The Emergency Room During Mass Casualty Incidents

4

Hany Bahouth

Abbreviations

AD	Administrative director
CEO	Chief executive officer
EMSC	Emergency medical services coordinator
ER	Emergency room
HN	Head nurse
MCI	Mass casualty incident
MedDir	Medical director

4.1 Introduction

Mass casualty incidents (MCIs), man-made or natural, have increased in recent years. In the 1970s, man-made events accounted for 16.5% of disasters and 4.3% of related deaths; in the 1990s, the number rose to 42.0% and 9.5%, respectively (not including "complex emergencies" involving armed conflict and a total breakdown of authority) [1]. There are different types of MCIs, primarily categorized as either progressive disasters or a sudden disaster. A progressive disaster is easier to manage in terms of preparedness and response due to its advancing nature (Hurricane storm). However, a sudden MCI is much more challenging for the entire medical system at local, regional, and national levels. The challenges are organizational, logistical, and relate to a wide range of medical and nonmedical fields through the different pre-hospital and inter-hospital phases of the event, including triage.

H. Bahouth (✉)
Trauma and Emergency Surgery, Rambam Medical Center, Haifa, Israel
e-mail: h_bahouth@rambam.health.gov.il

Y. Kluger et al. (eds.), *WSES Handbook of Mass Casualties Incidents Management*, Hot Topics in Acute Care Surgery and Trauma,
https://doi.org/10.1007/978-3-319-92345-1_4

Successful management of sudden MCIs requires a strong and planned coordination between the medical systems at their different phases of response and between the medical systems and the non-medical systems such as the police department, army, media, communication systems, and other ancillaries.

In most of hospitals around the world, including the Western countries, emergency rooms (ERs) lack the infrastructure to effectively manage an MCI [2]. Emergency rooms are generally designed with sufficient, but not excess, space [3]. Some hospitals are now increasing bed capacity by utilizing hallways, enabling double occupancy in patient rooms, and converting other non-treatment spaces in order to increase their ability to meet patient surges during a disaster [3]. Modular ERs with fold-and-stack walls, curtains, or other structures such as tents can help increase the available treatment spaces during MCIs [3].

Normally, the ER serves as a gateway to the hospital and is the most available point of access to immediate health care, but it also plays a central role during disasters. Pre-event preparedness and extensive early and detailed planning for mass casualty events is crucial to optimize care, to minimize chaos, and to improve outcomes [4].

Activation of an ER plan must be identical, regardless the time of day or day of week, including holidays. All types of hazards must be taken into consideration, and the plan must be able to meet the needs of the four main categories of MCI (conventional, chemical/toxicological, biological, and radiation).

The aim of this chapter is to describe systematically the setup and response of the ER in a MCI, with a specific focus on the logistical and organizational details.

4.2 Emergency Room Response in MCI

The basic actions and activation of the ER for the different types of MCI are similar and share many elements. These basic and common elements include (see Fig. 4.1):

1. Notification and Verification of MCI
2. ER activation
   - ER evacuation
   - Assumption of responsibility by key personnel
   - ER triage setup and implementation
   - Staff deployment
   - Equipment deployment and logistics
   - Setup and organization of ER treatment sites
   - Setup and organization of additional treatment sites
   - Patient identification, registration, and tracking

It should be noted that, as shown in Fig. 4.1, once a decision has been made to activate the ER for the MCI, several parallel processes are activated. All of these processes are discussed below in fuller detail. In addition, there are additional considerations that must be understood well before the MCI. These are discussed in Sect. 4.5.

