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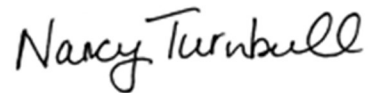
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This Doctoral Thesis, *Mass Shootings in the United States: Hospital Experiences in Preparedness, Response, and Recovery*, presented by Sarah Tsay, and Submitted to the Faculty of The Harvard T.H. Chan School of Public Health in Partial Fulfillment of the Requirements for the Degree of Doctor of *Public Health*, has been read and approved by:



Nancy Turnbull



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Date: April 11, 2023

MASS SHOOTINGS IN THE UNITED STATES:
HOSPITAL EXPERIENCES IN PREPAREDNESS, RESPONSE, AND RECOVERY

Sarah Tsay

A Doctoral Thesis Submitted to the Faculty of

The Harvard T.H. Chan School of Public Health

In Partial Fulfillment of the Requirements

For the Degree of *Doctor of Public Health*

Harvard University

Boston, Massachusetts

May 2023

Mass Shootings in the United States: Hospital Experiences in Preparedness, Response, and Recovery

ABSTRACT

The United States has more mass shootings than any other developed nation worldwide. These events are of particular concern to healthcare systems because they can result in many victims with complex, penetrating injuries that require extensive, time-sensitive care. Further, the US healthcare system continues to grapple with unprecedented staffing limitations, supply shortages, and capacity issues. The current context of converging challenges within US healthcare systems impairs their ability to respond to emergencies including mass shootings, stressing a critical need to better understand how hospitals can develop adequate emergency management plans to help them effectively respond to and mitigate the effects of these disruptive events.

This study aimed to address two questions: 1) What can we learn from the experiences of hospitals that have responded to recent mass shootings in the US? 2) What unique challenges do community hospitals, whose experiences with mass shootings have not been studied, face in preparedness, response, and recovery for mass shooting incidents? These questions were explored with a series of qualitative interviews with first responders to six mass shootings and one mass casualty event across the US, as well as analysis of five incident preparedness toolkits developed by national expert organizations.

Five major needs were identified that must be addressed when planning for, responding to, and recovering from mass shootings: 1) engaged leaders who advance preparedness; 2) mass casualty plans based on realistic assumptions and that consider the current healthcare system; 3) timely and consistent communication to combat misinformation during a hospital's response and recovery; 4) rapid regional

coordination for family assistance and reunification centers; and 5) robust support and mental health services for patients and staff.

Adequate and realistic planning at organizational and regional levels is essential to optimize and coordinate response to unexpected mass casualty events. An appropriate preparedness plan ensures that responsibility, accountability, and roles are clarified in advance and facilitates efficient communication, resource utilization, and safety of staff and patients—helping hospitals and healthcare systems better respond to and mitigate the effects of emergencies such as mass shooting events.

Providing health care is like building a house. The task requires experts, expensive equipment, and a huge amount of coordination.

-Atul Gawande

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II. Definitions

Academic medical center: A tertiary care hospital that is organizationally and administratively integrated with a medical school.

Blood bank: A place where blood or plasma supplies for transfusion are stored.

Boarded patient: A patient who remains in the emergency department after being admitted or placed into observation status at the facility but has not been transferred to an inpatient or observation unit.

Command center: A location from which leaders of a jurisdiction or organization coordinate information and resources to support incident management activities.

Community hospital: A hospital serving a local community, run by local leaders.

Critical access hospital: A medical center that provides healthcare services to rural, often underserved communities.

Emergency operations plan: A plan that details what a facility or agency will do to respond to and recover from all hazards.

Health care coalition: Groups of local healthcare and responder organizations that work together on challenges and find solutions that improve emergency preparedness and the health and safety of their communities.

Incident command (system): A standardized approach to command, control, and coordination of emergency response that provides a common hierarchy for responders from multiple departments or agencies to be effective.

Level-load: Redistributing patients from greater- to lesser-impacted hospitals.

Medical surge: The ability to evaluate and care for a markedly increased volume of patients.

Medivac (medical evacuation): Timely and efficient movement and en route care provided by medical personnel to a hospital.

START triage: Simple Triage And Rapid Treatment is the most widely used triage system in the US for

mass casualty incidents. First responders delegate movement of injured victims to designated collection points by using four main categories based on injury severity: black are deceased or expectant, with injuries incompatible with life or without spontaneous respiration; red are immediate, with severe injuries but high potential for survival with treatment; yellow are delayed, with serious injuries that are not immediately life-threatening; and green are walking wounded, with minor injuries.

Joint Commission: A US-based nonprofit organization that accredits more than 22,000 US healthcare organizations and programs.

Trauma bay: The area in which emergency assessment and treatment begins. From this area, patients may be transported to radiology, the operating room, or an inpatient unit for admission.

Trauma center levels: Rankings that depend on resources available in a trauma center and the number of patients admitted yearly. American Trauma Society defines level-I center as a comprehensive regional resource that is a tertiary care facility central to the trauma system, capable of providing total care for every aspect of injury. A level-II center can initiate definitive care for all injured patients. A level-III center has demonstrated ability to provide prompt assessment, resuscitation, surgery, intensive care, and stabilization of injured patients and emergency operations. A level-IV center has demonstrated an ability to provide advanced trauma life support prior to transfer of patients to a higher-level trauma center. It provides evaluation, stabilization, and diagnostic capabilities for injured patients. A level-V center provides initial evaluation, stabilization, and diagnostic capabilities and prepares patients for transfer to higher levels of care.

Acronyms

CT	Computed tomography
DEPC	Department of Emergency Preparedness and Business Continuity
ED	Emergency department
EMS	Emergency medical services
FEMA	Federal Emergency Management Agency
HVA	Hazard vulnerability analysis
ICU	Intensive care unit
MCI	Mass casualty incident
RAMP	Rapid Assessment of Mentation and Pulse (triage)
SALT	Sort, Assess, Life-saving Interventions Treatment and/or Transport (triage)
START	Simple Triage And Rapid Treatment (triage)
THREAT	Threat suppression, hemorrhage control, rapid extrication, assessment, transport

III. Dedication and Acknowledgments

*This thesis is dedicated to my parents, **Frank and Julie Tsay**, who ventured to the United States to pursue higher education many years ago and stayed to ensure I had access to medical care, despite all obstacles. This achievement, and all to come, are thanks to your love and sacrifice.*

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IV. Introduction

Our healthcare systems are in a perpetual state of emergency. Currently, more than 80% of hospital beds are in use nationwide, with more than 85% of all hospital beds full in Massachusetts and eight other states as of December 2022 (Follman et al., 2023). Anne Klibanski, president and CEO of Mass General Brigham, the largest hospital system in Massachusetts, recently said in an interview, "We are caring for patients in the hallways of our emergency departments. There is a huge capacity crisis, and it's becoming more and more impossible to take care of patients correctly and provide the best care that we all need to be providing. Everything has changed, and now all those issues at the forefront are only getting more exacerbated over time" (Advisory Board, 2022).

