



# Civilian hospital response to mass casualty events: Basic principles

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**M**ass casualty events caused by military operations, terrorist attacks, accidents, and natural disasters are unfortunately ubiquitous events worldwide. Effective professional and institutional responses to such events require forethought and adherence to a predetermined plan. Surgeons and hospitals play key roles but must work collaboratively with the other interdependent components of the emergency response system.

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## **Definitions**

A disaster caused by either a natural or man-made event may result in mass casualties as well as a complete loss of social infrastructure. The key issue is provision of security, shelter, food, and water to the populace. (Management of the disaster scene itself is beyond the scope of this article.) A mass casualty event occurs when the number of patients exceeds the ability of the available medical resources to individually manage each patient. In contrast, a multiple casualty event occurs when an institution is able to individually manage each patient by mobilizing additional resources. The goal of the medical response is conversion of a mass casualty event in the field to a multiple casualty event for each hospital. Although the outcome of injured patients is improved by triage and transport to a designated level I trauma center,<sup>1,2</sup> once a hospital receives a number of severely injured patients which overwhelms its capacity, it ceases to function as a level I trauma center.<sup>3,4</sup> Each hospital in a given geographic area must therefore cooperate with the emergency medical system (EMS) and be prepared to receive patients in the event of a mass casualty event.

## **Management at the scene**

Security is the initial priority at the scene of a mass casualty event. The area must be secured. If the event is caused by a terrorist bombing, a careful search for additional terrorists and unexploded ordnance is imperative to prevent a “second hit” aimed at injuring the rescue team. This may result in a delay in transport of the patients to the hospital.<sup>5</sup>

Victims should be concentrated and managed with attention to airway, breathing, and circulation.<sup>6</sup> The simple triage and rapid treatment (START) system uses a protocol consisting of assessment of airway patency, respiratory rate, and pulse to achieve rapid field triage.<sup>7</sup> Airway control, tourniquet application to prevent exsanguination from penetrating extremity injuries, and decompression of tension pneumothorax are the only three life-saving maneuvers that can be performed in the field.<sup>8</sup> Immediate transport of patients with life-threatening injuries to the hospital is essential. Rapidly deteriorating patients should be transported to the clos-

est available hospital.<sup>4,7</sup> The field commander should distribute critically ill patients among the receiving hospitals to avoid overloading a single hospital. The goal in the field is to create order out of chaos and convert the field mass casualty event to a multiple casualty event for each hospital.

Field management involves a complex interaction between the EMS, the police, the fire department, and, on occasion, the military. Command authority must be established. These relationships should be codified before a mass casualty event occurs to prevent confusion. Attention should be focused on the victims, not the parochial interests of the various responding agencies or the egos of individual commanders.<sup>9</sup>

## **Hospital management**

The emergency room (ER) should be immediately cleared upon notification of a mass casualty event. ER staff should discharge or admit these patients. The initial hospital triage should take place outside of the hospital, preferably in an area adjacent to the ER. The initial triage separates the patients into “walking wounded” and “stretcher” categories. The triage officer might be a surgeon—for example, in 12 of 14 Israeli hospitals recently surveyed, a senior surgeon serves as the triage officer.<sup>10</sup> Walking wounded patients enter the ER by a separate door and are managed by junior physicians and nurses. A surgeon commands the walking wounded area to identify and correct any errors in triage.

Stretcher patients enter the main door of the ER, where they immediately undergo a secondary triage by a senior surgeon. Patients are separated into immediate care and delayed care groups based on cardiorespiratory and neurologic findings.<sup>10</sup> Most of the patients sent to the hospital will have relatively minor injuries. The individuals who have borne the brunt of the explosion usually are dead at the scene. However, hidden within the large number of stable patients are several who are dying. The challenge is to identify these patients and put them in the care of expert teams in the immediate care area.

Each bed in the immediate care area is staffed

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by an anesthesiologist, a junior surgeon, two nurses, and a senior surgeon. The role of the anesthesiologist is airway control. The junior surgeon provides vascular access and the senior surgeon makes a decision regarding diagnostic and therapeutic interventions and disposition. The immediate care area is commanded by a senior surgeon who makes triage decisions when immediate care patients compete for limited resources. The goals of therapy in the immediate care area are airway control, vascular access, and control of external hemorrhage.

Each bed in the delayed care area is staffed by a physician (preferably a junior surgeon) and a nurse. A senior surgeon commands the delayed care area to provide advice and identify any triage errors.

The walking wounded area is staffed by nurses and junior physicians. A senior surgeon or physician should command this area to provide advice and effect rapid decisions.

Patients who are dead on arrival to the hospital should be triaged to the morgue. Patients who are dead in the field, in general, should not be transported to the hospital.

Expectant care is a triage category used in mass casualty events. Patients in this category have devastating resource-intensive injuries that would overwhelm the existing medical assets, preventing treatment of other patients with a greater chance for survival. In this situation, patients initially receive minimal comfort care and are treated after the other patients or when additional resources are mobilized. The need for triaging patients to expectant care can be minimized by converting a mass casualty event to a multiple casualty hospital event. This can be achieved by the appropriate distribution of immediate care patients among the different receiving hospitals.