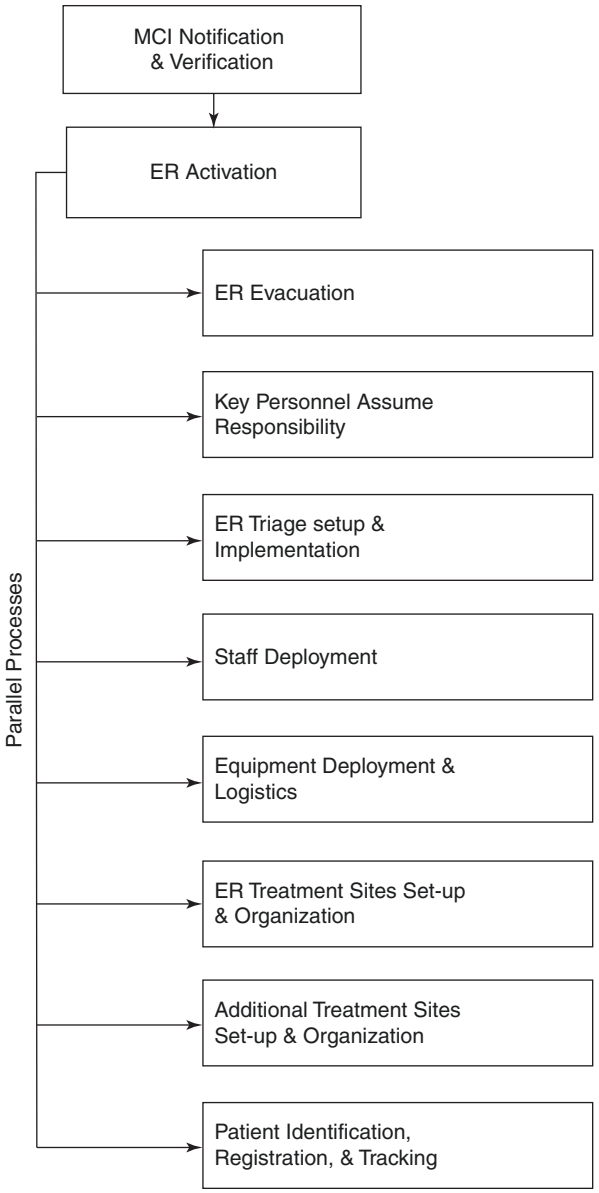

Fig. 4.1 Emergency room response in mass casualty incidents

4.3 Notification and Verification of MCI

Official notification and verification of a MCI must be managed in a simple, organized, and systematic manner based on predefined protocols and checklists. Notification and general awareness that a disastrous event has occurred may come via unofficial channels such as the news, media, or the admission of a patient claiming injury in MCI. Official notification may come through hospital channels

(administration, authorized personnel, hospital security) or recognized public services (police, fire department, pre-hospital emergency medical system (EMS)). Hence, the need for verification of the MCI is critical before the ER is activated to implement MCI response plan.

Verification must include information on the type of MCI, its extent, estimated number of injured adults and children, the location of the event, and the expected time for the first patient's arrival.

Immediately upon verification of the MCI, a discussion should be held between the authorized decision-makers, such as the senior surgeon on call, the senior ER physician on call, and the charge nurse for a brief evaluation of the situation, and to confirm officially the decision to activate the ER for the MCI [1].

Approval to activate the ER for the MCI depends on the hospital/local/national policy. Different countries utilize different protocols, with some requiring the formal approval of the hospital's chief executive officer (CEO), director, or his deputy.

The Israeli experience, which has had to manage numerous MCIs, revealed that there was a low threshold for implementation of the MCI protocol due to difficulties in obtaining accurate and detailed information. As a result, the decision was made that a CEO or his/her deputy was required to approve activation of the ER in response to a large-scale event.

4.4 Emergency Room Activation

Activation of the ER in a MCI begins immediately after notification and verification of the event, and the appropriate approval to respond to the event. The responsibilities for activating the ER are divided between designated staff such as the senior surgeon on call, the ER senior physician on call, and/or the ER charge nurse, based on predefined protocols and checklists.