These already stressed healthcare systems are further challenged by the increasing frequency of mass casualty incidents (MCIs). MCIs generate a sufficiently large number of casualties to severely challenge available healthcare resources or their management systems or to render them unable to meet the healthcare needs of the affected population (Ahmad, 2018). Although the Joint Commission requires hospitals to maintain emergency preparedness plans for MCIs, these plans are becoming more difficult to execute in the face of frequent climate- and weather-related emergencies as well as compound and cascading emergencies that hospitals must respond to (Food and Agriculture Organization of the United Nations, 2021). As emergency departments (EDs) and hospitals have generally become busier and more crowded, emergencies that result in MCIs can easily overwhelm hospital resources, staff, and space.

What would you do if an entire wing in the ED caught on fire? How would you quickly move patients out and where would they go? That's, effectively, how we should be planning for a sudden influx of patients. Whether it be an explosion, mass shooting, or train derailment, we will need to make space to treat victims in our ED immediately, and every second matters.

My team at Brigham and Women's Hospital, within the Mass General Brigham system, has used this philosophy to completely rethink our mass casualty plans, referencing the World Health

Organization Mass Casualty Management Toolkit (Reynolds et al., n.d.). As we work with departments across the hospital, from trauma to security to radiology, the reaction is the same—it seems impossible. Hospitals across Boston are already struggling with limited bed capacity, unprecedented staff turnover, and increasingly complex patients, resulting in a consistent theme: there are not enough resources to meet demand. Additionally accommodating a sudden influx of dozens of critically injured patients seems almost unfathomable.

Of particular concern for hospitals in the US are mass shooting incidents. We now live in the “era of the gun,” with gun violence surpassing car accidents as the leading cause of death for children in the US (Gebeloff et al., 2022). While only accounting for a fraction of overall gun violence deaths, there are more mass shootings in the US than anywhere else in the world, with a staggering 690 mass shootings in 2021, 648 in 2022, and 146 as of April 10, 2023 (Gun Violence Archive, 2023), with the number only continuing to increase. These events are of particular concern to hospitals and other first responders due to the combination of complex, penetrating injuries from gunshots that require extensive, time-sensitive care and the need to treat a potentially large number of victims very rapidly. Further, these incidents are unpredictable and can happen in rural or urban settings, easily exhausting local resources depending on the location and nature of the event.

In the US, hospital trauma centers are designated by levels (I, II, III, IV, or V) that refer to the number of patients admitted annually to the facility as well as the types of resources available (American Trauma Society, n.d.). A level-I trauma center is a comprehensive tertiary care facility that can provide total care for a patient, including surgical care to trauma patients 24 hours a day. Most resources and guidance for MCI management in the US are developed for, and created by, healthcare and emergency management practitioners in level-I trauma centers. An assumption built into many MCI planning resources is that critical patients will be directed or transferred to level-I trauma centers that

have the expertise and resources to care for these patients. However, only approximately 3% of all hospitals are level-I trauma centers, with most located in densely populated urban settings.

In reality, incidents often occur long distances from trauma centers, with MCIs occurring on average 4 miles from non-trauma centers, 21 miles from adult trauma centers, and 83 miles from pediatric trauma centers. Ultimately, during an MCI, victims are rushed or transported to the nearest hospital that can provide appropriate care, which is rarely a Level I trauma center. More commonly, local community hospitals, which are typically Level II-V trauma centers or non-trauma centers, handle these events, although they often are not properly equipped to respond to the complex and demanding needs of MCIs. While most research on MCI response and planning has been completed at level-I trauma centers, little is known about how community hospitals can adequately plan for, respond to, and recover from MCIs. As hospitals continue to struggle with adequate resources and MCIs become more frequent, it is essential to understand how hospitals can better prepare to mitigate the direct and indirect impacts of these events, particularly when caring for the most vulnerable populations.

The role of healthcare emergency management, the spectrum of disaster management applied to healthcare environments, grows harder to define. What was once an uncommon disaster, such as an ongoing pandemic or a bed capacity of more than 100% in the ED, is now commonplace. Adequate and realistic planning at organizational and regional levels is key to optimizing and coordinating response to these unexpected MCIs.

Therefore, this study explored the experiences of responders at community hospitals to prepare for, respond to, and recover from real mass shooting incidents in their communities. Rather than including all MCIs, the study focused on mass shooting incidents. Although many other events may result in an MCI in hospitals (e.g., train derailment, explosion, severe weather), each hazard comes with its own complications in hospital response, which will not be covered in detail in the scope of this research. Further, while many best practices focus on the immediate needs within the first hour of an

event, this study explored the long-term considerations of mass shooting incidents and situated appropriate planning in the context of strained healthcare systems dealing with prolonged shortages in staffing, hospital beds, and supplies. The study addressed the following two questions:

1) What can we learn from the experiences of hospitals that have responded to recent mass shootings in the US?

2) What unique challenges do community hospitals face in preparedness, response, and recovery for mass shooting incidents?

V. Literature Review

This section explores peer-reviewed literature, gray literature, and media publications describing the history and impact of mass shooting incidents in the US. From this, the general response from public safety and healthcare first responders in the event of a mass shooting is described. Subsequently, the section covers the principles of healthcare emergency management in hospitals and health systems, as well as the policies and principles that guide preparedness and response to patient surge events and MCIs, with mass shooting incidents representing a subset of MCIs. The section ends with an overview of current strains on healthcare and the implications for MCI preparedness.

