



How Violent Attacks Are Changing The Demands of Mass Casualty Incidents: A Review of The Challenges Associated with Intentional Mass Casualty Incidents

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Abstract

Antagonistically induced mass casualty incidents (MCI) introduce unique conditions that are rarely addressed in current MCI policies. Many of today's MCIs are intentional acts of violence, such as mass shootings, improvised explosions, mass stabbings, vehicle rammings, and other similar assault tactics. Not only have the methods changed, so too have the impacts. These violent incidents are occurring more frequently and involve far more victims than in the past due to the choice and power of weapons. The injury patterns, especially those associated with gunshots and explosives, have become more devastating and far more time sensitive than conventional traumatic injuries, such as those caused by blunt trauma. Mindful of the propensity for additional attacks, victims are more inclined to leave the area of the attack long before emergency medical services can arrive. This article explores some of the challenges for public safety in controlling the incident.

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Introduction

The policies in place today for response and mitigation of a mass casualty incident (MCI) are not much different than original constructs developed several decades ago. Much of the rationale behind this approach is based on assumptions such as victims being unable to communicate to others outside of the scene, geographically remote locations of these events, confined geographic scope at a single scene, no threat of violence, a controlled distribution of patients to definitive healthcare, and reliance upon emergency medical services to treat and transport patients.¹ Most of the mass casualty events of the past were caused by accidents, including mass transit crashes, structure failure, weather events, and industrial accidents.

But the world has evolved a great deal from when these systems were conceptualized. Now most victims can communicate immediately with their cell phone; more MCIs, particularly those caused by violence, tend to happen in densely-populated areas; simultaneous intentional acts of violence can spread resources across a large geographic area; violence now often causes the MCIs; patients self-transport; EMS is often bypassed by patients themselves or empowered bystanders; and patients are not evenly distributed amongst hospitals.² Applying this outdated approach to a modern reality results in poor leveraging of resources, overwhelmed hospitals, and, ultimately, inferior patient care.

The causes of mass casualty incidents have evolved significantly since the current response approach was developed. While we still face the possibility of traditional accidents, many of the incidents today are intentional acts of violence, such as mass shootings, improvised explosions,

mass stabbings, vehicle rammings, and other similar assault tactics.³ These intentional MCIs are increasing in frequency, and result in far more victims than accidental MCIs. The weapons used inflict life-threatening major trauma, such as penetrating injuries and blast wounds, which are extremely time sensitive. To protect themselves from ongoing attacks, victims and bystanders who are involved in these incidents often flee the area long before traditional emergency medical services arrive. This undermines the controlled distribution of patients to hospitals, often overwhelming the closest emergency room with untreated, catastrophically wounded patients.

This article examines the current approach for responding to MCIs. It will examine industry standards, policies, protocols, and directives to determine the broad commonalities in MCI response in the U.S. It will evaluate the efficacy of these approaches using after-action reviews and other retrospective analyses. The article will identify those strategies that have failed to provide optimal care for the patient or have negatively impacted the broader healthcare system and will recommend more promising models for alternative approaches. We will explore some of the challenges for public safety in controlling the incident, such as ubiquitous communication, mobile mapping applications, social media, and ride shares.

Defining the Mass Casualty Incident

There is not a universal definition of a mass casualty incident, as it varies across disciplines, agencies, authorities, and jurisdictions. For policy and declaration purposes, a great deal of work has gone into defining specific gross numbers of patients that would constitute an MCI. Over time, it has been accepted that the number of patients does not matter as much as the resources available to treat them. This relative definition takes into consideration local resources that are immediately available, including personnel, vehicles, equipment, and supplies, particularly at the EMS and hospital domains.⁴ The available resources are countered with the number injured, their types of injuries, the severity of their injuries, and the rate at which they require care.⁵ As such, any imbalance between the needs of the victims and the availability of healthcare resources stresses the system.⁶ In some rural locations with minimal resources, a single car accident with five patients may overwhelm the resources. In a larger urban area, resources may not be exhausted until several dozen patients present with severe injuries. In general, this definition specifies an MCI as an event wherein the number and severity of injuries exceeds the resources immediately available to treat them effectively.

Several authors have offered similar definitions. Lincoln defines additional parameters by stating “a mass casualty incident (MCI) is defined as an event that overwhelms the local healthcare system, where the number of casualties vastly exceeds the local resources and capabilities in a short period of time. Any MCI can rapidly exhaust available resources for not only the MCI but the normal day-to-day tasks of the hospital.”⁷ Hart, et al. add temporal considerations and include a systems perspective in stating the term MCI “refers to an event that *overwhelms* the local healthcare system, with a number of casualties that vastly *exceeds* the local *resources* and capabilities in a short period of *time*.”⁸ The World Health Organization highlights the diminished care provided during MCIs by defining them as “disasters and major incidents characterized by quantity, severity, and diversity of patients that can rapidly overwhelm the ability of local medical resources to deliver comprehensive and definitive medical care.”⁹ Briggs suggests that

patient flow rate into hospitals is a key component, defining an MCI as an “incident where the number of patients (or the rate of their arrival to a medical facility) overwhelms local resources (and the ability to immediately supplement them).”¹⁰

Beyond the imbalance between demand and available resources, MCIs are defined by the unique conditions they present to clinicians and the system as a whole.¹¹ An MCI does not only challenge a responder in terms of quantity, as is usually cited. Instead, most of the obstacles are those related to the quality of the incident. These are particularly pronounced in MCIs that result from violence or terrorism. Providers are met with unfamiliar wound patterns or etiologies, such as those that result from high power ballistic rounds, blasts, or biological or chemical exposure.¹² Responders must also perform their tasks under the possibility of additional violence and in hostile environments.¹³ Because of the complexity of the event, responders will work with nontraditional partners, including those from other disciplines or the public. The majority of patients tend to bypass EMS, disrupting the responders’ ability to completely control the scene.¹⁴ Many of the incidents are spread over multiple sites or vast geographic areas unlike routine calls for service.¹⁵ Finally, the unusual volume, rate, and nature of patient injuries demands a different standard of care than is provided under normal demand.¹⁶

A definition that encompasses a number of these unique aspects is necessary. This definition should consider demand, system resources, impact upon operations, and the unfamiliar nature of the challenges the responders will face. For the purposes of this paper, an MCI is defined as an event where the number of patients, the severity of their injuries, and their rate of presentation immediately and vastly overwhelms any or all resources and capabilities of the healthcare system, creating unfamiliar challenges to the providers, thereby impacting system operations and routine standards of care.

History and Evolution of Mass Casualty Incidents

The concept of a mass casualty incident has existed for quite some time. Previously, these events were commonly labeled “disasters,” and were often caused by weather or similar natural events. But other disasters, such as those involving ships, were not uncommon and produced large numbers of injured or dead. Beyond these circumstances, most MCIs were the result of war. Civilians were rarely exposed to MCI conditions prior to the Industrial Revolution. With the advent of industry, MCIs became more frequent. The industrial revolution introduced dangerous factories, motorized forms of mass transit, and dense populations in urban areas. These circumstances combined to create dangerous conditions with large numbers of people exposed thereto.¹⁷ No longer was the threat of MCI limited to earthquakes, hurricanes, floods, tornadoes, and sea disasters. New, more deadly hazards such as bus, plane, and train crashes; chemical spills; radiation leaks; and industrial explosions now threatened citizens. These accidental MCIs, coupled with the preexisting natural events, spawned the creation of a new field aptly named “disaster medicine.”¹⁸

The concept of disaster medicine is meant to provide healthcare to victims by boosting preparedness, response, and recovery efforts specifically targeted towards catastrophic events. It involves numerous facets of the community and creates a comprehensive system for these unique circumstances.¹⁹ Derived from military medicine, it aimed to address the unique challenges, standards of care, logistical concerns, and ethics related to treating large numbers of patients. Though the term and concept appeared in many post-World War II writings, it became more formalized with the creation of the National Disaster Medical System in the 1980s.²⁰ The concept became part of the vernacular of emergency managers and created a cadre of specialist physicians, planners, managers, and policy makers. As part of the work in the field, in conjunction with emergency medical services (EMS) agencies and hospitals, emergency managers created standard practices for MCI response, which were generally adopted by consensus across the United States.

The tenets of MCI response and management emphasize controlling the event and patients at the scene, then transporting to definitive care. The responsibility for scene management lies primarily with EMS, with law enforcement and fire/rescue providing ancillary assistance. EMS is to arrive, assess the scene, make a determination of needed resources, locate and deploy the resources, triage each individual patient, provide on-scene care, and then transport patients in a manner that distributes patients across healthcare facilities, all while maintaining incident command. Law enforcement provides scene security, while fire/rescue supplies extra manpower to assist with operations. The incident dynamics are communicated with area hospitals, who are then given the opportunity to plan for arrival of patients already partially treated and managed by EMS professionals. This approach requires that patients remain on scene until EMS evaluates, treats, and transports them; that there be sufficient resources in a timely manner to affect positive treatment for patients; and that the area be of reasonable geographic scope to control it as a single incident.