Activation of the ER includes: implementation of in-house and call-in lists; verification of available beds in the ER and alternate care sites; notification of all hospital facilities outside of the ER, including the operating room, blood bank, radiology, laboratory, and hospital security; triage site activation, notification of meeting points for medical staff, activation of the emergency stretcher plan, deployment of equipment and carts, and distribution of identification vests and portable radios.

4.4.1 Evacuation of the Emergency Room

The ER may have only minutes to accommodate the first wave of casualties that may arrive without any warning, quickly overwhelming department resources [5, 6]. The first step in preparation is to clear the ER of non-critical patients, preferably via a central exit. The surgeon in charge and the ER physician will make decisions with regard to those patients who can be safely moved to preplanned alternate care areas, or discharged. This space will serve as a staging area until floor beds are

available. Patients from the ER area will be evacuated to available beds in the hospital. If no beds are available, patients will be placed in corridors, under nursing/medical supervision as needed [7]. Critical patients will await suitably monitored transportation to an appropriate floor. Documentation is limited to registration of personal details (name, ID number, diagnosis, and gender) and their destination, allowing for the rapid transport of 50–80 patients from the ER within 10 min.

4.4.2 Assumption of Responsibility by Key Personnel

Successful MCI management depends on a few key personnel: the medical director (MedDir), the administrative director (AD), the institute's head nurse (HN) [8], and the emergency medical services coordinator (EMSC) [9]. They have been assigned to their roles well before the MCI occurs. They have been specially trained and will work according to predefined protocols.

The MedDir is usually a highly experienced trauma surgeon or a general surgeon equally experienced in trauma. The MedDir receives all pertinent information from the triage officer and the EMSC, such as the location and magnitude of the MCI and the estimated number of victims [8]. The MedDir responsibilities include, at a minimum:

1. Establishing the trauma teams: The most experienced surgeon in each of these teams is its chief and the only team member who reports directly to the MedDir.
2. Establishing smaller teams to yellow treatment site (see Sect. 4.4.6.2) and assigning a senior surgeon to supervise that area.
3. Implementing the appropriate surgical interventions.
4. Prioritizing surgeries at the operating room, the imaging modalities, specially the CT Scan, and the admissions to Intensive Care Units and wards.
5. Briefing the arriving personnel regarding the MCI.

The AD alleviates the burden of administrative issues from the MedDir. Based on the Israeli experience, it is recommended that directors of Emergency Departments be assigned to this position.

The AD's responsibilities include management of all logistics, including prioritizing admissions, use of imaging modalities, and surgical assignments, ensuring all blood bank-related issues and communications with the hospital administration.

The hospital HN responsibilities include: (a) assisting the MD by managing all nursing-related issues; (b) managing transfer of patients out of the ER; (c) directing the nurses recruited from the wards until more ER nurses arrive; and (d) collecting patient status and disposition data, and, determine if special equipment or resources are needed in the ER.

The EMSC is responsible for updating the triage officer on the type of MCI experienced, the location of the MCI, the expected casualty load, and the extent of injuries [8].

4.4.3 Emergency Room Triage Setup and Implementation

Triage is a vital and critical process for managing MCIs [10]. Problems in the quality of triage are expressed in terms of over-triage and under-triage. Over-triage leads to competition for treating the severely injured. Under-triage results in medical error and delays the provision of medically necessary care. Both problems increase the fatality rate among patients who might have potentially survived. During an actual MCI, the triage officer has time for only a rapid glance at each arrival; this brief examination occurs within a matter of seconds. Their decision must rely on a global clinical impression of the patient rather than on physiologic measurements. Many triage methods exist; one very simple method is the "ask-look-feel" method [6, 9].

The first priority for ER activation is preparation of the triage area outside the ER. The triage officers are the first medical professionals to process the MCI victims in the hospital setting. Originally, this responsibility was reserved for the most senior ER surgeon; however, experience has proven that a less qualified surgeon or ER physician can handle it equally well [11]. Preparation of the triage site requires the triage officer's attendance, two ER nurses, and at least two clerks for patient registration and photography. Severity labeling is performed according to the triage officer's decision. Triaged patients must also be given identifying armbands and charts.