A. Mass Shooting Incidents

Gun violence is an epidemic of staggering proportions in the US. Firearm-related injuries recently surpassed car accidents as the leading cause of death for children and adolescents in the country (Gebeloff et al., 2022). As the New York Times somberly stated at the end of 2022, “we are now living in the era of the gun” (Gebeloff et al., 2022). Mass shooting incidents account for a small subset of overall gun violence deaths, though their frequency and deadliness continue to increase annually. Over the past four decades, mass shootings have caused at least 1,000 deaths and 1,500 injuries in the US, accounting for less than 1% of all firearm-related deaths annually (Follman et al., 2023). Although these are relatively infrequent events, their impacts extend beyond injuries to victims and demand significant public interest and community resources.

Despite the high-profile nature and public attention around mass shootings, there is not a standard legal definition of the term, and subsequently there are significant variations in mass shooting statistics (Booty et al., 2019). Numerous databases document mass shooting events, including the Gun Violence Archive (Gun Violence Archive, 2023), Violence Project (Violence Project, 2023), Mother Jones

(Follman et al., 2023), Federal Bureau of Investigation’s Supplementary Homicide Reports (National Center for Juvenile Justice, n.d.), and USA Today (USA Today, 2023). However, these databases operate on different definitions of a mass shooting event, including minimum number of victims and the context and location of the shooting. This leads to inconsistent knowledge of the epidemiology of mass shootings. The public health impact of mass shooting incidents is also difficult to measure, though recent studies have shown the adverse psychological effects of mass shootings on individual survivors and members of affected communities (Lowe and Galea, 2017; Soni and Tekin, 2020).

The lack of an official definition of mass shootings, as well as the difficulty in defining “exposure” to shootings, has hindered research to inform evidence-based policy (Everytown Research & Policy, 2020). In addition, because mass shooting events are rare, it remains difficult to evaluate the effect of policies and strategies, such as stricter gun control or physical security measures, on the frequency or lethality of mass shooting incidents (Schell and Smart, 2021). The common recommendation followed by the Gun Violence Archive and most literature is that a mass shooting incident involves the use of a firearm that results in four or more casualties (injuries and deaths) excluding the perpetrator, regardless of place or gang- and/or drug-involvement (Violence Project, 2023).

While most public attention focuses on the perpetrator(s) and victim(s) in a mass shooting incident, far less attention is given to the response capabilities of health systems in these events. Information about where victims receive care is generally not available beyond what a hospital is willing to share with media sources.

A1. Mass Shooting Incidents in America

There are more public mass shootings in the US than anywhere in the world (Fox, 2017)—690 events in 2021 and 648 in 2022, the most on record since the national nonprofit the Gun Violence Archive began tracking mass shootings in 2014 (Gun Violence Archive, 2023). In 2021, 702 people died

and 2,844 were injured in mass shooting incidents. A mass shooting occurs more than once per day on average in the US, and the number of mass shootings continues to increase (Fleegler, 2019).

Approximately 42% of all American households have a gun, with an estimated 393 million total firearms in the country. This is nearly half (46%) of the estimated 857 million civilian-owned guns in the world (Hennepin County Medical Center et al., 2016). The US also leads other western countries in gun violence and is an extreme outlier in gun deaths, with a rate of four of every 100,000 people dying by gun violence every year. For comparison, Canada has a rate of 0.5 of every 100,000, and the United Kingdom has a rate of 0.04 of every 100,000 (Tavernise, 2021). Gun violence contributes to more than 110 deaths each day in the US.

Mass shootings represent only a fraction of gun deaths in America's gun violence crisis. However, they are of particular concern to first responders and healthcare systems because they result in complex, penetrating injuries that are often fatal without extensive, time-sensitive care and because of the need to treat a potentially large number of victims very rapidly. Time is critical in mass shooting events, and rapid access to care is crucial to reduce the number of lives lost. Furthermore, these incidents are unpredictable and can happen in rural or urban settings, easily exhausting local resources depending on the location and nature of the event (Schell and Smart, 2021).

Assault weapons and high-capacity ammunition magazines are disproportionately used in mass shootings, resulting in far more deaths and injuries than shootings involving other firearms. Assault weapons are typically high-powered, semiautomatic weapons that, combined with high-capacity magazines, allow a shooter to fire rapidly and discharge a large number of rounds over a short period (Everytown Research and Policy, 2023). According to Everytown Research and Policy, mass shootings involving an assault weapon account for 16% of all mass shootings but 25% of mass shooting deaths and

76% of injuries. When used in mass shootings, assault weapons leave six times as many people shot per incident as when there was no assault weapon used (Everytown Research & Policy, 2023).

A2. On-Scene Emergency Response

In 2013, after a series of mass shooting events, the American College of Surgeons brought together a group of stakeholders from the medical, law enforcement, fire/rescue, and emergency medical services (EMS; emergency services that provide urgent pre-hospital treatment and transport to definitive care) communities to develop strategies and policies to enhance survivability from mass shooting events. This group, called the Hartford Consensus (Joint Committee to Create a National Policy to Enhance Survivability from Intentional Mass Casualty Shooting Events, 2013), developed the THREAT algorithm—**T**hreat suppression, **H**emorrhage control, **R**apid Extrication to safety, **A**ssessment by medical providers, and **T**ransport to definitive care—an approach to follow in a high-threat or active shooter scenario. This protocol is consistently used to respond to mass shooting events, enabling first responders to perform lifesaving interventions.

The first priority in any active shooter scenario is to stop the shooting. Police must rapidly respond to the attack. Courses such as the Law Enforcement Active Shooter Emergency Response are offered nationwide for law enforcement officers to rapidly assess the situation and develop teams for immediate reaction (Federal Emergency Management Agency, n.d.).

The second priority is to facilitate effective emergency care for casualties as quickly as possible. The standard is for EMS personnel to stage at a location close to the shooting but at a safe distance. Once law enforcement has determined that a building is safe, EMS can care for victims. This is typically limited to care immediately needed to save lives, including hemorrhage control, sealing of sucking chest wounds, airway management, and proper movement of casualties to a safe evacuation area.

Once the shooting scene is evacuated, it is the responsibility of EMS leadership to synthesize available information to quickly transport patients from the scene and to hospitals. Careful attention should be paid to how patients will be distributed among available hospitals to not prolong waiting periods for care or overwhelm any single hospital (Khajehaminian et al., 2017). However, while extensive guidelines for field triage are established, significant knowledge gaps remain. For instance, “research is needed that includes...multiple EMS agencies, trauma and non-trauma hospitals. [The] impact of geography on triage and issues regarding proximity to trauma centers. . . [are] poorly understood” (Sasser et al., 2012).

