Management of Mass Casualty

Mike M. Mallah, David R. Mann, Richard Davis and Peter Bird

Introduction

Natural disasters, war and conflict, terrorist attacks and transportation injuries have led to increased civilian injuries and casualties over the past several decades. Hospitals in resource- limited settings have a great challenge responding to these issues. To achieve the best possible outcomes, it is paramount to consider management of mass casualty incidents in advance and to be prepared for them long before they occur.

Management of mass casualty is a broad subject including several perspectives: a centralized government perspective, a pre-hospital, emergency medical services perspective, and a hospital perspective. In the hopes of being most beneficial to the reader, this chapter is written from a hospital perspective. It is understood that in most resource-limited settings, pre-hospital care, and even pre-hospital coordination and allocation of patients, is non-existent. Patients often arrive at your facility with little or no warning, in excess of what you can safely handle, with no option to transfer elsewhere.

While there is no consensus definition for a "mass casualty," we will adopt the World Health Organization definition: **A mass casualty incident is an event which generates more patients at one time than locally available resources can manage using routine procedures. It requires exceptional emergency arrangements and additional or extraordinary assistance.**

Notably, what qualifies as a mass casualty incident will be very specific to the practice setting. For example, two or three patients arriving simultaneously in a more rural hospital with only one available provider may overwhelm that specific system, particularly in the low resource setting. However, even in limited resource urban centers, the same volume of patients may be appropriately managed. In order to adequately handle each situation, it is crucial to be critically honest about a facility's capabilities.

In this chapter, we discuss the Mass Casualty in three phases: **Before**, **During**, and **After** the event.

A mass casualty event at a large hospital. Facilities with training programs can call on multiple workers quickly to deal with a rapid influx of patients.

Before

Anticipation of and preparation for a mass casualty incident will lead to improved outcomes Specifically, it will be vital to understand the landscape of resources available at your current facility. Below, we discuss Personnel, Equipment/Supplies, Medicines, Space, and Medical Records. We follow with a brief discussion on planning, that coordinates all these resources.

Personnel:

Identifying the number of people available to an organization is the first step in evaluating your resources. This will allow you to ensure that supplies and other resources can be well utilized by the personnel. Additionally, if there are training or skill deficiencies identified prior to a Mass Casualty, personnel can be recruited and trained.

It would be ideal to have a full complement of operating theater, laboratory, x-ray and central supply technicians on duty 24-hours per day; the hospital leadership needs to decide whether they are busy enough to justify this expense. A small rural hospital that is unstaffed on evenings and weekends should encourage injured patients to be sent elsewhere, providing basic resuscitation and stabilization prior to transfer.

Ancillary Staff

Small hospitals face the disadvantage that many of these skilled workers are not in the hospital 24 hours per day. But mass casualties can and do arrive at all hours of the day and night. You should

advocate to Administration for the full-time immediate availability of the following people:

- Radiographic technologists
- Operating Theatre technicians
- Central Supply technicians
- Representatives of Finance and Management
- Information Technology
- Security

Nursing

Similarly, nurses are crucial for conducting a mass casualty well, especially in the Emergency Department. Nurses play the following roles:

- Nurse-in-Charge: This valuable person manages all the logistics of the mass casualty, coordinating the team of nurses and ancillary staff. Most large hospitals have a senior nurse on duty full time- usually this person takes on this role. Likely they were also the one who decided that criteria for mass casualty were met and activated the team, as described further below. The Nurse-in-Charge will be the key point of contact for the Physician-in-Charge.
- Casualty nurses: These nurses have experience caring for injured patients. Usually, they cannot stay with one patient, but will assist multiple clinicians caring for multiple patients simultaneously.
- Operating Theatre nurses: These nurses can assist anesthetists, prepare the room, and care for patients in the Recovery suite.
- Ward and Intensive Care nurses: In addition to their regular duties, these nurses can help mobilize patients and create more bed space, allocating more critical patients to beds near the nursing station, recognizing deteriorating patients, and making other critical decisions.

Clinicians

Clinicians, whether physicians or others such as Clinical Officers, must be able to work closely as a team. The team's leader must be aware of the strengths and weaknesses of every member of the team, and must assign patient care duties accordingly. Communication is essential: in order for the leader to make effective decisions, they must receive timely feedback from each clinician on the condition of the patient under that clinician's care.