The triage site should have a single entry point. Models employing multiple triage points have been shown to scatter resources and add to confusion [5]. The triage site should be comprised of a wide and comfortable area to provide easy access and exit for ambulances, the stretchers, and for the ease of logistics. The stretcher concentration point must be in close proximity to the triage site.

The triage officer must be fully familiar with the basic concepts of the triage process. Physicians able to fulfill this role should be trained and familiarized with the triage protocol process and documentation as part of their duties before the MCI. Selection of a triage officer should take into account the time of the event (morning, evening, or night shifts) to accommodate the in-hospital staff until the arrival of more experienced personnel.

Re-triage is the dynamic process that occurs inside the ER at the different treatment sites. Some of the red patients will be evaluated and re-triaged to either yellow or green and vice versa (see Sect. 4.4.6).

4.4.4 Staff Deployment

Staff deployment for a sudden MCI is of paramount importance to the successful management of the event. The deployment process has two parallel components: (1) staff deployment from within the hospital and (2) the calling in of staff from outside the hospital. Matching the sudden surge of patients with adequate staff in a sudden MCI can affect the level and the quality of care in such events [7].

Staff deployment includes doctors, nurses, radiology technicians, blood bank technicians, laboratory technicians, transport personnel, security staff, and clerks.

4.4.4.1 Staff Deployment Within the Hospital

There are several methods for deploying staff from within the hospital—via a hospital-wide paging system, in-hospital public announcement system and speakers, and/or beepers and cell phones that are automatically activated by a central computer [4]. To allow rapid mobilization of medical teams, a core of nurses who normally work outside the ER should have been trained on a regular basis to work in the ER and to become familiar with its setup and supplies. These volunteer nurses should spend several shifts a year in the ER to retain their knowledge and skills. When a MCI occurs, these "cross-trained" nurses are responsible to immediately report to the ER [4]. In addition, all surgical attending physicians and residents present in the hospital should report to the ER, where the senior administrator on call will assign and direct them to care areas within the ER. Non-general surgical residents from specialties such as gynecology, ENT, and ophthalmology should also report and be utilized as necessary.

4.4.4.2 Staff Deployment from Home

A disaster plan "call tree" must be in place in each department, with an established and well-practiced notification process such as an alphanumeric paging system or cellphones. Hospital administration should have up-to-date staffing lists on hand with telephone numbers and areas of expertise for all personnel [4].

The main weakness of the "call tree" method is the assumption that the listed people are available and will answer their phones [7]. This weakness must be taken into account throughout the deployment process. All staff and personnel who are called in from home need to bring their hospital/institute identification badges or tags to simplify their identification and assignment.

Prearranged meeting points are part of the personnel call-in plan, to facilitate the assignment of recruited staff as needed, according to their specifically assigned roles and to control the "staff overcrowding phenomena" in the ER. The overcrowding of personnel is a true challenge in MCIs and this "mass provider's incident" is well known in such situations. The senior hospital administrator is also responsible for crowd control, turning away curious and unnecessary staff members and bystanders with the help of the security staff [4].

4.4.5 Equipment Deployment and Logistics

Critical to the management of any MCI is the presence and adequate maintenance of medical supplies and equipment. A system for accessing all equipment that may be needed during an MCI, such as mechanical ventilators, tourniquets, regulated medical waste bags, cleaning supplies, and additional resources such as narcotic pain medicine, antibiotics, bags of crystalloid fluid, and intravenous tubing, must have been arranged long before the MCI occurred [12].

A shortage of equipment and medical supplies has been reported in different previous MCIs. Medical supplies located in the basement were destroyed or inaccessible after the Northridge earthquake incident and in the Houston, Texas flooding

of 2001 [13]. During the Rhode Island Station Nightclub fire, receiving hospitals quickly ran out of intubation supplies and the supply of antidote was depleted rapidly after the Tokyo sarin gas attack [5].