In the aftermath of an event, non-ambulatory patients with serious injuries require two types of resources: transportation, and hospital resources (e.g., beds, medical personnel, and equipment for treatment). The main patient distribution problem is that there may be so many patients requiring transportation to hospitals at the same time that available treatment capacity at a single hospital is not sufficient to provide the necessary treatment. Because transportation resources are limited, the decision of where to send a patient takes away a transportation resource from those who remain on scene, and the further away a patient is sent the longer it will take to get that same resource back on site. Furthermore, because hospital resources are limited, the decision of where to send a particular patient affects the available treatment capacity at future points in time (Hennepin County Medical Center et al., 2016).

It is imperative that EDs and emergency managers are notified early of incoming transports and, when possible, maintain direct communications with EMS or law enforcement officers on scene. Many rural areas encounter challenges with limited resources and regional coordination. The long delays and distance for EMS to travel for care highlight the need for coordination and mutual aid requests (Hick et al., 2004). Careful planning of resource allocation is necessary, as well as early response to requests for additional resources.

B. The US Healthcare System in Emergency Response

A responding hospital's immediate priorities during an MCI are to provide mass casualty care while simultaneously securing the hospital to ensure the safety of patients and staff. Upon notification of an event, hospitals begin a long list of pre-scripted actions, including activating mass casualty roles, activating calls to offsite staff, providing information to the rest of the hospital, and creating space in the ED or other parts of the hospital (Greater New York Hospital Association, n.d.). A hospital command center and incident command must be established to manage the dynamic response needs and issues that occur after the first 30–60 minutes (Autrey et al., 2014).

B1. Emergency Medicine

Hospital EDs are often at the frontlines of these incidents, faced with ensuring patient safety, managing a sudden dramatic increase in demand with limited supply, and serving as the main portal into a health system. With increasing overcrowding in EDs, hospitals must be prepared to rapidly implement MCI response to immediately transition from standard operations to crisis standards-of-care (American College of Emergency Physicians, 2011). As these are low-frequency but high-stakes events, they represent a challenging area of medical care and health systems management. There is rarely a single correct management strategy, and decisions must be made quickly and with limited information.

Since the ED serves as the entry point to care, ensuring it can handle a sudden large volume of patients is often the initial focal point in an MCI. Upon arrival at the ED, victims should be assessed for security threats and then rapidly triaged by key staff. Registration issues, availability of imaging, rapid arrival of multiple patients, and availability of tourniquets, blood products, and trauma and surgical resources are potential bottlenecks that must be addressed prior to the event (Hennepin County Medical Center et al., 2016).

EDs can also expect many victims to self-present to the closest facilities using their own transportation. Self-presenting patients are often the first to arrive, frequently before the hospital is even notified of an MCI (Greater New York Hospital Association, n.d.). A frequent theme in MCIs is that hospitals receive so many patients in such a short period of time that it is impossible to get patients registered quickly enough to get information into the electronic health record system, requiring manual documentation and processes (Hennepin County Medical Center et al., 2016).

During an MCI, clinicians and healthcare leaders must switch to a disaster mindset—by definition, patient needs will likely exceed available resources. The focus then becomes doing the most good for the greatest number of patients. Constant triage of patients is essential, including recognizing when clinical intervention will no longer benefit a patient (Hertelendy et al., 2021).

Moreover, while many MCI plans center on ED response due to acute and immediate needs, multiple departments and clinical services across the hospital are crucial and must prepare to surge. Trauma services, surgeons, intensive care units (ICUs), and hospital medicine also are important players, alongside radiology, pathology, pharmacy, and other key stakeholders to ensure victims and patients in the hospital receive uninterrupted, high-quality care to patients over their entire continuum of care (Figure 1).

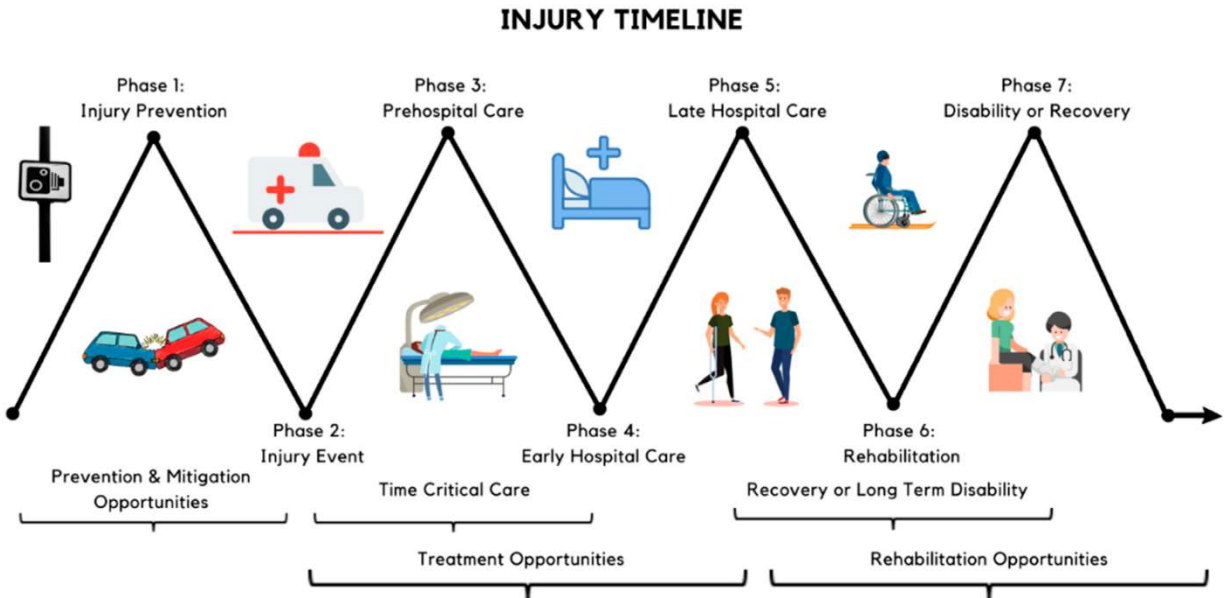


Figure 1: Continuum of care from injury to recovery (Alharbi, 2022)

B2. The US Trauma System

Mass shooting incidents often occur far from trauma centers, with incidents occurring on average 21 miles from adult trauma centers and 83 miles from pediatric trauma centers (Myers et al., 2020a). Moreover, the large proportion of serious injuries and on-scene security concerns during an event may delay care. Therefore, all nearby hospitals, regardless of trauma care status, should be prepared to care for pediatric and adult patients during an event.