- Physician-in-Charge: This is the team leader; they must be a senior clinician with intimate knowledge and understanding of the hospital and its people. This physician's role is most analogous to "orchestra conductor" or "traffic police," watching out over all the patients and deciding simultaneously on the care of all of them, in light of a detailed understanding of the hospital's and the team's strengths, weaknesses, and other characteristics. The Physician- in-Charge will be the key point of contact for the Nurse-in-Charge. The Physician-in-Charge need not automatically be a surgeon; a non-surgeon physician with experience in the Casualty Department, such as a specialist Emergency Medicine Physician, can do this job quite well.
- Other specialist physicians: These should be surgeons or other specialists with an understanding of trauma resuscitation steps. Some of these may be able to step in as Physician-in-Charge. Each one will be assigned to one patient only, providing feedback to the Physician-in-Charge.
- Clinical and Medical Officers: These are generalist clinicians who play a similar role as the physicians above, caring for only one patient, doing interventions as needed, and giving feedback to the Physician-in-Charge.
- Trainees: Residents and interns will have a range of skills. The Physician-in-Charge must understand each one's capabilities and assign them accordingly. A very junior trainee may be most helpful as an assistant to one of the other clinicians above in caring for one complex patient. A junior or mid-level trainee may care for a patient alone. A senior surgical trainee may take a patient to the Operating Theater alone. In all cases, the Physician-in-Charge must assign them duties that fall within their skillset and watch them as closely as possible.

All clinicians caring for patients will have some degree of independence and must know the principles of initial management of the injured patient. These can be taught and then reinforced during care for individual patients, according to the Advanced Trauma Life Support (ATLS) course or

other courses. You may also design an "in house" course of your own.

In a city or on a Mission Station it may be easy to mobilize personnel, whereas rural hospitals' staff may live quite a distance away and be functionally unavailable. Depending on the frequency of mass casualty incidents, personnel may be offered a "retainer" or salary bonus in return for being available on short notice for emergencies.

An adjacent or nearby nursing school can be an excellent source of workers: senior students can act as nurses (under the watchful eye of other nurses.) Junior students can help with transport or other logistical issues.

This "ministore" serves the adjacent outpatient and casualty departments. It is staffed full-time and contains enough emergency supplies for a mass casualty, rapidly available. The clerk knows every piece of equipment and can access it rapidly. The Central store is elsewhere in the hospital and can replenish the ministore in real time if needed.

Equipment

Commonly used equipment such as plain gloves, gowns, chest tubes and chest tube bottles, dressings and splints, plaster and suture will be needed in large quantities. There are two strategies to assure availability:

- Casualty Store: A room, adjacent to the casualty, staffed by a clerk, where such equipment is always stored and disbursed for patient care during all hours. By design, there is enough equipment available for surges such as a mass casualty even though these happen rarely. The advantage of this system is that it allows equipment to be rapidly available, and some measure of inventory and cost allocation is available even during a mass casualty event. Also, the equipment can be easily located, since the clerk knows quite well where everything is. The disadvantage is that it requires a full-time employee staffing the store; if a hospital's Emergency Department is not very busy, maintaining this employee may not be a justified expense.
- Mass Casualty Carts: Rapidly accessible carts are created with essential consumables (e.g. gauze, bandages, IVs, chest tubes) and medications (e.g. fluids, pain medications, sedatives, antibiotics). Once prepared these should be stored near the designated triage center. The cart should only be accessible by the lead nurse in the event of a mass casualty event to prevent depletion of the supplies and to ensure their immediate availability. The advantages of this system include immediate availability; the cart can be rolled directly to an unstable patient's bedside. The disadvantages are mostly related to its designation for use in mass casualties only: Personnel will be unfamiliar with its contents when these are needed in an emergency. If the cart is unlocked, staff will "pilfer" it for supplies during normal patient care because of convenience. If it is locked, it may be difficult to locate the key when it is needed, and it may be ignored or not stocked properly after the previous mass casualty event.

Management of Mass Casualty

Mike M. Mallah, David R. Mann, Richard Davis and Peter Bird

A Mass Casualty Cart in a resource-rich hospital, containing portable suction and oxygen, a defibrillator, and a separate "toolbox" (Orange) with medications that might be needed, which can be carried with the patient during transport.

You should develop surge distribution plans to provide expedited delivery during mass casualty events, should more supplies be needed. In the case of the Casualty Store, this is backed up by a larger Central Supply elsewhere in the hospital that can replenish it if needed. In the case of the Mass Casualty Carts, these can be replenished by other carts that have been created for this purpose and stored elsewhere.