The ER design must incorporate appropriate storage areas for such items. Given the current trend at medical institutions for small inventories and "just-in-time" supply management, a determination about what is considered "critical" stock and where it should be stored must be made on a per-hospital basis depending on local standards [12, 14].

Available medical supplies and equipment must meet the needs for both conventional and non-conventional MCIs (hazardous materials [HazMat]) and be stored at pre-designed sites. Based on the Israeli experience, it is recommended to store the HazMat equipment for MCIs outside the ER, but in close proximity to the decontamination site, including intubation and resuscitation supplies, wire mesh, a gurneys barricades, and markers.

Ready to use predesigned carts that include the basic equipment for management of injured patients are also recommended. These carts are designed based on the Advanced Trauma Life Support® methodology which uses the A, B, C method (Airway, Breathing, Circulation) to locate all items on any cart, thereby simplifying their use and placement. Special carts are available for conventional and non-conventional MCIs, and pediatric use. All carts should be stored in designated MCI storage rooms in the ER vicinity. In our institute, the expiratory date for the equipment and medications in these carts and storage rooms is controlled by computer software.

Additional logistic considerations include provision of adequate food supplies for the increased staff and patients, planning for sufficient equipment on hand, and ensuring the availability of staff to continuously clean medical instruments and maintain the medical equipment.

4.4.6 Setup and Organization of ER Treatment Sites

The most common setup of the MCI treatment sites is to have three sites, designated as red, yellow, and green.

4.4.6.1 Red Site Treatment Area

The red site is designated for treatment of the severely injured. It can be located in a shock-trauma room (if available) or any other designated area in the ER. Available equipment at this site must meet the need for monitoring (ventilators, cardiac monitors, pulse oximeters) and treating life threatening conditions. If the scale of event is quite large, with more space needed to accommodate the severely injured, preplanned spaces on the same floor and in close proximity to the original red site should be opened. The senior surgeon on call is in charge of this site, with the most senior surgeons and physicians and nurses providing care there. Generally, at least one physician and one nurse should be assigned to each patient at this site. As more help arrives, additional nurse and physicians can then be assigned to this site and to the yellow sites.

4.4.6.2 Yellow Site Treatment Area

The yellow site is designated for treatment of the moderately injured. It too is located in a designated area inside the ER. Preferably, a surgeon should in charge of this site (if available). In unavailable, an ER or other physician can be assigned until the surgeon arrives. Mainly junior surgeons and ER physicians staff this site. One physician and one nurse can take care of more than one injured patient until additional medical staff arrives.

4.4.6.3 Green Site Treatment Area

The green site is designated for treatment of the mildly injured. These patients, often referred to as "walking wounded," typically comprise 50% of MCI victims, and can be managed in an area further removed from the ER. A senior or junior physician may be in charge of this site. It is recommended to provide a minimum of one nurse for every ten patients.

4.4.7 Setup and Organization of Additional Treatment Sites

Additional treatment sites relate to pediatric patients and victims with mental health issues.

4.4.7.1 Pediatric Site

It is recommended that the pediatric site be located within the ER and not in a remote area. Severely injured pediatric patients should be treated at the red site. All others can be treated at a designated pediatric site. The pediatric surgeon on call or the senior pediatric ER physician should be in charge of this site. As mentioned above, carts and equipment should be readily available based on the pre-arranged equipment distribution and logistics plan.

4.4.7.2 Mental Health Site

The mental health site is a designated area for patients with acute stress reactions or other behavioral health problems. A psychiatrist, psychologist, or social worker can be in charge of this site. One nurse for ten patients is recommended.