The American College of Surgeons established the trauma system in the US to prioritize getting the right patients to the right place in the right time. Trauma centers are designated a level based on their specific capabilities (Figure 2) (American Trauma Society, n.d.). A level-I trauma center provides the highest level of surgical care to trauma patients 24 hours a day. Most level-I trauma centers are teaching hospitals and are referral centers for other hospitals in their regions. Level-II trauma centers initiate care for injured patients and include 24-hour immediate coverage by general surgeons and other specialties, but some tertiary care needs may be referred to a level-I trauma center. Level-III, IV, or V trauma system

hospitals can stabilize seriously injured patients until interfacility transfer is available and are often capable of treating mild to moderate injuries (American Trauma Society, n.d.).

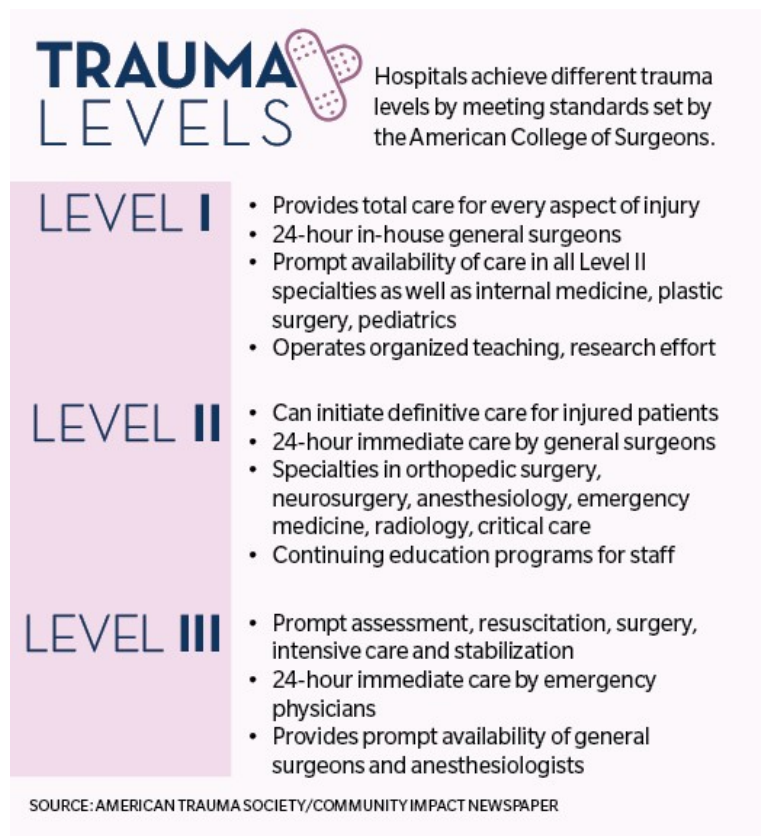


Figure 2: US Trauma System Levels (Arrajj, 2017)

In an MCI, a trauma team is activated once the trauma center is notified of severely injured patients. All essential health professionals, including nurses, emergency physicians, and surgeons, need to be in the ED resuscitation room before patient arrival. After a patient arrives, this team continuously assesses the victim and provides care until the patient can be transferred to an operating room or ICU (American College of Surgeons, n.d.).

Most resources and guidance for MCI management in the US are developed for and created by healthcare and emergency management practitioners in well-equipped level-I trauma centers. An assumption built into many MCI planning resources is that critical patients will be directed or transferred

to level-I trauma centers that have the expertise and resources to care for these patients. However, the American trauma system is inconsistent across geographies, and there are significant gaps in access to trauma care. Of the approximately 6,100 hospitals in the US, only approximately 188 (3%) are level-I trauma centers (Ziran et al., 2008). Most level-I trauma centers are located in densely populated urban settings, meaning that about 50 million Americans are unable to reach a level-I or -II center within one hour (Soto et al., 2018). Conversely, in areas such as the northeast, where trauma centers are more numerous, 40 million Americans have access to 20 or more trauma centers within one hour (MacKenzie et al., 2003). In addition, many hospitals, particularly those that are small and/or in rural areas, do not have Emergency Departments.

Ultimately, when MCIs (and, more specifically, mass shooting incidents) occur, the hospitals where patients present are rarely level-I trauma centers. Thus, this study aims to better understand the experiences and unique needs of responders at community hospitals that have handled mass shooting events so that their experience can help other community hospitals better prepare for, respond to, and recover from mass shooting incidents in their communities.

C. Emergency Management in Healthcare

Emergency management creates the framework within which communities and institutions can reduce vulnerability to hazards and manage disasters. Emergency management protects communities by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters (US Homeland Security, n.d.).

By applying these core principles to healthcare, the role of emergency management varies by system and institution—healthcare organizations do not uniformly prepare for emergencies. Yet it is essential that hospitals be prepared for any disaster scenario. This requires significant financial and

leadership resources for planning, training, and other purposes. In reality, most hospitals have a variety of competing needs and priorities and thus need to channel limited funding in many directions other than emergency preparedness.

Having a comprehensive emergency management program recently became a requirement for accreditation by the Joint Commission and for certification by the Centers for Medicare and Medicaid Services (Joint Commission, 2022). Hospitals are required to have short- and long-term plans for emergency management, a program that includes conducting education and exercises, and a clear response structure in emergencies (Hertelendy et al., 2021). Hospitals must develop communication plans that comply with state and federal laws to share hospital contact information, medical information, and documentation with patients as well as a system to track on-duty staff and sheltered patients in an emergency. Hospitals must plan and train all key personnel in the structure and relationship of the hospital incident command system, which is an incident management system consistent with principles of the country's incident command system yet tailored for a hospital or healthcare environment (Backer et al., 2014). A hospital incident command system allows hospitals to improve their emergency management capabilities to plan for, respond to, and recover in planned and unplanned events (Backer et al., 2014).

