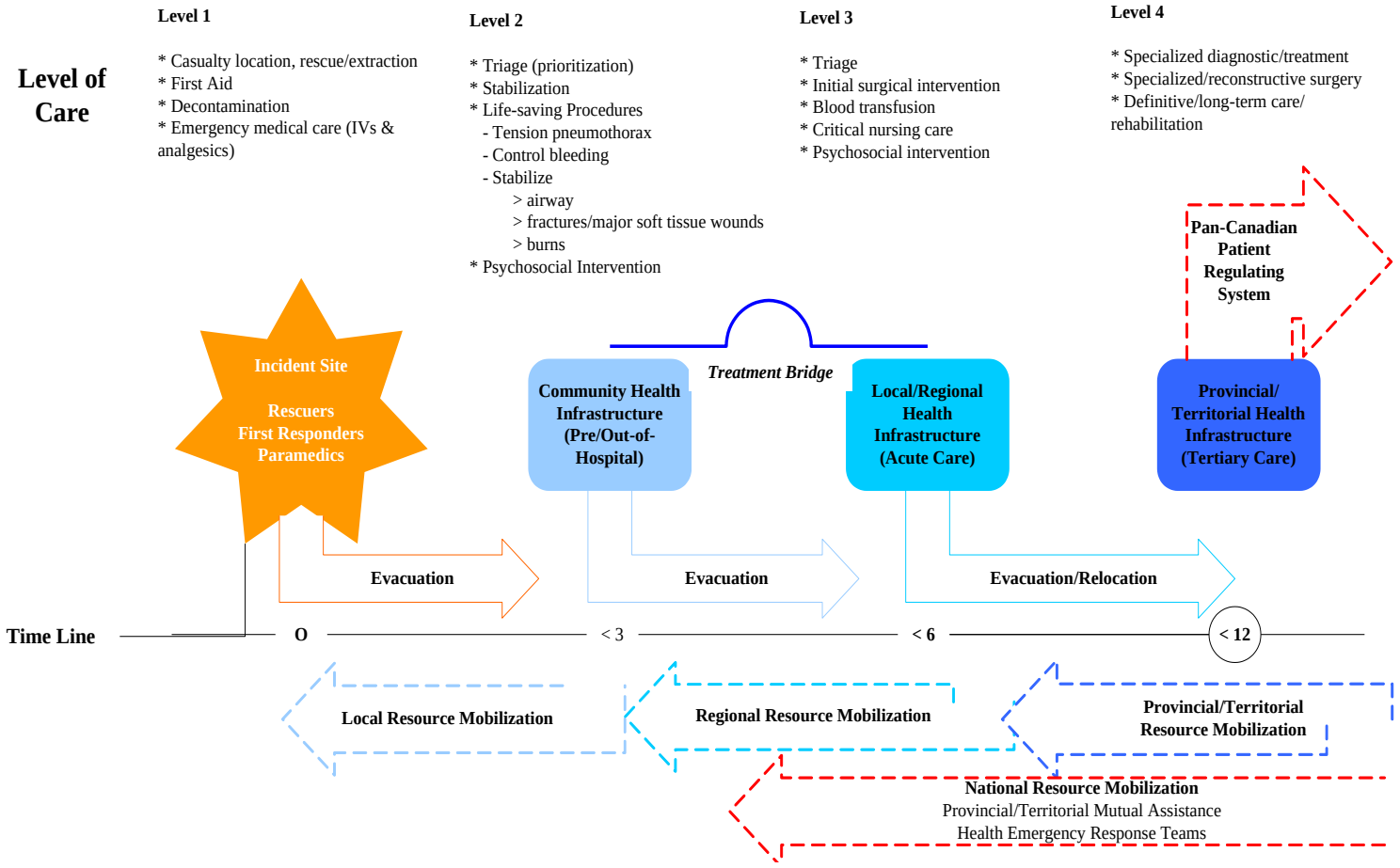
- Rapid discharge of emergency department (ED) and other outpatients who can continue their care safely at home
- Rapid discharge of inpatients who can safely continue their care at home (or at alternate facilities if they are available)
- Cancellation of elective procedures, with reassignment of staff members and space
- Reduction in the use of imaging, laboratory, and other ancillary services
- Expansion of critical care capacity by placing select ventilated patients on monitored or step-down beds, using pulse oximetry (with high/low rate alarms) in lieu of cardiac monitors, or relying on ventilator alarms (which should alert for disconnect, high pressure, and apnea) for ventilated patients, with spot oximetry checks
- Conversion of single rooms to double rooms or double rooms to triple
- Designation of wards or areas of the facility that can be converted to negative pressure or be isolated from the rest of the ventilation system for cohorting contagious patients or use of these areas to cohort those health care providers caring for contagious patients to minimize disease transmission to uninfected patients
- Use of cots and beds in flat space areas (such as, classrooms, gymnasiums, lobbies) within the hospital for non-critical patient care
- Transfer of patients to other facilities either locally or regionally.

Expand staff capacity with:

- Call-in of appropriate staff members
- Changes in staff scheduling (such as, duration of shifts, staffing ratios, changes in staff assignments)
- Requests for supplemental staff from neighbouring jurisdictions[18].

[18] Enhanced by the availability of a skills inventory/professional services registry, such as the US Emergency Systems for Advance Registration of Volunteer Health Professionals (ESAR VHP.)

Annex D – Model Disaster Health Services System



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