4.4.8 Patient Identification, Registration, and Tracking

Outside the ER and immediately following triage, every patient must be registered by at least two clerks to prevent bottleneck at the entrance of the ER [15, 16]. During registration, each patient receives a colored armband (red, yellow, green) and medical chart. They should be assigned a temporary identification number that is used as their temporary medical record number (T-number) which is placed on their armband and the medical chart. The color of the armband is used to direct the patient to the appropriate treatment site. The medical chart should have been designed in advance (by the medical and nursing staff) to facilitate simple and basic

medical documentation and basic information. As stated above, no written documentation is done at the triage site, only categorization of severity. Digital cameras should be used by one of the registration clerks to photograph comatose or intubated patients and infants, and anyone without an attending family member. The T-number must be included in the picture.

Patient tracking during an MCI is essential, and a real-time assessment of patient location is paramount. This is critical not only for the efficient management of patient flow and resource allocation, including operative suites and ancillary testing, but also for updating families with regard to patient status [17].

Potential patient tracking systems include use of a bar code as well as manual tracking systems. If bar codes are used, computers and bar code scanners should be accessible at all entrances and exits to the ER.

In Israel, a national, manual-input casualty tracking system called "Adam," developed by Rambam Medical Center in Haifa, aids in tracking patients across facilities.

Based on the Israeli experience, fully computerized systems for patient documentation have been found unsuitable for the chaotic MCI environment and paper-based systems that are used during large MCIs are much safer [4].

4.5 Additional Important Considerations

4.5.1 Emergency Room Inter-communication

Communication in the ER throughout the MCI is critical. The communication system used, between all staff involved in the MCI as well as external parties (EMS, polices, etc.), must be available, reliable, clear, and secure. Communication problems and failure have been common in past MCIs and are frequently raised as an issue for improvement in debriefings after the events [18].

Channels for communications must be available to ensure contact from outside the hospital to the hospital and vice versa. This section focuses on ER communication.

Failure of communication inside hospitals can be a result of extensive damage to landlines (earthquake, flooding), damage to cellular towers, overwhelmed cellular lines, and varied signal strength. While cellular telephones are extremely useful, cellular networks have failed in recent MCI scenarios [19, 20]. In such cases, two-way radios can provide a secure and clear alternative. Two-way radios should be maintained on hand in a secure location and be fully charged. If two-way radios are used, at least two channels are needed: one for medical communications and one for security. The medical channel is dedicated for communication between the triage area, operating room, radiology services, transport, treatment sites, command center, and the surgeon on charge of the event. Limiting the number of personell using the two-ways radios will improve the communication process and increase its efficacy.

4.5.2 The "One Way" ER Concept

A concept that is widely implemented in the Israeli ER and states that the flow and movement of the patients into and out of the ER is unidirectional. The main idea behind this concept is to accommodate and maximize efficiency in managing surge volume. The front entrance is utilized solely for patient triage, and the rear exit is used solely for patient egress, creating controlled patient flow through the department. Patient flow should occur from the ER to alternate inpatient destinations (operating room or radiology/testing areas, ICU or ward bed). All patients leaving the ER for the radiology department (mainly CT scan) are admitted to a nearby facility that is staffed by a senior physician and nurse, waiting for medical decision and plan for the final destination of the patient. Minimizing patient movement throughout the hospital during a MCI also helps minimize patient misidentification and confusion.

A "controller" should be at the exit door from the ER. The role of the controller, either a nurse or clerk, is to ensure full documentation in the medical chart and verify the patient's destination.

4.5.3 Response to Chemical, Biological, and Radiation Events

The basic concepts for activating the ER for a conventional or non-conventional MCI are the same. The main difference is the need to protect hospital staff and for decontamination and/or isolation of the injured. Decontamination and isolation facilities must be appropriately located [6]. The response to one of these hazards has to be rapid and occurs prior to entering the ER. Failure of the decontamination process may result in significant hazards to the treating staff members [9, 21, 22]. It is recommended that the decontamination site be close to the ER, in order to make the process easier.