C1. Hospital Surge Capacity and Mass Casualty Incidents

Surge capacity is defined as a hospital's ability to meet increased demand for resources due to a sudden increase in patients. This can be further subdivided into three categories based on capacity of the public health system, the community, and a specific healthcare facility. While many types of events can call upon such capacity, none is more time-sensitive or potentially consequential than a large-scale MCI such as a mass shooting (Federal Emergency Management Agency, 2013). An MCI occurs when the demand for clinical services brought on by a sudden event exceeds the capacity of a health system to

supply them. They can happen anywhere, at any time, and impact an entire community (American College of Emergency Physicians, 2011). While MCIs are a type of patient surge event, the sudden and unpredictable demands that they require make them particularly difficult to plan for. Real-world MCIs usually occur without notice and require decision-making in a chaotic, information-poor environment.

Every ED must have a MCI management plan that aligns and integrates into a hospital-wide plan. When possible, the responsibility of the MCI plans should be with the authority that coordinates pre-hospital and facility-based emergency care, facilitating regional trauma response coordination. A MCI plan ensures that responsibility, accountability, and roles are clarified in advance and also facilitates efficient communication, resource utilization, and safety of staff and patients. The Centers for Medicare and Medicaid Services 2017 Final Rule on Emergency Preparedness requires healthcare facilities to maintain an emergency operations plan that is updated annually; most hospitals also develop MCI-specific plans in addition to the emergency operations plan that contain processes to triage and support patients, assuming limited redistribution of patients to available medical resources (Centers for Medicare & Medicaid Services, n.d.).

To complicate matters, caring for patients involved in a surge event occurs in addition to basic care of patients daily presenting to a healthcare facility. Considerations for handling a sudden influx of patients include appropriate staffing or staff redeployments, beds and space to place patients, sufficient medical supplies and equipment, and systems to coordinate resources and patient transfers to ensure patient safety and survival (Adams, 2009).

MCIs can stem from any significant emergency that creates a number of patients that overwhelm a hospital. Events such as natural disasters, train derailments, or chemical, biological, radiological, or nuclear attacks may complicate patient care (e.g., decontamination, access to care) (Table 1). The scope of this study is limited to mass shooting incidents, which, while complicated in

many ways, primarily result in blunt or penetrating trauma and require rapid access to care, particularly trauma resources and general surgery.

Table 1: Anticipated Injuries per Mass Casualty Incident Category (Greater New York Hospital Association, n.d.)

ANTICIPATED INJURIES PER MCI SCENARIO ⁴										
MCI Category	Blunt Trauma	Penetrating Trauma	Burns	Crush	Exacerbation of Chronic Disease	Gastrointestinal Illness	Respiratory Impact	Submersion Injury	Infected Wounds	Contaminated Wounds
Chemical			X				X			X
Biological					X		X			
Radiological			X							X
Nuclear	X	X	X	X	X	X			X	X
Explosive	X	X	X	X			X		X	X
Tornado	X	X		X					X	
Hurricane	X	X			X	X	X	X	X	
Flooding	X	X					X	X	X	X
Earthquake	X	X	X	X	X	X	X		X	
Wildfire			X				X			
Plane Crash	X	X	X				X			
Bus Crash	X	X		X						
Major Motor Vehicle Collision	X	X	X	X						
Mass Shooting	X	X								

D. Healthcare in Context

Over the past 25 years, US hospitals have experienced significant changes in operations. Among other factors, large-scale penetration of health maintenance organizations in the early 1980s, the Emergency Medical Treatment and Labor Act in 1986, and Medicare reform associated with the

Balanced Budget Act of 1997 have limited the ability of hospitals to turn away patients who are unable to pay for services and have limited the amount hospitals can collect for provided services (Thompson et al., 2009). These changes have forced hospitals to improve operating efficiency by cutting staff and managing patient length of stay. Loss of inpatient beds has left many hospitals with minimal surge capacity to handle spikes in demand. As a result, beds are often in short supply, and the problem is expected to worsen (Solberg et al., 2003).

D1. Bed Capacity

Hospital capacity increases are driven by increased demand in ED, inpatient, and ICU admissions, as well as a lack of available beds in other settings. In the behavioral health space, 20% of inpatient psychiatric beds are currently offline due to insufficient staff. This results in many individuals waiting in EDs for behavioral health evaluations and available psychiatric beds. Over the past year, close to 25% of ED beds in Massachusetts have been occupied by patients with behavioral health problems, with some hospitals seeing 100% of their ED beds occupied by these patients (Massachusetts Health & Hospital Association, 2022). Across the state, hospital beds are 94% occupied according to the latest data (Massachusetts Health & Hospital Association, 2022). At Mass General Brigham, an average of 6% of patients seeking emergency care in July–October 2022 left the hospital unseen, which is three times the level that used to trigger alarms (Lazar, 2022). In general, when a hospital has more than 85% occupancy, ED boarding times often exceeded the national standard of four hours (Janke et al., 2022). The rate at which people leave hospital waiting rooms before being treated has nearly doubled from 1% in 2017 to ~2% in 2021 (Massachusetts Health & Hospital Association, 2022).

D2. Workforce Shortages

The hospital capacity crisis is exacerbated by hospital staff turnover. While the COVID-19 pandemic affected employment across multiple sectors, it is especially troubling in healthcare, where it

places demands on an already constrained system and affects care capacity (Massachusetts Health & Hospital Association, 2022). Hospitals are reporting increased burnout and clinician distress, with burnout affecting approximately 60% of emergency physicians and 47% of physicians (Kane, 2022). Across the country, the average hospital personnel turnover rate is 25%, with 27% for nurses (Millard, 2022). According to the 2022 National Health Care Retention and RN Staffing Report, essentially every five years, Emergency Medicine will turn over their entire nursing staff. In Massachusetts, there are an estimated 19,000 acute care hospital positions unfilled, creating severe capacity issues across hospitals (Massachusetts Health & Hospital Association, 2022).