Disaster medicine and the concepts of MCI operations developed largely as a result of the Industrial Revolution with the introduction of accidental disasters.²¹ The changing landscape of disasters prompted changes to best meet the needs of the patients within the existing systems and structures. Most recently, a new phase has emerged, one that adds intentional MCIs as a threat even more potent than those in the natural and accidental categories. Incidents such as the 1995 Tokyo subway sarin attack (over 4,000 non-fatally injured), the World Trade Center attack of 2001 (7,364 non-fatally injured), 2004 Madrid railway attack (1,180 non-fatally injured), the 2005 subway and bus attacks in London (775 non-fatally injured), and the Las Vegas mass shooting of 2017 (817 non-fatally injured) show just how devastating these events can be and the degree of strain they can immediately place on a healthcare system that operates at near capacity on a daily basis.²²

The malicious and violent intentional acts of violence, such as mass shootings, mass stabbings, vehicle rammings, and improvised explosive devices, demand a change in the way MCIs are managed. The Congressional Research Service reports an increase in these intentional attacks, with an average of 31 mass murders that resulted in four or more persons being murdered.²³ On a larger scale, intentional MCIs, which result in casualties that overwhelm the healthcare system, have risen as well.²⁴ The trendline of these events shows an approximate 5% increase

each year since 1900.²⁵ Along with the increased frequency, the lethality of these events has grown. Omitting the extraordinary events of the Murrah Federal Building bombing of 1996 and the attacks of September 11, 2001, more people have been killed in intentional MCIs in the last ten years (428 killed between 2009-2019) than in the previous 60 years (405 killed between 1948-2008).²⁶ During this time, as technology and resources have evolved, so too has the response to MCIs. While not codified and, in fact, usually ignored in policies and procedures, patients now self-transport or are transported by other citizens; they no longer rely on EMS to access definitive care; they have means to communicate widely outside of the scene; and they are often treated by bystanders.²⁷ These MCIs usually become more complicated to control, especially if outdated methods are being used.²⁸ However, new approaches are providing more patients with faster access to definitive care, presumably saving more lives.²⁹ It is time to rethink the public safety approach to MCIs. Examining past events will allow for analysis and recommendations for improvement.

Scope of this Article

Mass casualties can present as the result of numerous etiologies. The injury patterns dictate the appropriate treatment course, which varies greatly. For example, the chemical burns associated with a manufacturing plant explosion would require vastly different treatment and specialties than the blunt force trauma associated with a building collapse. Likewise, intentional mass casualty incidents, MCIs that result from a targeted act of violence, cause unique challenges.³⁰ These include unusual wound patterns, hostile environments, multiple scenes, and emotional elements.³¹ This article aims to address basic concepts of MCI response, which are universally applicable, but it concentrates on experiences of MCIs caused by malicious intent. Though the case studies examined will be limited to intentional MCIs, the recommendations are applicable for the majority of MCIs that occur in the United States: common trauma-inducing events, such as mass transit wrecks, structure failures, improvised explosives, mass shootings, mass stabbings, and vehicle borne attacks. In order to avoid diluting the overall construct, we will exclude the more nuanced events (such as chemical, biological, radiological, and nuclear events that require a specialized response by advanced, cross-disciplinary teams, rather than by EMS) from this article.

The events to be examined include a scale of relativity, depending on whether the circumstances strained the public safety and medical resources. We omit events where all victims died, or those that left very few viable victims, such as sinking ships and airliner crashes. Because of the unique response resources and practices of the military, we also omit any MCI that involves a strictly military response. We also exclude protracted events during which injuries present over a lengthy duration. This includes most weather events, such as hurricanes and tornadoes. These are also excluded because they stretch across a wide geographic area and, as such, put unique strains on a system unlike a localized immediate MCI.

Finally, temporal confines will be placed upon the research. Because modern EMS and the industry's response to MCIs were formally established in the early 1980s, we will only examine events past 1980. A brief review of events prior to that time shows disorganized response to MCIs, and that there have been significant changes in public health and emergency medical systems since their publication.³² As such, these case studies do not offer much towards creating

a modern-day approach to this problem. Despite changes in system design and maturity, a comparison of the case studies of several decades ago and those of just a few years ago shows that the same problems and obstacles to effective response persist.³³

Recurrent Problems with The Current MCI Model

The review of after-action reports, research, and other literature revealed common deficiencies with adherence to the current MCI model.³⁴ These challenges included incident command and control; triage; on-scene treatment; misallocation of resources; applying conventional tactics during unconventional events; the assumption that EMS will be able to take charge; poor distribution of patients to receiving facilities; communications; and hospital surge operations. In general, after action reports have placed an emphasis on inadequate resources to meet surge demand.³⁵ As such, corrective actions have been directed towards increasing capacity and available resources, effectively increasing the quantity of the resources available.³⁶ The assumption is that “we have too little” or “we are doing too little.” However, despite vast differences in available resources, nearly all MCI after action-reports cite the same challenges.³⁷ In fact, Auf der Heide suggests that many of the problems experienced in planning and responding to disasters seem to be ‘learned’ over and over again in disaster after disaster.”³⁸ This suggests that it is not merely a matter of having too little to address these incidents, but rather, that the industry is taking the wrong approach.³⁹

Triage Trouble

When confronted with a volume of patients with injury patterns that will exhaust immediately available resources, medical providers are forced to assess patients and triage them according to the nature of their injury. This utilitarian method is meant to have maximal impact for the most people.⁴⁰ Triage is intended to identify the small proportion of patients who are critically injured, but salvageable, and direct the limited resources and transport assets to them in a most expedient manner.⁴¹ Because of the unusual circumstances, this is different than the normal patient assessment and decisions made by EMS providers during routine demand. During MCIs, providers must alter their standards of care, taking on a battlefield mentality and limiting treatment to damage control.⁴² Patients are typically divided into the categories identified in table 1 below.

Table 1: Triage Categories of Patients of Mass Casualty Incidents⁴³

Category	Condition	Treatment	Typical Percentage of Total Patients
Red/Immediate	Patients with immediate life-threatening injuries that remain salvageable.	Patients with immediate life-threatening injuries that remain salvageable. These patients require immediate intervention and transport. They are to be treated and transported first.	10% or less
Yellow/Delayed	Patients that have potentially life-threatening injuries, but do not need immediate intervention.	Patients are currently stable, but will need medical assistance within several hours to prevent them from deteriorating. They do not require immediate transport, but should be reassessed often and transported to a hospital as soon as the red patients are evacuated.	Approximately 15%
Green/Minor	Patients that have minor injuries that are not life-threatening.	These patients, who are commonly referred to as "Walking Wounded," do not need medical attention for several days. Transport should be delayed or alternative sites found in order to keep these patients from detracting from the care offered to the Red and Yellow patients.	Approximately 75-80%
Black/Deceased	Patients who have died or have injuries that will certainly lead to death.	The severity of injuries and limited resources mean the patient is unlikely to survive regardless of interventions. Patients should be provided with palliative care, if possible, and not transported.	N/A

During this initial encounter with patients, providers are expected to provide only immediate life-saving interventions, such as adjusting airways or controlling massive hemorrhage. Triage time is to be limited to a 30-60 second encounter with each patient.⁴⁴ The existing model calls for patients to be treated and transported in order of triage categories. While awaiting transport, patients are staged in treatment areas where on-scene clinicians can provide basic prehospital medical care.

The most common prehospital triage algorithm is the Simple Triage and Rapid Treatment (START) approach.⁴⁵ This methodology was developed in 1983 by Hoag Hospital and the Newport Beach, California Fire Department.⁴⁶ It was meant to quickly assign a triage category using easily observable patient status, including response to command, capillary refill, and respiratory rate.⁴⁷ Over time, there have been minor revisions to the criteria used, but it remains based upon respiratory performance, hemodynamic status, and mental status. As one of the oldest triage methods, it is widely accepted and is near universal in the prehospital setting in the U.S. But, as Lerner et al. stated, “There is no existing measure with which to judge the accuracy or appropriateness of mass casualty triage decisions in either trauma or disaster literature.”⁴⁸ Likewise, there is uncertainty that the very parameters on which the discriminators are based are scientifically precise indicators of patient condition and survivability likelihood.⁴⁹ This naturally leads to questions of whether triage is necessary and if it has any positive impacts. While there are few parameters to check, the algorithm to guide clinicians through the process can be confusing because of the surrounding environmental factors of an MCI and the fact that the logic being applied is not used on a routine basis. Figure 1 below shows a simplified version of the START method.