The protocol of the Israel National Committee on HazMat preparedness is as follows: personal protective equipment (PPE) of at least class C or equivalent must be made available to the decontamination staff quickly and in sufficient quantities. Staff in the ER are provided only with respiratory protection and butyl Rubber gloves [14].

Decontamination is carried out with warm water showers and ancillary disrobing and soaping equipment. A hot line is permanently marked on the pavement.

Patient isolation may be required in the event of a biologic or infectious MCI. Hence, the ER must also have a dedicated isolation area with strict protocols for management of these special situations.

4.5.4 Diagnostics and Blood Tests

There are a few considerations to be noted with regard to blood tests, X-rays, and ultrasonography during MCI.

Two blood tests are recommended in MCIs: (1) blood typing and crossmatching; (2) arterial blood gases. Based on the Israel experience, it is recommended to be very selective in taking blood for lab tests. Note that patients with a "red" designation will need many more tests; those with a "yellow" or "green" designation should have blood tests taken only as needed.

Chest and pelvic X-ray studies should be requested strictly based on need. The main issue regarding these types of X-rays within the ER is the movement of staff outside the room or behind a wall, unless the space is divided by walls and each injured patient is treated in separate room.

Our and others experience during MCIs indicates that bedside diagnostic ultrasonography is an excellent tool to further triage in the ER of hemodynamically unstable patients, internal torso injury in comatose patients, or in patients who have external signs of torso penetration from blast shrapnel [23, 24].

4.6 Summary

Handling mass casualty incidents is always highly challenging in terms of organization, logistics, and medical aspects. Optimizing the response to any MCI requires great efforts at the local, regional, and national levels, and well-organized coordination between different aspects and phases of management and between different authorities. At the hospital level, the setup and response of the emergency room plays a crucial rule in MCIs. This ER response includes many parallel processes to activate and prepare the ER for handling and managing the casualties of the event. As described in this chapter, the overall process must be well organized and controlled to achieve best results and efficiency. The process itself is based on many organizational details, as described, and on MCI-specific altered standards of care that are unfamiliar to the staff. Utilizing the same methodologies as in routine emergencies is doomed to failure. Predefined protocols will have a major positive effect on the entire process. An effective method for testing efficacy of protocols and to identify weaknesses is through repeated drills of the ER staff, including both the medical and non-medical teams. By becoming familiar with the protocols and the details of the entire MCI response process, the ER staff will avoid the phenomena of "Paper Plan Syndrome," and the teams will become much more confident and effective when working in the emergency room under the constraints of a mass casualty incident.

References

1. World Health Organization (WHO). Mass casualty management systems: strategies and guidelines for building health sector capacity. Health Action in Crises Injury and Violence Prevention. Geneva: WHO; April 2007. http://www.who.int/hac/techguidance/tools/mcm_guidelines_en.pdf.
2. Niska RW, Shimizu IM. Hospital preparedness for emergency response: United States, 2008. Natl Health Stat Report. 2011;37:1–14.
3. Woolard RH, Borron SW, Mackay JM. Chapter 21: Emergency department design. In: Ciottone GR, editor. Ciottone's disaster medicine. Philadelphia: Elsevier. p. 125–9.