Space

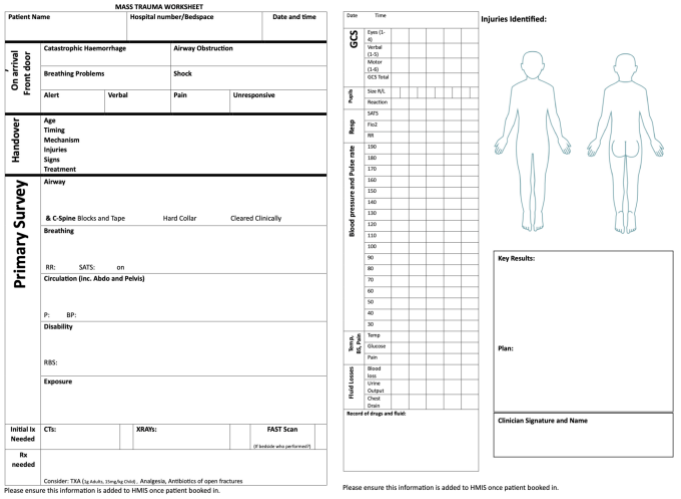
When planning for mass casualty events, you should be aware of the total number of beds/spaces available to accommodate patients. Are there additional spaces that could be converted to accommodate patients if needed? For example, how many patients could be accommodated into hallway spaces? How many beds could be converted to provide ICU level care? Can beds near the nursing station be used as a "surrogate" for critical care beds, where patient deterioration would be noted sooner? Can beds, rooms, or spaces typically designed for one or few patients be "surged" up to house more than the designated number during routine operating? Understanding the space available will allow you to utilize your decreased resources more efficiently.

Medical Records

In order to keep track of multiple patients' diagnoses and treatment plans, you must be able to generate medical records quickly. Your Medical Records department may not be able to create enough new files at once by the usual process. If you use an electronic medical record, access to multiple computers simultaneously can be another choke-point. But even if your hospital's medical record system is only a small notebook carried by the patient themselves, we recommend using a worksheet like the one below.

A well-designed worksheet encourages the clinician to follow a standardized approach. It is structured to be systematic, including the Glasgow Coma Scale, and priorities for assessment such as airway, breathing, circulation, etc.

The worksheet accompanies the patient during the mass casualty event, and the Plan section can record orders ("X-ray of Chest, Pelvis, Lateral C-spine.") Eventually the worksheet is added to the patient's medical record, usually at the time of admission. We include a copy of this worksheet for download here.


MASS TRAUMA WORKSHEET

Patient Name | Hospital number/Bedspace | Date and time

On arrival Front door: Catastrophic Haemorrhage | Airway Obstruction; Breathing Problems | Shock; Alert | Verbal | Pain | Unresponsive

Handover: Age, Timing, Mechanism, Injuries, Signs, Treatment

Primary Survey: Airway; & C-Spine Blocks and Tape | Hard Collar | Cleared Clinically; Breathing; RR: SATS: on; Circulation (inc. Abdo and Pelvis); P: BP:; Disability; RBS:; Exposure

Initial Ix Needed: CTs: | XRAYs: | FAST Scan (if bedside who performed?)

Rx needed: Consider: TXA (1g Adults, 15mg/kg Child). Analgesia, Antibiotics of open fractures

Please ensure this information is added to HMIS once patient booked in.

GCS | Pupils | Resp | Blood pressure and Pulse rate | Temp, BM, Pain | Fluid Losses | Record of drugs and fluid:

Please ensure this information is added to HMIS once patient booked in.

Injuries Identified:

Key Results:

Plan:

Clinician Signature and Name

A worksheet that helps clinicians evaluate the patient according to typical trauma priorities.

Planning

Once all of the above are understood, all that remains is to "put it all together" into a cohesive system that can respond as needed.

Management of Mass Casualty

Mike M. Mallah, David R. Mann, Richard Davis and Peter Bird

First, a clear **trigger** should be outlined to "activate the system." This will be different for every institution given the resources available. For example, a specific hospital might designate the arrival of three simultaneous trauma patients as a mass casualty event. If so, this criterion should be clearly outlined and staff informed that if the criteria is met, the system can be activated.

You may choose to have a certain number of patients be the trigger. But we also recommend allowing senior clinicians and nurses to use their discretion in activating the system. If your hospital's trigger is four patients, and three critically ill patients arrive with survivable injuries requiring immediate treatment, it is quite reasonable to activate the system.

Secondly, a clear **communication** strategy should be outlined. If a "mass casualty incident" is activated, who initiates that activation? Is the activation decided on by an individual or a group? Often this is the senior nurse on duty in the hospital (variably called the House Supervisor or the Coverage Nurse.) This person activates a central communication method in order to connect the involved parties. The communication platform WhatsApp has been used frequently given its accessibility and end-to-end encryption. Often the Nurse-in-Charge or Physician-in-Charge will need to make phone calls directly to other personnel to decide on activating the system; this is another reason why such roles should be filled by people who are quite familiar with the hospital and its resources.