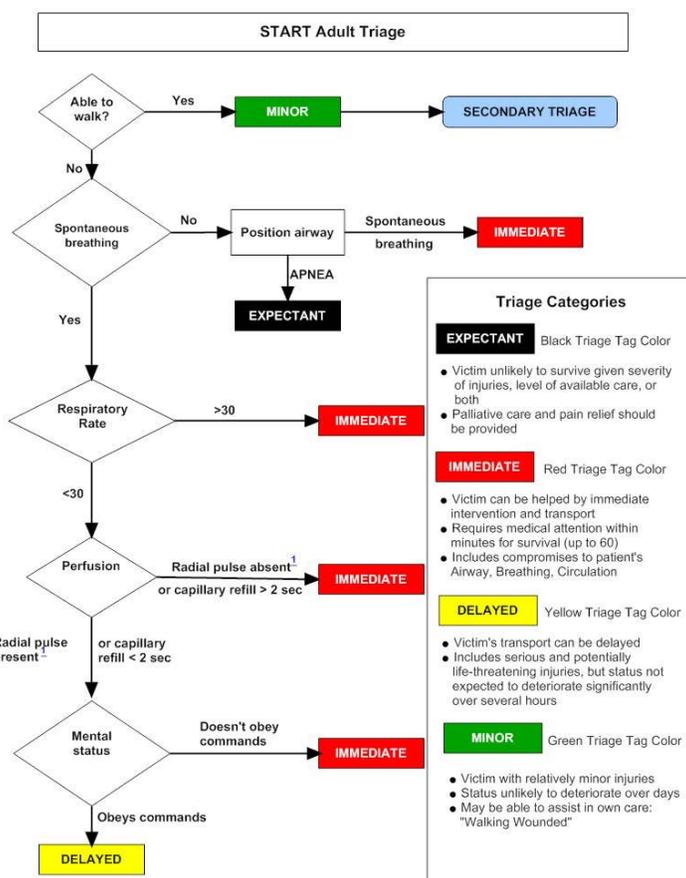
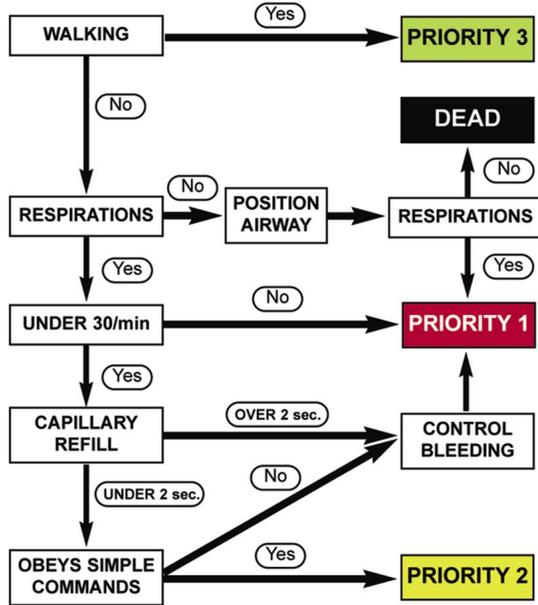


Figure 1: START Triage Algorithm⁵⁰

The method is further confused by variation in the way it is visualized.

Figures 2 and 3 below show the same process as Figure 1, but in a more complicated visual algorithm.

PRIMARY TRIAGE



If you are unable to obtain a capillary refill, check the radial pulse. If absent then control any bleeding and prioritize the patient **PRIORITY 1**.

Figure 2: Variation of START Algorithm Visualization⁵¹

START - Simple Triage And Rapid Treatment

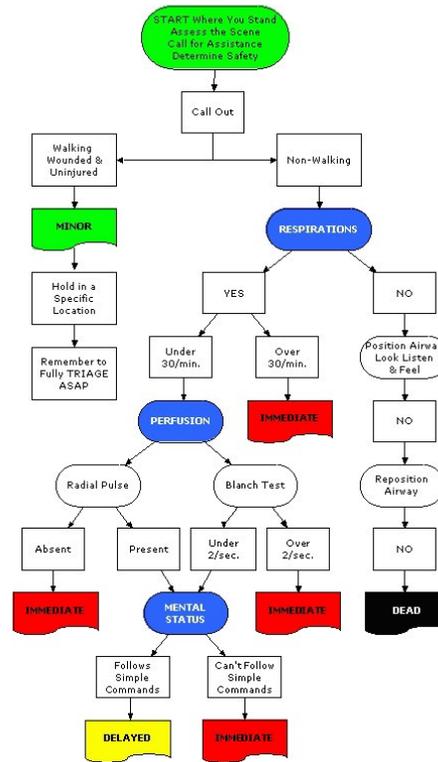


Figure 3: Variation of START Algorithm Visualization⁵²

Arguably more complicated and perplexing, these two visualizations would, in theory, lead to the same result given the objective criteria and measurement thereof. But, given unfamiliarity with the process, conflicting visuals, the stress of the unusually demanding event, and the fact that providers may face a single MCI in their entire career, it is understandable that providers cannot successfully and consistently apply the algorithm to provide reliable results for patient classifications.⁵³ Further complicating these challenges is the fact that the START algorithm for children, JumpSTART, has different criteria for all objective data and allows for additional resuscitation attempts.⁵⁴

A review of drills and incidents shows the deviations for the intended outcomes of triage. A New York City Fire Department exercise in 2006 where 130 patients were triaged through START resulted in an accuracy rate of 78%.⁵⁵ Another study shows that patients are over-triaged, placing them in higher priority categories, thereby misusing limited resources, putting 79 of 148 patients (53%) into unnecessarily higher priority categories.⁵⁶ The Virginia Tech shooting panel report found that tactical medics, using START, were able to correctly identify high priority patients.⁵⁷ However, of the 49 victims, only 17 were not deceased, suggesting less of a demand on providers, which may have eased stress and allowed for calmer application of the criteria or more resources available to conduct the triage. Further, the panel indicated that 69% of those patients were over-triaged.⁵⁸ Despite strides to reach full accuracy of triage guidelines, Cone, et al. state that “[t]here are no data to show whether correctly sorting patients into categories

set forth by any particular triage system results in improved outcomes for an individual patient or a group of patients as a whole.”⁵⁹ In fact, the entire utility of the triage system is undermined in incidents like the 2005 Los Angeles train accident, which involved 241 patients. During this event, EMS units transported critical patients to community hospitals rather than specialty centers, which was blamed on confusion of the START triage nomenclature.⁶⁰

There are challenges beyond the accuracy of the triage. Most notably, providers reported that they were not completely familiar with the algorithm and, therefore, made erroneous decisions.⁶¹ The clinicians also cited the fact that triage at an MCI is antithetical to their routine assessments and treatment courses and, as such, is counterintuitive.⁶² Other reports showed that providers expended too much time on each patient. Providers admit to being emotionally driven by triage and treatment decisions.⁶³ Beyond the assessment itself, clinicians often did not limit themselves to the minimal lifesaving interventions that are permitted during triage, but instead continued to treat the patients aggressively as they would under normal circumstances.⁶⁴ Triage tags, documentation, and patient accountability efforts also delayed triage and subsequent care for the patients.⁶⁵

The circumstances that caused the MCI and the conditions of the patients and environment can also impact triage accuracy. Following START methodology, a critical burn patient without airway compromise would be appropriately labeled as non-immediate, and assigned to the delayed or minor level, when in actuality, immediate, intensive, and constant care is required for that patient to survive.⁶⁶ Under duress such as active violence, patients may need to be moved out of order from their triage categories. Comorbidities, such as mental or physical disabilities, can provide false impressions, leading to both over- and under-triage potential. Even triage that is performed completely accurately can lead to inaccurate results and subsequent treatment.⁶⁷ EMS entities should consider revising the complicated triage methodology to a simpler approach that is easier to execute during times of stress. A less complicated approach could be easier to comprehend and execute even though providers are unfamiliar with the process because of the infrequency of the events. A sorting and sifting method, such as the Sort, Assess, Lifesaving Interventions, Treatment/Transport (SALT) approach, have been found to yield more accuracy and be completed in less time.⁶⁸ This method, however, introduces a fifth category, Expectant, which may further complicate the triage process.⁶⁹ Because of the same treatment being provided to both categories, Expectant and Dead could be combined to minimize classifications. There are numerous other models throughout the world that could be considered for adoption.