E. Hospital Preparedness

Although hospitals are required to maintain emergency preparedness plans, EDs and hospitals have become busier and more crowded. Plans are often based on previous, not current, healthcare constraints and do not consider the current hospital reality. As emergencies become increasingly frequent, complicated, and more devastating, those that result in MCIs can easily overwhelm most hospital resources, staff, and space (Ahmad, 2018). In addition, the priorities and roles of emergency management vary dramatically based on the needs and expectations of hospital leadership. With dramatic turnover in hospital leadership—the average tenure of a hospital CEO is only 18 months (Millard, 2022)—emergency preparedness plans, trainings, and priorities can be reset frequently.

Academic medical center, such as Brigham and Women’s Hospital, are typically level-I trauma centers and, as such, are provided with robust resources to address MCIs. However, they are a critical last line of defense in a major emergency, often delivering care to patients whose needs cannot be addressed at smaller community hospitals or urgent care centers closer to the event. Therefore, investment in preparedness for community hospitals is critical in order for these institutions to respond

to MCIs. Methods of regional resource distribution, including transferring patients to other institutions, are also strained by understaffing and lack of resources (e.g., EMS to transport patients).

As previously indicated, hospital emergency response plans have traditionally centered on responses by the ED and associated surgical services to mass trauma-type events. Less attention has been given to involvement of other hospital departments in either incident management operations or MCI planning (Persoff et al., 2018). Historically, however, other hospital departments (i.e., ICU, operating rooms, and medical–surgical nursing) have been critical to expedite patients out of the ED rapidly and through the continuum of care (Lynn et al., 2006). Further, hospital surge capabilities have markedly diminished over the past decade due to ED overcrowding, in part by admitted patients occupying room space (“boarding”), further decreasing hospitals’ capacity to accept new patients (Massachusetts Health & Hospital Association, 2022). MCI guidance and planning must be reformed to emphasize daily bed occupancy in the ability for hospitals to respond to public health emergencies and disasters, which are occurring with increased magnitude and frequency worldwide (Hertelendy et al., 2021).

Adequate and realistic planning at organizational and regional levels is key to optimize and coordinate responses to these unexpected events. While many best practices focus on the immediate needs within the first hour of an MCI, this study aimed to place MCI planning in the context of a strained hospital dealing with the current realities of compounding and consecutive emergencies. Even as health systems continue to struggle to operate under the long-term impacts of surge, it is important to understand and mitigate direct and indirect impacts of MCIs, particularly for the most vulnerable populations.

VI. DrPH Project in Context

A. Host Organization: Brigham and Women's Hospital, within the Mass General Brigham Health System

Mass General Brigham is a Massachusetts-based physician network and hospital system that includes Mass General Hospital and Brigham and Women's Hospital, two of the nation's largest and most prestigious teaching hospitals. It is also the largest private employer in Massachusetts, with more than 74,000 employees and 14 hospitals.

Brigham and Women's Hospital, a founding member of the Mass General Brigham health system, is a 793-bed general medical and surgical hospital in the Longwood Medical Area. It is the second largest teaching hospital affiliated with Harvard Medical School and the largest hospital in the Longwood Medical Area of Boston. Brigham and Women's emergency medicine services a population of 63,000 per the annual census and includes a level-I trauma center and burn center (Brigham and Women's Hospital, n.d.).

B. Role and Resources

I serve as the Director of Emergency Preparedness for Brigham and Women's Hospital and Brigham and Women's Faulkner (Faulkner) Hospital, a role I assumed in November 2021. In my daily role, I manage a small team that responds to any emergencies that affect Brigham and Women's Hospital, Faulkner Hospital, or more than 25 ambulatory sites within the Brigham and Women's family. My team also is responsible for sustaining and building activities and programs that mitigate against, prepare for, respond to, and recover from any hazard that may impact Brigham and Women's ability to provide critical services to the community.

Brigham and Women's Hospital has a strong emergency management program that was historically embedded within the ED and reported to the Executive Director of Emergency Medicine. However, as of December 2021, the program was centralized into a Mass General Brigham enterprise-wide department: the Division of Emergency Preparedness and Business Continuity (DEPC). DEPC is led by Dr. Paul Biddinger, Chief Preparedness and Continuity Officer of Mass General Brigham, and David Reisman, Vice President of DEPC. Dr. Biddinger is also Program Director for Mass General Hospital's Center for Disaster Medicine and holds appointments at Harvard T.H. Chan School of Public Health and Harvard Medical School. He is an active researcher and leader in the field of public health preparedness.

My role reports directly to the Vice President of DEPC at Mass General Brigham, who oversees emergency management for all hospitals and ambulatory care sites within the enterprise. My doctoral project aligns with key priorities across DEPC; thus, Dr. Biddinger has served as a research advisor and mentor for me throughout this project.

While this work will support the ongoing work of Brigham and Women's Hospital in MCI planning, the aim of these recommendations is to support and inform MCI planning efforts of all hospitals within our system, including community hospitals such as Faulkner Hospital.

C. The Boston Marathon: One Decade Later

The emergency preparedness ecosystem of Boston was tested and forever changed by the Boston Marathon bombing. On April 15, 2013 at 2:49 PM, two concealed homemade pressure cooker improvised explosive devices detonated several hundred yards away from the finish line at the Boston Marathon. In total, three individuals lost their lives on scene and 281 people were injured, with 127 patients evaluated at one of the six level-I trauma centers located within two miles of the event. Patients arrived at nearby hospitals mere minutes after the bombs exploded, traveling by ambulance,

foot, private vehicles, and police vehicles. Once patients arrived, they were quickly organized and triaged according to each ED's protocols (Federal Emergency Management Agency, 2013).

The tragedy of the 2013 Boston Marathon bombing provides insight into the Boston emergency management ecosystem. Considering the strategies used and key lessons from mitigation, preparedness, response, and recovery efforts associated with the event can inform the ways that emergency management, EMS, and hospital personnel respond in dire emergencies.

In the years preceding the Boston Marathon bombing, MCIs had been a major focus of preparedness efforts across the country, including at local Boston hospitals. In particular, large and heavily publicized mass shootings across the country emphasized the importance of seriously considering and preparing for higher-magnitude disasters, with emergency managers developing, disseminating, and training on their own MCI plans and protocols (Gawande, 2013).