The roles of the Physician-in-Charge and Nurse-in-Charge are the most important in a mass casualty event. Nurses who can take this role should be among the most experienced and should understand the hospital well. Specifically, knowing who plays what role, and who else could play it if the right person isn't available, is the kind of knowledge that only comes with experience.

The Physician-in-Charge faces similar demands. As described further below, this person must be able to coordinate multiple complex activities at the same time. There is no substitute for experience with the facility and knowledge of its working parts here. Therefore, the most senior physician in the hospital is usually the one who plays this role. In these days of "Global Surgery," visiting surgeons who are on-call must be properly prepared if they are to play this role. For example, a visiting trauma surgeon with extensive patient care experience who does not know your hospital well would be better suited performing direct patient care, rather than being the Physician-in-Charge.

During

The Nurse-in-Charge and Physician- in-Charge work closely together. Neither takes care of an individual patient. They conduct the mass casualty event itself and should be not distracted by the needs of a singular patient. During the event, these two "in-Charge" leaders coordinate the entire team's roles, ensure proper management and triage, and monitor crowd control.

A Yellow vest allows the Physician-in-Charge to be easily identified even in a chaotic environment. The Nurse-in-Charge wears one as well.

Roles

A highly experienced physician should be the Physician-in-Charge, ideally with training in emergency medicine or trauma. As stated above, a thorough understanding of the hospital is the most important attribute. In the absence of a physician, an individual with the most medical training may serve in this position.

If there are additional clinicians, the Physician-in-Charge will coordinate physician efforts. These include other physicians, specialists, resident physicians/house officers and other trainees present. The Physician-in-Charge must delegate responsibilities appropriate for other personnel at their level of training. As patients and clinicians

arrive, try to "match" the level of the clinician to the perceived injury burden of the patient.

The Physician-in-Charge will decide which patient receives which treatment and will prioritize patients based on their needs. This includes deciding the disposition of the patients, whether to the x-ray department, the Operating Theater, the ward, or the critical care unit. In order to do this, the Physician-in-Charge must have a general idea of the condition and injury burden of every patient. This information is relayed by the individual clinician caring for the patient.

The Nurse-in-Charge manages logistics, coordinates nursing efforts, and ensures that triaged patients receive the care indicated by the Physician-in-Charge. Nurses should be proportionally distributed to ensure that triaged patients receive the adequate level of care based on the acuity of their injuries. The Nurse-in-Charge also ensures that patients are transported efficiently and prevents bottlenecks of patients which may obstruct halls or overwhelm services. Specifically, we attempt to send only one patient at a time to the x-ray department, to avoid patients waiting unsupervised in the hallway where their deterioration might not be noticed.

Management

Patients are triaged according to their condition, as below:

Designation	Condition
Red	Critical condition but salvageable with immediate intervention: airway, breathing, or circulation problem.
Yellow	Possibly in critical condition or may deteriorate soon, but does not require immediate intervention.
Green	Injuries sustained but not in critical condition. Has the potential to deteriorate in the future but does not require immediate intervention.
Black	Survival is not likely with any intervention: caring for this patient would divert resources from patients who otherwise have a reasonable chance of survival.

Table showing one technique for triaging patients during a mass casualty event. Note that patients designated "Black" may, under other circumstances, get a full effort at resuscitation. During a mass casualty event, we recognize that resources are limited and best directed to other patients with a better chance of survival.

Below we delineate the duties of the Physician-in-Charge: These points can be distributed beforehand to potential Physicians-in-Charge, and posted in a prominent place:

- Don't personally manage any patient!
- Delegate tasks: Have someone by your side if possible as a scribe / runner / phone caller.
- Liaise closely with the Nursing team and the Nurse-in-Charge, especially to mobilize ancillary staff.
- Find out the details of the incident: Mechanism, how long ago, any more patients at the scene?
- Triage casualties and assign staff as appropriate, ideally one clinician and one nurse per patient.
- Move "Walking Wounded" to the Outpatient Department or elsewhere outside of the Emergency Department.
- Assure ATLS protocols are being followed.
- Consider moving unstable patients directly to the operating theater to be resuscitated and treated there.
- Assign FAST Ultrasound scan to one experienced person with a portable machine.
- Alert anesthesia. If during a normal business day, do not start any elective cases in the operating theater until you can estimate how many patients will need urgent operations.
- Control the flow of patients to x-ray and other patient care areas outside of the Emergency Department. Try not to have any patients waiting in unsupervised areas.