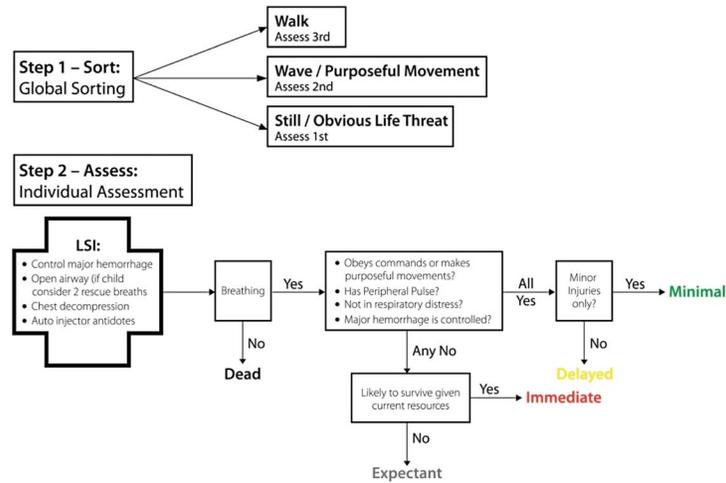


Figure 4: SALT Triage Algorithm⁷⁰

Without changing the criteria or intended classification results, START triage could be presented in a visualization that is less cumbersome and easier to understand. Simplifying the fashion that the information is presented and can be referenced during an emergency may resolve reliability and time-consumption concerns. The Canadian Triage and Acuity Scale (CTAS) separates patients into the same categories as START.⁷¹ However, the assessment portion is simplified to include limited physiological markers, then a rule-out scenario to place others in remaining categories. This is the national standard across Canada, allowing for consistent triage across the country and across the prehospital and hospital settings.⁷² An example of this, which is widely used in Canada, is shown below in Figure 5.

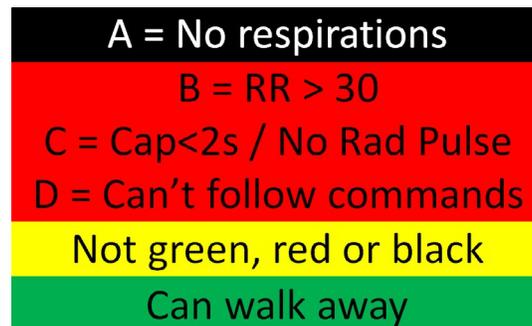


Figure 5: Simplified CTAS Triage Categories⁷³

An approach that has gained popularity over traditional triage is the concept of “sifting and sorting.”⁷⁴ Patients with purposeful movement or those that can stand up and leave, do so, sifting out only the patients who require assessment. Sorting then allows providers to quickly break patients into three categories: (1) requires immediate life-saving interventions, (2) has non-life-threatening injuries, and (3) has injuries incompatible with life.⁷⁵ The patients who need immediate life-saving intervention are treated in place, but only with minimal interventions, such as airway management and hemorrhage control. The others do not receive treatment until they are moved to a more stable environment where they can be thoroughly triaged, such as a

non-hostile area or a medical facility.⁷⁶ This allows for only immediate necessary interventions in the chaotic and hostile environment while allowing for triage to be completed in a more consistent form in a controlled environment.

The use of planned or spontaneous simplified triage has also showed promise in past events. In these events, patients were categorized as urgent or non-urgent.⁷⁷ Once at the emergency room, patients were further divided into more specific categories. The results showed more consistent prehospital triage, more expedient categorization, and a more thorough assessment at the hospital.⁷⁸

As Carresi explains, any incident with multiple victims will result in decision of which patients to treat and transport first, regardless of whether a system exists, is adequate or appropriate, or is understood by providers.⁷⁹ Without a clear system, Caressi states “the possibility of mistakes is quite high, as decisions become arbitrary or, worse, random.”⁸⁰ Agencies should give consideration to alternative, simplified triage methods to allow for uniform and reliable results that promote clinically appropriate medical care.

Treating on Scene

While awaiting transport to definitive care, patients are provided treatment on the scene of the event in a designated treatment area. This area, established by EMS, is in a location away from the immediate incident, but within walking distance. The area is somewhat controlled and more conducive for field medical care than the original location of the patients. Patients are grouped according to their triage category. Providers, when available, will apply medical interventions within their scope of practice to preserve patients until transport units become available. Beyond typical EMS field care, this area allows for providers to monitor a broad number of patients within a confined space, routinely reassessing and adjusting triage and transport priorities as patient conditions change.

The Boston Marathon of 2013 was staffed and equipped with a number of medical tents to address the surge of patients that present during mass athletic events.⁸¹ When the bombs detonated, these tents were used as casualty collection points and treatment areas until transportation to hospitals could occur. The event highlighted a flaw in the on-scene treatment concept, which is when providers become hyper focused on treatment and disregard the fact that moving a critical trauma patient to definitive care is the utmost priority. Doctors present at the event reported that medical tent personnel, including EMS personnel, nurses, and doctors did not readily recognize that the tents were insufficient to definitively treat the patients, thereby delaying transport.⁸² This event clarified that the treatment area is for treating minor wounds and maintaining delayed patients until transport assets become available. For immediate patients that require time-sensitive definitive care, the treatment area is merely a point of collection and distribution, not an area to initiate treatment.

Some of the recent intentional MCIs have resulted in staggering numbers of injured victims.⁸³ In each of those cases, the trend continued with 75-80% of these patients presenting as walking wounded that did not need medical care for many hours or days.⁸⁴ These patients, due to their accessibility and sheer numbers, tend to overwhelm resources and congest treatment areas, including hospitals.⁸⁵ Many of these patients seek their own means of transportation and medical help, usually at the closest hospital, resulting in the closest medical resources being overwhelmed by patients who are lower priorities.⁸⁶ Meanwhile, the more severely injured patients must await triage and transport from EMS, which leads to a delayed arrival to a hospital. The Disaster Research Center noted that this results in “reverse-triage,” wherein the least serious patients arrive at the hospital first.⁸⁷ Beyond the initial misallocation of resources, this can also lead receiving facilities to be unaware that more serious cases are yet to arrive.⁸⁸ Referring to the World Trade Center attack of 2001, Simon et al. state “[i]t is clear from this attack and other disaster that local hospitals will rapidly be swamped by anyone that can get there on their own.”⁸⁹

While it is commonly accepted that self-evacuation is unpreventable, this is an area where early scene control can minimize the impact on hospitals and broader healthcare system.⁹⁰ Consideration should be given to providing onsite treatment or alternative destinations for those with minor injuries. After the bombing and mass shooting attacks in Oslo, Norway in 2011, minor casualties were treated by local physicians and healthcare employees at a hotel in Sundvolden.⁹¹ At the Boston Marathon bombings, medical aid tents that were established for runner injuries were used to treat minor injuries.⁹² State and federal entities have deployable assets, such as those from the Disaster Medical Assistance Team.⁹³ However, these can require many hours of advance notice, making this model ineffective for acute onset disasters of a limited duration.⁹⁴ Instead, a local hospital-based resource could be mobilized much more quickly.⁹⁵ Hospitals should not be considered the only point of definitive care. Properly equipped, scenes, tents, gyms, libraries, community centers, and schools can be more appropriate areas to treat those who do not require intensive hospital intervention.⁹⁶ This can lessen the burden on hospitals, as well as EMS, by requiring fewer field personnel and transport assets.⁹⁷

A concern repeated in numerous after-action reports is that triaging, transferring, and treating patients on scene is usually done by different providers at each functional point.⁹⁸ With minimal patient contact, and limited exchange between responders while transferring, patient data, such as immediate threats and care rendered, can be lost.⁹⁹ While this seems to consume more time and require some duplication of effort, it is arguably preferable, as it forces providers to reassess patients and adjust care.¹⁰⁰ It also allows for each evaluation to be done in a progressively less chaotic and more sterile environment, leading to more accurate assessment. In this sense, some of the perceived challenges to on-scene care can actually result in more positive patient treatment.

Conventional Methods Applied to Unconventional Demand

In reviewing multiple incidents in comparison so the 2004 Madrid train bombings, Caressi observed the following:

There are two main strands to the approach of emergency services to major incidents and disasters. The first is to consider mass casualty emergencies as an extension of routine emergencies. The only thing to do in the case of a disaster is to increase the level of response resources and to employ the same organisational schemes as those used on a daily basis—disasters are regarded as a *quantitative* problem. The second is to consider major incidents and disasters as special situations that require specific procedures that are different from those used in everyday emergencies—disasters are regarded as a *qualitative* problem. The favoured approach of EMSs in Madrid follows the former trajectory. The typical approach to disaster response is to deploy more units at the scene, although the procedures utilised—medical reports, radio communication codes, patient to medic ratio—are the same as those used in routine emergencies.¹⁰¹

This same concept of applying conventional methods in an unconventional setting has been a common theme in review of after-action reviews. Patients are typically over-triaged in a manner that matches how they would be evaluated and treated during a routine, individual emergency.¹⁰² After the Las Vegas shooting of 2017, many of the ambulances transported only a single patient at a time.¹⁰³ When approached by walking wounded en route to the scene, many fire and rescue units stopped to render aid.¹⁰⁴ At the Madrid train bombings, providers attempted to use traditional patient documentation processes, delaying evacuation and care.¹⁰⁵ At the same event, ambulance crews stuck together as they would on a singular patient event rather than spreading out to attend to numerous patients. Often, patients were treated with 3-4 person crews while others were left unattended.¹⁰⁶ If this normal ratio was to be maintained, it is estimated that 3,500 to 5,000 medics would be required.¹⁰⁷ Medical supervisors, who routinely provide advanced prehospital care, failed to recognize their role as incident commanders and instead treated patients as usual, resulting in an uncontrolled scene.¹⁰⁸ In each of these instances, providers tried to address the challenges in terms of quantity, only increasing their routine practices to meet the unprecedented demand.