Following airway control, vascular access, and control of external hemorrhage, immediate care patients should be transported to one of three places: the operating room (OR), the computed tomography (CT) scanner, or the intensive care unit (ICU). Most blast injury patients do not require immediate access to the OR unless they have vascular injuries related to traumatic amputations or penetrating shrapnel.<sup>11</sup> The CT scan is a key diagnostic procedure in blast injury

patients and is usually the rate-limiting step in the orderly flow of patients through the diagnostic and therapeutic hospital triage cascade.<sup>12</sup>

### ***Hospital organizational changes***

In order to maintain flexibility and accommodate the surge of patients in a mass casualty event, individual hospitals must shift from standard day-to-day operations to a system that resembles a military hierarchy called the Hospital Incident Command System.<sup>13</sup> This system organizes the emergency response within the hospital and offers a scalable response to incidents of any magnitude. It replaces the normal hospital administrative architecture with a chain of command headed by a predesignated incident commander, a senior surgeon.<sup>10</sup>

The key individuals required for the initial management of the immediate and delayed care patients are surgeons; anesthesiologists; intensivists; ER, ICU, and OR nurses; radiology technicians; and radiologists. Commanders should mobilize these individuals based on pre-arranged phone trees, beeper systems, virtual private networks, and media announcements. Reliance on cellular phone technology is dangerous because the system is either shut down immediately after a terrorist attack to prevent the use of cellular phones to detonate additional bombs<sup>14</sup> or is overloaded by worried relatives calling each other.<sup>15</sup> Management of the surge of volunteer physicians, nurses, and civilians in the clinical arena is an unsolved problem.<sup>10</sup>

The abundance of volunteer and mobilized physicians and nurses has permitted the assignment of physician/nurse teams to each immediate and delayed care patient at the Shaare Zedek Medical Center in Jerusalem, according to Ram Spira, MD, of the department of surgery at that institution. This team accompanies the same patient throughout the diagnostic and therapeutic cascade until the patient has reached the definitive care unit. This system has substantially improved communication with the patient, the family, and the hospital incident commander.

### ***Hospital security***

Immediately after a mass casualty event, police should be assigned to clear key traffic arteries to facilitate the flow of ambulances to the

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hospital. The hospital area should be secured. Entrance to the hospital grounds should be controlled through one gate. All ambulances should be inspected before admission to the hospital grounds to ensure that they contain neither terrorist operatives nor ordnance. Entrance to the ER should be controlled by armed guards. Relatives should enter the main hospital after passing through security screening.

### ***Operating room considerations***

All elective surgery should be cancelled until the extent of the mass casualty event is known; however, all operations already in progress should proceed.<sup>10</sup> The recovery room should be prepared for function as an extended ICU. Extended ICU capability is important in the initial four to six hours after the event to facilitate resuscitation as well as diagnostic and therapeutic triage.

### ***Intrahospital and interhospital transfer***

It may be necessary to transfer patients from surgical to medical wards in order to free up surgical beds to receive casualties. If a particular patient requires treatment beyond the capability of the receiving hospital (for example, a patient with head injury arriving at a hospital without neurosurgical capability), timely transfer of the patient following initial resuscitation is necessary. Alternatively, in a military situation, receiving hospitals may need to transfer stable ICU patients to other institutions farther from the front in order to have adequate bed capacity to receive the next wave of casualties. A predetermined interhospital transfer plan should be established with the help of the EMS.

### ***Patient tracking***

A mass casualty documentation system should exist. An example of a good nationwide patient-tracking system exists in Israel, where specially numbered medical folders, wristbands, and nylon sacks (for personal possessions) are prepared in advance. These items accompany the patient at all times. The location of each casualty is documented in a computer database continuously. A computerized list of patient location and injury severity is provided to the incident commander every 15 minutes. Digi-

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tal photographs are taken of all unidentified patients and placed on a secure, national Web site to help families identify missing relatives, regardless of their location.


### ***Injury patterns***

The most common form of terrorist-related, mass casualty event is a bomb explosion. The patterns of blast injury can be divided into primary (injury caused by the blast wave), secondary (penetrating trauma caused by shrapnel), tertiary (blunt trauma caused by striking solid objects), or quaternary (a wastebasket category including burn, crush, or inhalation injury).<sup>11</sup>

One form of primary blast injury that can complicate management of the patient's other injuries is "blast lung" injury. This injury is a pulmonary contusion caused by the impact of the blast wave. It can be associated with significant hypoxemia and require intensive ventilator support.<sup>11</sup>

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## Conclusion

An effective medical response to a mass casualty event seeks to convert a mass casualty event in the field to a multiple casualty event for each hospital by appropriate distribution of immediate care patients to the various receiving hospitals. The hospital response involves establishing security, mobilizing additional resources, and conversion to the hospital incident command system. An intrahospital triage cascade occurs that prioritizes diagnostic and therapeutic procedures with the goal of saving the maximum number of lives possible. 

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