4. Singer AJ, Singer AH, Halperin P, Kaspi G, Assaf J. Medical lessons learned from terror attacks in Israel. J Emerg Med. 2007;32(1):87–92.
5. Okumura T, Suzuki K, Fukuda A, Kohama A, Takasu N, Ishimatsu S, Hinohara S. The Tokyo subway sarin attack: disaster management, Part 1: community emergency response. Acad Emerg Med. 1998;5(6):613–7.
6. Almogy G, Belzberg H, Mintz Y, Pikarsky AK, Zamir G, Rivkind AI. Suicide bombing attacks: update and modifications to the protocol. Ann Surg. 2004;239(3):295–303.
7. Lynn M. Mass casualty incidents: the nuts and bolts of preparedness and response for acute disasters. New York: Springer Science + Business Media; 2016.
8. Sofer D, Klausner JM. Trauma system configurations in other countries: the Israeli model. Surg Clin North Am. 2012;92(4):1025–40.
9. Kluger Y, Mayo A, Soffer D, Adadgem D, Halperin P. Functions and principles in the management of bombing mass casualty incidents: lessons learned at the Tel-Aviv Souraski Medical Center. Eur J Emerg Med. 2004;11(6):329–34.
10. Foley E, Reisner AT. Chapter 54: Triage. In: Ciottone GR, editor. Disaster medicine. Philadelphia: Elsevier Health Sciences; 2006. p. 337–43.
11. Cushman G, Pachter HL, Beaton HL. Two New York City hospitals' surgical response to the September 11, 2001, terrorist attack in New York City. J Trauma. 2003;54(1):147–55.
12. Gale SC, Donovan CM, Tinti M, Ahmed H, Gracias VH. Organization and operations management at the health care facility. Ann Emerg Med. 2017;69(1S):S29–35.
13. Nates JL. Combined external and internal hospital disaster: impact and response in a Houston trauma center intensive care unit. Crit Care Med. 2004;32(3):686–90.
14. Halpern P, Goldberg SA, Keng JG, Koenig KL. Principles of Emergency Department facility design for optimal management of mass-casualty incidents. Prehosp Disaster Med. 2012;27(2):204–12.
15. Benson M, Koenig KL, Schultz CH. Disaster triage: START, then SAVE—a new method of dynamic triage for victims of a catastrophic earthquake. Prehosp Disaster Med. 1996;11(2):117–24.
16. Feliciano DV, Anderson GV Jr, Rozycki GS, Ingram WL, Ansley JP, Namias N, Salomone JP, Cantwell JD. Management of casualties from the bombing at the Centennial Olympics. Am J Surg. 1998;176(6):538–43.
17. Vanderwagen C. Implementing the National Health Security Strategy [White paper]. Aptean website. http://www.irms360.com/vanderwagen-national-health-security-strategy. Accessed 28 Apr 2018.
18. D'Andrea SM, Goralnick E, Kayden SR. 2013 Boston Marathon bombings: overview of an emergency department response to a mass casualty incident. Disaster Med Public Health Prep. 2013;7(2):118–21.
19. Kirschenbaum L, Keene A, O'Neill P, Westfal R, Astiz ME. The experience at St Vincent's Hospital, Manhattan, on September 11, 2001: preparedness, response, and lessons learned. Crit Care Med. 2005;33(1 Suppl):S48–52.
20. Gavagan TF, Smart K, Palacio H, Dyer C, Greenberg S, Sirbaugh P, Fishkind A, Hamilton D, Shah U, Masi G, Ivey RT, Jones J, Chiou-Tan FY, Bloodworth D, Hyman D, Whigham C, Pavlik V, Feigin RD, Mattox K. Hurricane Katrina: medical response at the Houston Astrodome/Reliant Center Complex. South Med J. 2006;99(9):933–9.
21. Horton DK, Orr M, Tsongas T, Leiker R, Kapil V. Secondary contamination of medical personnel, equipment and facilities resulting from hazardous materials events, 2003-2006. Disaster Med Public Health Prep. 2008;2(2):104–13.
22. Centers for Disease Control Prevention (CDC). Update: investigation of bioterrorism-related anthrax and interim guidelines for exposure management and antimicrobial therapy, October 2001. MMWR Morb Mortal Wkly Rep. 2001;50(42):909–19.
23. Sajed D. The history of point-of-care ultrasound use in disaster and mass casualty incidents. Virtual Mentor. 2010;12:744–9.
24. Sztajnkrycer MD, Baez AA, Luke A. FAST ultrasound as an adjunct to triage using the START mass casualty triage system: a preliminary descriptive system. Prehosp Emerg Care. 2006;10:96–102.