A review of multiple mass casualty incident response plans showed that the bulk of standard practices, policies, and procedures that are applicable during small scale routine events are also used during an MCI, despite the strain on the system and providers. Plans call for patients to be distributed amongst numerous different hospitals, but maintain hospitals as the only acceptable destination. Providers are not given an option of using less conventional destinations, such as urgent care, clinics, public health centers, or alternative care sites. Once patients are received, hospitals do not have plans to redistribute the patients, often citing the Emergency Medical Treatment & Labor Act (EMTALA) as obliging the hospitals to treat the patient through the entire continuum of care until discharge rather than allowing for transfer once the patient is

screened and stabilized. While triage slightly alters which patients will ultimately be treated, EMS providers are expected to perform their normal scope of practice with MCI patients. Most plans call not only for routine documentation, such as full patient care reports, to be completed, but also additional steps such as triage and patient accountability to be performed during these times. Many disaster plans focus on increasing available resources during times of surge.¹⁰⁹ Aylwin's study reveals that such approaches have only a small effect on surge capacity.¹¹⁰ Instead, Aylwin explains, resources must be conserved by every aspect of the system going into "damage control mode of operation."¹¹¹ This concept, originating from surgical procedures, reduces efforts to only the absolute necessary to keep the patient alive.¹¹² Extending this perspective to all aspects of the disaster scenario, Wheeler explains that the usual management of trauma practiced across the country "differs greatly from the kind of trauma management called for during a mass casualty emergency."¹¹³

The unique and often unprecedented demand on providers and the system requires a solution other than simply doing more of the same practice on a larger scale.¹¹⁴ Consideration should be given to transporting patients to alternative sites or to bringing physicians and enhanced medical care to the field to treat and refer patients.¹¹⁵ Hospitals should be prepared to conduct triage as if the hospital is the scene itself and be prepared to transfer patients to neighboring, more appropriate hospitals through a comprehensive system of interhospital and EMS transport resources, as well as buses and other unconventional conveyances.¹¹⁶ This practice is successfully applied by Magen David Adom, the national EMS provider in Israel, following MCIs.¹¹⁷ Policymakers and counsel should clarify the laws, such as EMTALA, that govern normal obligations of hospitals and their applicability during large scale events. EMS agencies should modify their standard scope of practice to include crisis standards of care and eliminate any expectations of documentation and tracking that may hinder the ability of the provider to transport the patient or delay the transport in any way.¹¹⁸ Hospitals and public safety should work in unison to have emergency personnel, such as firefighters, emergency medical technicians, and paramedics, respond to the hospital to assist with triage, redistribution, patient movement, and patient care.¹¹⁹

Self-Evacuation

The current model of MCI response features a planning assumption that victims will be reliant upon EMS to treat and transport them.¹²⁰ It places heavy emphasis on the concept that once the event occurs, it is the duty and expectation of all involved that EMS will respond, take control of the scene, and assess and treat all patients.¹²¹ In the past, much of this could be attributed to the fact that victims had no means to care for or transport themselves. However, new technology has made it easy to communicate, locate hospitals, and request rides.¹²² As such, victims have become empowered and oftentimes bypass EMS either before the arrival or during the triage and treatment phase by self-transporting to local hospitals.¹²³ The majority of patients involved in an MCI are not transported by ambulance.¹²⁴ Prioritizing transportation as the primary goal, victims, bystanders, law enforcement, public transportation, taxis, and ride shares all come to bear in response to an MCI.¹²⁵ Under threat of ongoing violence, bystanders and patients are particularly inclined to flee the scene, as witnessed in the Pulse Night Club and Las Vegas shootings, the World Trade Center and Pentagon Attacks, the Madrid train bombings, and the Boston Marathon.¹²⁶

When a lone gunman opened fire upon a crowd of thousands of people in Las Vegas on October 1, 2017, bystanders and patients alike took charge of their wellbeing and sought out transportation. Off-duty police officers and medical responders loaded patients into privately owned vehicles.¹²⁷ As Las Vegas Metropolitan Police Department officers arrived, they began conducting improvised triage and used their cruisers to transport patients immediately.¹²⁸ The first people to arrive at Sunrise Medical Center, which ultimately received 220 patients from the incident, arrived by police car. Following in quick succession were private vehicles, such as pickup trucks, filled with grievously injured patients. Ambulances were the third wave to arrive. A physician reports that there were three to four gunshot victims in each arriving police car and private vehicle.¹²⁹ University Medical Center of Southern Nevada, which received 110 patients, reported the same pattern.

The Boston Marathon bombing that took place on April 15, 2015 was an example of the emergence of civilian responders and self- and buddy-transport. As medical teams were unable to treat the plethora of victims and tourniquets were exhausted, bystanders took it upon themselves and quickly used shirts, belts, and other devices to control bleeding.¹³⁰ These same citizens carried patients to medical tents and local hospitals. Within 18 minutes of the event, all patients had been transported to a medical tent or hospital, with many of those transports conducted by civilians in an improvised fashion.¹³¹ Doctors present at the event credit the bystanders with saving lives because of the speed they afforded in treating and moving patients in a system that was vastly overwhelmed.¹³²

At the Pulse Nightclub shooting on September 14, 2016, a similar pattern emerged. Orlando Regional Medical Center, located just three blocks from the incident, received the majority of patients by means other than ambulance. Within 36 minutes, the hospital had received 36 gunshot wounds that came in by police cars and vans, bystanders, and patients themselves.¹³³ Only 30% of the total patients from the event were transported by EMS.¹³⁴

Similar trends have been seen, especially during incidents that involve violence. Examples include the following:

- Murrah Federal Building bombing, 1995: 33% of patients transported by ambulance.¹³⁵
- Tokyo, Japan sarin attack, 1995: 11% of patients transported by ambulance.¹³⁶
- World Trade Center attack, 2001: 7% of patients transported by ambulance.¹³⁷
- Madrid train bombings, 2004: 33% of patients transported by ambulance.¹³⁸

The events that took place in Las Vegas highlighted some of the challenges that non-EMS transport introduces. As the patients arrived by means other than ambulances, hospital personnel were faced with unusual circumstances in which catastrophically wounded patients arrived with no prehospital treatment. The volume, varying degrees of injuries, and uncontrolled nature of the conditions created a secondary MCI at the hospitals themselves.¹³⁹ At the time of the Las Vegas shooting, Sunrise Medical Center had an emergency room staffed with four emergency physicians, one trauma surgeon, and one trauma resident.¹⁴⁰ This small team would take on the monumental and unconventional task of mass amounts of scene triage while also treating patients.

In traditional MCI response, EMS plays multiple important roles, two of which are controlling patients and distributing them to receiving facilities in a manner that minimizes overwhelming the facilities and directs critical patients to specialty centers. When patients and bystanders bypass these traditional constructs, most patients arrive at the closest hospital.¹⁴¹ An off-duty emergency medical technician who attended the Harvest 91 Festival in Las Vegas treated two patients and then decided to transport them in his vehicle. Unfamiliar with the area, he asked his girlfriend to find a hospital on her phone, which showed Sunrise Medical Center to be the closest.¹⁴² This was likely the scenario with many of the non-EMS transports, with people using Waze and other mapping applications, leading them to the closest hospital, thereby overwhelming Sunrise. Meanwhile, a more comprehensive trauma facility, University Medical Center, was just three miles away and received minimal patients.¹⁴³

The closest hospital is not always a specialty center, and patients transported outside of EMS arrive in the same state as they were found, with no treatment conducted to stabilize the victim.¹⁴⁴ However, recognizing that the definitive care for a trauma patient is a hospital setting, the leveraging of all available treatment and transport resources to minimize delay in patient arrival is important.¹⁴⁵ This tactic provides an arguably better outcome than forcing patients to wait until sufficient traditional EMS resources are available, though this is merely intuitive, as no empirical evidence exists to show that patients actually benefit from ad hoc transport.¹⁴⁶ It has become accepted that transport to hospitals by means other than traditional ambulance is likely unavoidable, and perhaps even desirable.¹⁴⁷ Planners who incorrectly assume that EMS and public safety authorities will have control of patient disposition do a disservice in failing to prepare the system for this reality.¹⁴⁸ Instead, emergency plans should include stipulations to account for this practice. The plans should include a means for directing civilians to the most appropriate facility. This could include public address, radio, and emergency cellular push notifications. Throw kits to provide life-sustaining care during transport can be provided.¹⁴⁹ Recognizing that the bulk of patients will self-evacuate to the nearest hospital, ambulances should consider transportation to other facilities.¹⁵⁰