Management of Mass Casualty

Mike M. Mallah, David R. Mann, Richard Davis and Peter Bird

If you have a portable ultrasound machine, assign one person to perform bedside Focused Abdominal Ultrasonography for Trauma examinations on patients, beginning with the most critical, as assigned by you.

Patients will generally leave the Emergency Department to go to:

- Admission: the ward or a critical care unit after full evaluation. In general, needed treatment is done first in the Emergency Department, including cleaning and suturing lacerations, splinting fractures or placing traction pins, and other interventions.
- Operating Theater: you must make sure the one doing the operation is qualified to do so. If you are the Physician-in-Charge and the patient needs an operation, you may send another qualified surgeon, or you may choose to hand over the "in-Charge" role to someone else who is capable of doing the job.
- Discharge: After evaluation and treatment, they do not meet the criteria for admission.

Crowd Control

Security is very important here: Hospital Security Guards must gently but firmly cause all non-medical personnel to leave the Emergency Department. This will be difficult, as emotions are high and family members are concerned. They may insist that their family member receives precedence, and this could become an unnecessary distraction at a time when attention is most needed. "Walking wounded" should be monitored closely for deterioration, but otherwise they should stay elsewhere, in a place such as the Outpatient Department, waiting their turn to be evaluated. Police officers and soldiers will enter the Emergency Department and display varying levels of professionalism as they watch the proceedings; sometimes these can be "redirected" with a request to help with crowd control.

After

In resource-rich settings, there is heavy emphasis on practice and "drills" of mass casualty events. However, full scale practice of plans within resource-limited settings may not be feasible due to limited resources and the impact on everyday operations. Despite this fact, limited practice sessions can decrease the confusion and delays of poorly coordinated efforts. Once your institution is initially prepared and a plan is set, practice it.

While practice and simulation are reasonable surrogates prior to a mass casualty, the events themselves are often the most informative. Conduct an audit, formal or informal, and ask the following questions:

- What worked well?
- What do we need to adjust?
- How is our plan vulnerable and how can we mitigate those weaknesses in future events?
- Were there any clinical competence issues, or need for additional training, exposed?

Many issues that are exposed by an audit cannot be addressed very well: a mass casualty is a chaotic and brutal event and mistakes will be made. The most likely weakness to be exposed will be the competence of your team in initial management of the injured patient. Fortunately, this problem is the one that you can control best, through better preparation. If more teaching sessions are needed, organize them without delay. In general, an official ATLS course will be expensive and difficult to access in a low-resource setting. But its principles are the most applicable here, and your clinicians should be very familiar with the priority-focused approach that it teaches. Consider organizing your own "in-house" courses that teach the same principles.

The answers to the questions highlighted above are critical in the aftermath of an actual mass casualty event and can also shed light on weaknesses

within local, regional, and country level disaster responses. Debriefing after these events will allow teams on every level to go back to the drawing board and optimize their plans. Incremental improvements can then be made and thus hopefully increase your capability to provide quality care in the face of mass casualties.

Resource-Rich Settings

Industrialized countries are usually divided geographically into "catchment areas" with a robust emergency service infrastructure:

- Prehospital services such as ambulances, helicopters, and fixed-wing aircraft, staffed with skilled practitioners up to and including specialist Emergency Medicine physicians.
- One hospital designated as the area's "Trauma Center." At this Center, skilled personnel and facilities can be rapidly mobilized. Within the area, there may be other hospitals that can also care for less injured patients as well.
- Coordinated communication services including all of the above resources, allowing rapid decisions such as mobilizing personnel and equipment, and sending injured patients to several hospitals so that one hospital is not overwhelmed. Trauma Centers serving other catchment areas may receive patients from the one where the accident occurred if needed.
- Trauma practitioners frequently conduct mock exercises at all levels to ensure preparedness.

Because of these advantages, a true "mass casualty" which suddenly overwhelms an individual hospital's resources, is relatively rare in resource-rich settings. Large-scale terrorist attacks, train derailments, or natural disasters would be dealt with in the above framework.

The authors acknowledge the work of Doug Norcross, MD FACS and Ben Cassidy.

Mike M. Mallah MD
Medical University of South Carolina
USA

David R. Mann DO MS
Medical University of South Carolina
USA

Richard Davis MD FACS FCS(ECSA)
AIC Kijabe Hospital
Kenya

Peter Bird MBBS FRACS
AIC Kijabe Hospital
Kenya

June 2023