Distribution of Patients to Hospitals

A consistent challenge with MCIs is the unequal distribution of patients to surrounding hospitals, with the closest hospital receiving the majority of patients.¹⁵¹ The Disaster Research Center found that in 75% of MCIs, more than half of the patients were transported to the closest hospital.¹⁵² In 46% of the cases, more than 75% of patients went to the closest hospital.¹⁵³ In these cases, the un- and underused surrounding hospitals had an average bed vacancy of 20%.¹⁵⁴ This was exemplified in the Madrid subway bombings of 2004, during which 1,180 patients were distributed to 15 hospitals. The closest ones were overwhelmed by the volume and rate, while the Military Central Hospital, which is designed for surge operations during a disaster, only received 5% of the patients.¹⁵⁵ Following the Las Vegas attack of 2017, Sunrise Medical Center, a level II trauma center, received 199 patients in the first few hours.¹⁵⁶ Staff, resources, and physical space ran thin at Sunrise, which used all of its universally-compatible O-negative blood in the 28 surgeries completed in the first 24 hours.¹⁵⁷ Meanwhile, University Medical Center, three miles away and the state's most comprehensive trauma center, received only 104 patients and reported that many of its beds went unused.¹⁵⁸ Hours after the incident, UMC still had nine empty trauma bays and three open operating rooms.¹⁵⁹

Much of this is caused by patients being transported by means other than EMS, as discussed in the previous section.¹⁶⁰ Ideally, these minor patients who are able to self-evacuate would be directed to more distant hospitals, conserving the nearby resources for the severely injured.¹⁶¹ However, without EMS controlling the distribution, it is impossible to control the destination, quantity, or rate of arrival of these patients.¹⁶² This often results in the nearby hospitals, particularly the closest, being overwhelmed by an initial wave of minor injuries.¹⁶³ Besides occupying precious resources, these less serious patients congest the area, preventing more serious patients from a clear throughput.

Distribution of casualties to the most suitable location for the patient and system is critical to the outcome of the patient and the functioning of the broader system.¹⁶⁴ Bed availability, capability to manage the specific wound pattern, and equitability amongst facilities must be considered.¹⁶⁵ When EMS is unable to manage patient flow, it is critical for the healthcare domain to regain control of the situation very early on. This will result in redistribution of the patients to stabilize the system. If hospitals view patients as “their property,” and do not transfer them, patient care will be compromised.¹⁶⁶

During an MCI, hospitals must position themselves as casualty distribution stations rather than solely a final destination for definitive care for all who arrive.¹⁶⁷ This means that the receiving facility will need to triage patients and determine which of those will require immediate life-saving interventions. The remainder of the patients should be redistributed to other facilities via secondary transport.¹⁶⁸ Those patients with injuries that are not time sensitive, should be transported via ambulance, van, or bus to a hospital at such a distance that it is not immediately impacted by the event.¹⁶⁹ This distribution must be carefully orchestrated with all hospitals coordinating to absorb casualties in a proportionate fashion that matches patients with their needs. This should be done in coordination with EMS, who will be bringing additional patients via ambulance from the scene.¹⁷⁰ Ambulances should be directed to bypass the closest hospital, if it will not impact patient care, in order to avoid further contributing to the over-convergence at the site.¹⁷¹ Consideration should be given to use of the “First Wave Protocol,” a formula of pre-planning that determines surge capacity and distribution of a network of local hospitals.¹⁷² This controls not only the number of patients reporting to each hospital, but also the rate at which they are to arrive, one of the more critical aspects of MCI management.¹⁷³

Communication Challenges

Communications deficiencies were cited in every after-action report that was reviewed for this article. From recognition of the incident, to locating adequate resources, to scene operations, to distribution of patients, well-established communication is necessary for optimal outcomes.¹⁷⁴ In each event, at each step of the process, there have been communications challenges that have negatively impacted the coordination and operations, thereby hindering an effective response. Breakdowns in telephone service, radio equipment, scene-to-hospital communications, and even face-to-face dialogue have all been cited as obstacles.¹⁷⁵ These troubles have been so impactful that they are frequently listed as the most common, serious, and challenging shortfalls of an MCI.¹⁷⁶

Immediately following MCIs, it is not unusual for a local 911 center to be overwhelmed.¹⁷⁷ Between countless incoming calls reporting the event to the influx of responder radio traffic, the minimally-staffed communications centers struggle to keep pace with the evolving incident.¹⁷⁸ The infrastructure of landlines, cellular, and radio channels often fails when faced with the demand.¹⁷⁹ This can create a cascading communications deficit, further overwhelming the system.¹⁸⁰ While each 911 call must be adjudicated, many are superfluous or redundant. During the Marjory Stoneman Douglas High School shooting in 2018, a single 911 call center, that of the Clear Springs Police Department, received over 130 calls for the incident.¹⁸¹ But, most of those calls were from parents or family members calling to inquire about the incident.¹⁸² This quickly consumed the 14 available emergency lines, sending subsequent callers to non-emergency call takers.¹⁸³ Simultaneously, the Broward Sheriff's Office received an additional 81 emergency calls reporting the incident. The routing of the calls to different call centers was the result of different cellular carriers recognizing different locations, while landlines directed to a single center.¹⁸⁴ The very fact that different agencies are receiving calls for the same event creates challenges in understanding and managing the event.

Field communications for responders is also noted as an area of deficiency. In Las Vegas, poor radio signals in Mandalay Bay prevented responders from relaying critical information.¹⁸⁵ One officer, using binoculars, was able to identify the location of the shooter, but could not transmit this vital information due to radio congestion.¹⁸⁶ Responders used poor radio discipline and made chaotic transmissions about casualties, transport units, and other shooters that were often factually incorrect.¹⁸⁷ Trying to minimize radio traffic, numerous messages from dispatch centers were sent via mobile data terminal. However, these messages were never received either because of cellular service disruption or because providers were preoccupied.¹⁸⁸ The Clark County Fire Department did not assist with the triage site that had been established by the Casino Area Command at the Hooters Casino Hotel because it was never communicated that it even existed.¹⁸⁹ Poor communication led to the role of EMS Branch Director, a crucial leader in medical operations, being assigned twice, with neither reassignment being operationally effective.¹⁹⁰ Reports and echoes from the gunfire led to numerous inaccurate reports by providers and civilians of numerous shooters at multiple sites, further thinning scarce resources. Additional resources and off-duty personnel self-dispatched and never communicated such, making assigning tasks and accounting for personnel impossible.¹⁹¹

The Madrid train bombings of 2004 highlighted numerous similar communications challenges. The lack of clarity in dispatch led responders to believe there was a single incident site, not four, leading to over convergence at the Atocha station, while the other three saw scant initial response until the mistake was realized.¹⁹² Medical responders working at the sites never received the message that they were operating near undetonated explosives.¹⁹³ Different managers issued different orders, leading to inappropriate triaging and transport.¹⁹⁴ Without a clear single Incident Commander, crews did not coordinate and made decisions based on each individual team's assessment, not from a comprehensive perspective.¹⁹⁵ A staging area for units was not communicated to units until 15 minutes into the incident, leading to congestion and blocked streets that did not allow for egress of critical patients.¹⁹⁶ In a glaring communications failure, rail traffic on opposite lines was not stopped, making responders jump from the tracks as a speeding train came through the site.¹⁹⁷ The conductor stated that he was

aware of the incident, but sped past it so that his passengers would not see the carnage.¹⁹⁸ The radio frequencies of multiple agencies were not compatible with one another, hindering coordination.¹⁹⁹ All four explosion sites operated on the same frequency, causing confusion about the number of incidents, locations of patients and resources, and congestion that would not allow responders to receive orders from the Coordination Center.²⁰⁰ At one point, the police blocked all public safety and cellular signals in an effort to avoid remote detonation of additional devices, but this rendered communications systems inoperable.²⁰¹

The proper distribution of patients and maximum preparation time for hospitals requires that field providers be able to communicate with the hospital early and often in an event.²⁰² Accomplishing this remains a challenge during MCIs. Following the Las Vegas attack, numerous hospitals did not answer the radio when dispatch attempted to notify them of the event and incoming surge.²⁰³ The Nevada Core Systems Network (NCORE), a radio system designed to facilitate interagency communication to include hospitals, was not activated until an hour after the incident.²⁰⁴ In many instances, because so many patients self-evacuated and hospitals did not receive alerts, many of the hospitals became aware of the incident only once the first wave of patients arrived.²⁰⁵ The Disaster Research Center study showed that very few hospitals receive the vital information in advance and are unaware of the existence of the event, the type of injuries, the number injured, the severity of casualties, and the count to be distributed to that particular facility.²⁰⁶ This leaves hospitals minimally prepared and forced to deal with the sudden influx with only the resources immediately available.²⁰⁷

Other events have featured the same challenges. During the Fort Hood attack, two patients were transported to non-trauma facilities that could not provide adequate care.²⁰⁸ Columbine High School, Pulse Nightclub, and the World Trade Center events all experienced radio failure due to signal dead zones.²⁰⁹ At Virginia Tech, multiple false alarms due to miscommunication led to the ambulances being evacuated from the scene unnecessarily.²¹⁰

In an instance defined by inadequate resources, communications are usually overrun by too many responding units.²¹¹ As the units are quickly dispatched, they begin travelling towards the scene.²¹² Because of the magnitude of the incident, many surrounding jurisdictions' units are unfamiliar with the area, the radio etiquette, or the expected roles of units. Units will often use the radio to report they are responding, request directions, and determine their assignment.²¹³ With a potential for hundreds of responders to a single scene, this lack of radio discipline can quickly overwhelm the communication channels, dilute or obstruct meaningful communication, and desensitize incident commanders. This can lead to a thickening of the fog of war, obscuring situational awareness and resource allocation even further.

Social media and rumors also represent impactful communications challenges during MCI operations. Victims, bystanders, family, friends, even responders are subject to the influence of messaging delivered through various mediums, which, though accessible to all, is unvetted and oftentimes erroneous.²¹⁴ Shortly after the Las Vegas shooting, a local blogger named Christy Oldenkamp posted on Twitter that “[there were] [s]o many injuries that UMC hospital [was] having to divert to other hospitals.”²¹⁵ This rumor spread across Twitter and to other social media platforms and eventually EMS and neighboring hospital personnel were advised that

the University Medical Center was no longer accepting patients. In reality, this top-tier trauma facility was never closed. Due to the rumor and being farther from the scene, it took only half the patients that neighboring Sunrise received and a few hours after the incident still had nine open trauma bays and three empty operating rooms.²¹⁶ No one can determine to what extent that message impacted the distribution of patients, but many interviewed, including patients, bystanders, family, friends, hospital staff, and EMS personnel reported hearing this message and that it impacted their destination choice.²¹⁷

During the Orlando mass shooting event, a rumor also hindered hospital operations. For reasons still unknown, at 3:19 AM, 911 centers received reports of gunfire at the Orlando Regional Medical Center, the primary receiving facility of victims.²¹⁸ This resulted in a lockdown of the hospital with a full tactical response, interrupting patient care for over an hour until the scene was cleared.²¹⁹ Hospital staff was told to barricade themselves.²²⁰ One of the emergency room staff members texted coworkers who were reporting as reinforcements to tell them to not come to the hospital because of the shooter.²²¹ No evidence of a shooter was ever found and it is still unknown if this interruption impacted any patient's outcome.

It is recommended that proactive measures be taken to prevent overwhelming the 911 call centers. One possibility would be mass notification through the Wireless Emergency Alert (WEA) network to reach all area cell phone subscribers and notify them that emergency response agencies are aware of this event and are responding, and providing them with specific instructions, such as where casualty collection points are located and where those with minor injuries should report. If cell service is interrupted, this same message could be communicated via public address system or AM/FM radio. It is further recommended that minimal units be sent to distraction calls until they are verified by the first unit on the scene so to preserve as many available resources as possible. Radio systems should have conventional radio backups that allow for redundancy in communication despite tower or digital failures. Regions should publish MCI Action Guidelines that are distributed to all potential responding units in advance to clearly define their expectations and minimize unnecessary radio traffic. Field-to-hospital communication must occur, which requires hospitals to monitor and respond to their radios and the on-scene commanders to assign a dedicated responder solely for hospital communications. Public information officers should take a proactive approach during these events and publicize all known facts across multiple social media platforms. These communicators should also monitor related messages and correct any inaccurate facts and rumors. Lastly, responders should not become overly reliant upon communication technologies such as computers, cell phones, and radio systems. Instead, responders should become familiar with face-to-face dialogue, hand and flag signals, and other rudimentary means of communication that may be necessary in these events.

Hospital Operations

While emphasis is placed on the challenges that will be encountered on the scene of an MCI, hospitals will certainly be overwhelmed.²²² With the majority of patients self-transporting, it is likely that the local hospitals will be even more stressed than those at the scene.²²³ The disproportionate distribution to the closest facilities magnifies these challenges and has been said to create a “secondary MCI” at the hospital itself.²²⁴ As throughput at these facilities lags, it has a cascading effect to efficient management of the patients from the scene. While the influx and initial distribution of patients is out of the control of any one hospital, there are steps that have proven to minimize the impact. Lessons from the Madrid train bombing of 2004 show that far fewer hospital resources would have been necessary if they would have been leveraged more effectively and efficiently.²²⁵

Many of the promising practices have emerged from the Israeli healthcare system, where frequent terror attacks have forced the country to adapt to the demands of medical surge.²²⁶ Israel requires that all hospital facilities maintain the capability to immediately surge to 20% of the hospital’s normal capacity.²²⁷ Israeli practices show that hospitals need to adjust from traditional operations to serving as a casualty clearing station. Upon recognition of an MCI, centralized management that oversees both the hospitals and prehospital system is established.²²⁸ Individual nurses are assigned to specific functional tasks that remain their only responsibility throughout the duration of the event. These include ER patient evacuation, personnel recruitment, organization of emergency equipment, and quality assurance.²²⁹ An experienced senior surgeon is assigned to triage all patients before they enter the hospital.²³⁰

Patients are divided into three categories:

- Critical: beyond treatment with injuries that would likely be fatal even under routine circumstances. These patients are not treated.
- Severe: require immediate treatment with injuries that are immediately life-threatening.
- Moderate: treatment can be delayed for hours without endangering the life of the patient.²³¹

Following this secondary triage, patients are moved to different geographic areas so that personnel can focus on the patients meeting the Severe criteria.²³² If possible, patients that fall in the moderate category are transported to facilities outside the region that is immediately impacted.²³³ Only patients who have been triaged outside by the senior surgeon are admitted into the emergency room. In this area, only diagnosis and treatment of life-threatening injuries occurs.²³⁴ The patient is then sent to the operating room, intensive care unit, or surgical ward for further treatment.²³⁵ Once patients leave the emergency room, they will never return, as the other wards of the hospital are expected to continue the less urgent care of the patients, thereby clearing the emergency room for additional severe patients.²³⁶ Patients are provided with a modified standard of care, typically crisis standards of care, wherein only damage control is provided with definitive care delayed until the event and surge subsides.²³⁷

Israel requires that its providers be licensed by the nation. As such, providers have the authority to practice anywhere within Israel, allowing for prompt staffing surge at any facility.²³⁸ This is a challenge in the United States, as credentialing between licensing boards and specific facilities does not guarantee reciprocity, creating a barrier to staff surge during an MCI.²³⁹ The United States should consider a means of credentialing healthcare personnel to serve at any facility to maximize resources available in such as event. Planners should take into account the numerous aspects of sharing personnel, including authority, licensing, malpractice, liability, and reimbursement.²⁴⁰ The National Disaster Medical System has a model for obtaining federal credentials that are valid anywhere in the country, though the time and effort required has resulted in few physicians participating.²⁴¹ This system should be reanalyzed and simplified for more ubiquitous participation, perhaps with a requirement to take part in board qualifications or licensure.

The nontraditional nature of these events calls for unorthodox responses, such as dispatching public safety personnel to the hospitals. Perhaps most challenging to hospitals is the arrival of patients who have self-transported, with no prehospital care provided. Hospitals should take into consideration the need to move patients from vehicles other than ambulances and utilize personnel who are more familiar with patient stabilization and movement, such as those from fire and rescue.²⁴² Resources once intended to provide vast amounts of emergency equipment on the scene, such as MCI trucks and trailers, may be better utilized if deployed to hospitals, where surge supplies, equipment, and medications are not always immediately accessible.²⁴³ Law enforcement should respond to provide scene security, information flow, and target hardening, as they did in Las Vegas.²⁴⁴ Police should also establish perimeters around the facility to control access, stemming the flow of friends, family members, and media that can overrun the already crowded hospital.²⁴⁵ Law enforcement and public works should consider blocking roads to provide a dedicated corridor for patient transports and surge staffing arrival.²⁴⁶

Hospitals should expect to have little or no warning of the event and incoming patients.²⁴⁷ Because the least serious patients arrive first, hospitals should consider reserving beds, equipment, and staff resources for the more severe patients that will likely come as EMS is able to transport.²⁴⁸ All plans should include a planning assumption that the initial portions of the event will be handled only by in-house resources, as on-call resources will take time to deploy.²⁴⁹ Since most casualties arrive within 30 minutes, and nearly all within 90 minutes, only the resources nearly immediately available will have an impact on surge.²⁵⁰ Hospitals should plan on using other areas of the facility, such as cafeterias, waiting rooms, conference rooms, and parking garages, to conduct patient care.²⁵¹ Capacity should be maximized by discharging patients, transferring to urgent care or surrounding hospitals, and cancelling elective surgeries: techniques that greatly increased capacity following the World Trade Center attack of 2001.²⁵²

Situational awareness is critical during these events. Understanding the numbers, types, causes, and severity of injuries and the estimated time and flow rate of arrival are vital factors in allocating resources and making informed decisions.²⁵³ The Disaster Research Center showed that hospitals are rarely provided this information prior to the arrival of patients.²⁵⁴ To establish and maintain this situational awareness, hospitals should monitor and respond to their public safety communication conduits, designate a single person to serve as the liaison between the scene and hospital, and assign a staff member to serve at the Emergency Operations Center or Unified Command.

CONCLUSION

The frequency, nature, and magnitude of mass casualty incidents in the U.S. have changed dramatically since the original constructs of MCI management were established. Technological and cultural evolutions have changed the way civilians respond to these events, thereby disrupting the regimented public safety response and expectations. Cell phone ubiquity, technology, violence, self-transport, and nefarious motives all contribute to create far more complicated scenarios compared to the already overwhelming conventional events. Continuing to apply this outdated approach to a modern reality has resulted in many failures, including poor leveraging of resources, overwhelmed hospitals, and, ultimately, inferior patient care. The entire approach to MCI response, from civilian resilience to hospital throughput, must be rethought in order to satisfy the intense demands brought about by these events and best protect the victims.

The following table (Table 2) summarizes the findings explained in this document, as well as considerations and recommendations for how to better prepare for these circumstances. By addressing each of these considerations in the planning process, personnel and systems will be better equipped to respond to intentional MCIs.

Table 2: Summary of Research Findings and Planning Recommendations

<i>Finding</i>	<i>Planning Recommendation</i>
Many recent MCIs have been intentional attacks rather than accidents; traditional MCI plans do not take into account intentional MCIs.	Response agencies should have separate plans, or distinct annexes in a single plan, for MCIs that are caused by violence. The plan will take into account the nuances and qualitative differences of the intentional MCI.
Violent MCIs often involve active hostile environments, placing responders under ongoing threat.	Agencies must have a clear policy, accompanied by appropriate training, for personnel to operate as safely as possible in these environments. The department should maintain a clear policy regarding cold, warm, and hot zone medicine, and have formal plans for integration with law enforcement.
The injury patterns of targeted violent MCIs, especially those associated with gunshots and explosives, have become more devastating and far more time sensitive than conventional traumatic injuries, such as those caused by blunt trauma.	Medical clinicians in the field and hospital must be routinely and repeatedly trained in these unique, infrequently seen injury patterns. Training should include numerous simultaneous wounds, specialized implements, and austere conditions to closely mimic the demands of an intentional MCI.

<i>Finding</i>	<i>Planning Recommendation</i>
The number of victims from violent MCIs tends to be exponentially higher than many planning assumptions due to choice and power of weapons coupled with the assailant's intention to harm as many people as possible.	Plans and resources should be recalibrated for these "mega-MCIs" that require a completely different approach to incident management and clinical care. Agencies should be prepared for hundreds, even thousands, of patients.
Violent MCIs tend to happen in densely-populated areas, and are often spread across a broad geographic region or several locations.	Responses should include an initial 360-degree analysis to define boundaries of the event. Incident commanders should be ready to quickly and accurately deploy resources to multiple locations, using the concepts of area command. Command must maintain precise and updated situational awareness at all times, as field providers will likely become absorbed in a single scene.
The structured, hierarchical incident management approaches, such as the National Incident Management System and the Incident Command System, are not readily applicable to the complexity of these incidents, especially in the early phases.	The early phases of these massive events are inherently disorderly, but the apparent chaos is the natural emergence of empowered bystanders and victims, which is highly effective in quickly moving patients away from harm. Incident commanders should understand the limitations of hierarchical incident management systems. These commanders should be made familiar with theories of complexity and uncertainty, and taught adaptive management techniques that will allow them to lead through the fog of war towards a resolution. Emphasis should be placed on effectively treating patients rather than establishing an appearance of order.
Most patients are not transported to the hospital by emergency medical services, but instead transport themselves or each other, or are brought by police vehicles, thereby undermining the controlled distribution of patients expected to be performed by EMS assets.	EMS and health care systems should not assume that EMS will control the flow or destination of patients, instead accepting that most patients will self-transport. Plans should account for guiding civilians to correct destinations. Consideration should be given to the use of radio, wireless emergency alerts, and social media to communicate this guidance to civilians.
Patients overwhelm the closest hospital, leaving other nearby hospital and health care resources under-utilized.	Public safety should deploy an MCI response to the closest hospital. The MCI is the location of the patients, not the location of the incident. The hospital should be treated as a secondary MCI. EMS and hospital personnel should work together to redistribute patients across the health care spectrum to balance patient needs with system resources.

<i>Finding</i>	<i>Planning Recommendation</i>
<p>Receiving hospitals are not always specialty centers, and are unprepared for the types of injuries associated with these violent attacks.</p>	<p>All hospitals, even non-specialty centers, must be prepared for an influx of traumatic injuries at any time. Emphasis should be placed on providing life-sustaining, simple implements, such as tourniquets, airway adjuncts, and blood products. Staff should be trained in emergency care of the traumatic injuries that are consistent with acts of violence. Non-specialty hospitals should not expect to immediately transfer these patients to specialty centers, but instead have contingencies for treating in-house.</p>
<p>Under threat of ongoing violence, patients and bystanders do not wait on the scene, instead evacuating as soon as possible.</p>	<p>Response agencies should not expect patients to wait at the scene for their arrival and management of patient flow. Attempts to dissuade patients from self-transporting will be ineffective and will waste valuable resources. EMS should concentrate on the parameters over which they have control, such as the patients who are incapacitated.</p>
<p>Bystanders become immediate responders, with or without training, providing life-saving interventions, transport, and force multipliers.</p>	<p>Plans should include provisions for integrating with civilians to leverage all available resources during this period of immense demand. Communities should invest in public education to build a resilient culture. The public should be provided with access to first aid supplies, such as Stop the Bleed kits. These can be used to treat patients before the arrival of EMS, and after the arrival to supplement the limited EMS resources.</p>
<p>Because bystanders often transport patients before EMS arrives, hospitals are rarely provided with advanced notice of the incoming patients.</p>	<p>Immediately upon notification of an MCI, emergency communications centers should send notices to nearby hospitals to alert them of a possible influx of patients. Ongoing communication between the scene and hospital, either through designated radio or phone lines, or a liaison, is critical to comprehensive management of the incident.</p>
<p>Because they are mobile, minimally injured patients are usually transported first, while more severe patients are left at the scene. This creates reverse triage, where hospitals get a false sense of security that the early patients represent the worst cases. These patients absorb resources that will later be needed for the severely injured patients.</p>	<p>Hospital personnel should be made aware of this phenomenon during the planning and training process. Hospital personnel must anticipate this sort of patient flow, and reserve their resources for more severe patients. Communications with on scene personnel will allow hospitals to accurately anticipate the number, type, and rate of patients they will encounter.</p>

<i>Finding</i>	<i>Planning Recommendation</i>
The common START method of prioritizing patients in the field is ineffective, inefficient, inconsistent, and unrealistic.	Use a simpler method that emphasizes sorting and sifting, such as the Sort, Assess, Lifesaving Intervention, Treatment/Transport (SALT) or the Canadian Triage and Acuity Scale (CTAS). Expect further refinement of categorization only in a controlled setting, such as at the hospital.
On-scene treatment of moderate to severe injuries can cause delays in getting patients to definitive care.	Use on scene treatment areas only as a point of collection and distribution, with an emphasis on transporting all non-walking wounded patients as soon as possible. Minor injuries should be treated on scene to avoid overwhelming limited hospital resources.
Providers treat MCIs as an extension and expansion of routine emergencies, attempting to apply the same principles and approaches, just at a higher rate.	Providers should be deliberately prompted to shift from routine procedures, and instead employ disaster medicine techniques that an MCI requires. The need for this transition is not always self-evident, so incident commanders should announce this shift to all personnel. Clinical and supervisory personnel must be trained to understand the implications of such a declaration.
Social media can broadcast erroneous messages, negatively impacting response and community actions.	Emergency management and allied agency public information officers should broadcast clear, frequent, transparent messages to counter inaccuracies and provide clear direction to victims and the community.

Intentional MCIs continue to rise along a trendline of approximately 5% each year since 1900.²⁵⁵ The increased frequency, along with more devastating modes of attack, have increased mortality, as well. Omitting the extraordinary events of the Murrah Federal Building bombing of 1996 and the attacks of September 11, 2001, more people have been killed in intentional MCIs in the last ten years than in the previous 60 years.²⁵⁶ The need to address this type of emergency with appropriate planning and response strategies is clear. Planners must recognize that intentional MCIs are not merely a challenge of quantity, but are qualitatively distinct from accidental MCIs. By planning for these unique conditions and challenges, in addition to preparing for the sheer number of patients, response agencies and the broader health care system can better respond to and manage intentional MCIs.

About the Author

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