However, a decade later, the planning assumptions that made Boston's regional health system successful in responding to the Boston Marathon bombing must be re-evaluated. The current patient volume spike is unlike any other seen at tertiary medical centers across Boston. Historically, other departments in the hospital are expected to take on additional patients and expedite them out of the ED rapidly to make space for victims of reported MCIs (Lynn et al., 2006). However, in the current volume surge, EDs have consistently been at or over 100% occupancy in hospitals across Massachusetts (McPhillips, 2022). Staffing shortages of healthcare workers have been a constant concern, and supply chain shortages plague health systems daily.

In this new reality, Mass General Brigham DEPC is prioritizing MCI preparedness across member hospitals. At Brigham and Women's Hospital in particular, our team is painstakingly rethinking these plans with departments across the hospital, using resources and results from this research to establish concrete and usable plans. As we near the 10-year anniversary of this devastating event in Boston's

history and as MCIs, particularly mass shooting incidents, become increasingly common across the country, a question keeps healthcare emergency managers up at night: Are our systems prepared?

VII. Methods

A. Purpose and Research Questions

This study aimed to address the following questions:

1) *What can we learn from the experiences of hospitals that have responded to recent mass shootings in the US?*

2) *What unique challenges do community hospitals face in preparedness, response, and recovery for mass shooting incidents?*

To address these topics, I conducted semi-structured interviews with nine practitioners, mostly from community hospitals, who led their hospitals or departments to respond to an MCI. These interviews represented seven major MCIs, six of them mass shooting incidents, that have occurred in the US within the past decade.

B. Qualitative Methods

Because the purpose of this study was to explore complexities of mass shooting incidents, I used qualitative research methods to explore insights from semi-structured key informant interviews. Guidance and tools from national expert organizations that provide best practices for hospitals to plan for and respond to MCIs were used to develop the interview framework as well as interpret qualitative findings in the context of best practices in the US.

Qualitative methods are appropriate for this study because they offer opportunities to explore complexity and include diverse perspectives. Major gaps in the literature include specific narratives around regional coordination and response, as well as how hospitals consider and handle growing complexities in preparedness and recovery in the context of competing priorities and resource

constraints on healthcare systems. Most literature is targeted to and informed by academic medical centers and level-I trauma centers. By focusing interviews on community hospitals, this research provides understudied perspectives of these healthcare institutions and those who respond within them to better understand how this group can adapt and collaborate during emergencies. Ultimately, this study provides views of how response activities in these community environments can be strengthened in coordination with larger regional centers during mass shooting incidents.

I developed a guide for the semi-structured interviews using the emergency management cycle as a framework (see Section VIII and *Appendix D*). The emergency management cycle is referenced widely in the field of emergency management and depicts key functions in addressing an emergency through four phases: preparedness, response, recovery, and mitigation. Each interview focused on background information about the resources and structure of the interviewee's hospital or health system, preparedness of the hospital prior to the event, a timeline and description of the hospital's response to the event, lessons learned and new best practices developed from the experience, recovery from the event, current issues with MCI preparedness in the present healthcare context, and any additional points of discussion.

C. Qualitative Expert Interviews

The sampling strategy targeted a small but representative variety of viewpoints from nine experts representing six different mass shootings and one other MCI across the US. In addition, to provide context to the published landscape of preparedness, I reviewed five documents that serve as the most widely referenced guidance or toolkits for MCI response among practitioners.

The project was conducted primarily in July 2022–March 2023. During this eight-month period, I was working full-time at Mass General Brigham, overseeing the Emergency Preparedness programs at

Brigham and Women's Hospital and Faulkner Hospital. This study was approved as exempt human subjects research by the Harvard Longwood Institutional Review Board (see *Appendix B*).

C1. Eligibility Criteria

To be eligible for the study, participants had to have experience responding to a large mass shooting incident within the past 10 years. One event in the data was a mass casualty incident involving a vehicle collision, rather than a mass shooting incident. This was included as a case study in order to incorporate geographic diversity into the study. In particular, because this was a large event that occurred in the same metropolitan area of Brigham and Women's Hospital, the interview was included at the discretion of the investigator and host organization to identify any themes that may be unique to the Boston metropolitan area.

Candidates must have had a role involving clinical care of victims transported to the hospital or emergency management or a healthcare leadership role in coordinating and making decisions to respond to the specific event, as well as more than five years of experience in healthcare emergency management, healthcare administration, or clinical practice.

After compiling a list of major mass shootings from the past decade, I used media sources to identify hospitals involved in response. I then recruited experts through a snowball sampling method using a small group of informants to nominate other participants who met eligibility criteria as well as through postings on various professional forums, including the Association of Healthcare Emergency Preparedness Professionals.

Experts represented a diversity of viewpoints and were stratified on several predefined criteria: level of trauma center providing care and type of hospital, role in response, geographic location (urban vs. rural), and victim characteristics (pediatric vs. adult). Table 2 summarizes the roles and organizations represented in these interviews.

Table 2: Overview of Mass Shooting Incident Interviewees and Hospital Characteristics

Mass Shooting Incident	Location	Year	Number of Victims at Hospital	Type and Trauma Center Level	Interviewee's Role in Response	Number of Interviews
Pulse Nightclub	Orlando, FL (urban)	2016	35	Academic medical center, level I	Emergency manager (system), emergency medicine clinician	2
Harvest Festival	Las Vegas, NV (urban)	2017	105	Community hospital, level 3	Emergency manager (local), nursing	1
Walmart	El Paso, TX (suburban)	2019	11	Community hospital, level 2	Trauma clinician	2
Allina Healthcare Clinic	Buffalo, MN (rural)	2021	5	Critical access hospital, level 3	Emergency manager (system)	1
July 4 th Parade	Highland Park, IL (suburban)	2022	30	Community hospital, level 2	Emergency medicine clinician, emergency manager (system)	1
Robb Elementary School	Uvalde, TX (rural)	2022	15	Critical access hospital, level 4	Healthcare administrator, clinician	1
Apple Store (Vehicle Collision)	Hingham, MA (suburban)	2022	17	Community hospital, level 2	Emergency manager (local)	1

C2. Mass Shooting Incidents Experienced by Interviewees

Interviewees had experience responding to six mass shooting incidents and one other MCI (Figure 3).



*Dark star indicates mass shooting. Light star mass casualty incident.

Figure 3: Map of Incidents Experienced by Interviewees

- **Pulse Nightclub: Orlando, FL (2016)**

On June 12, 2016, a gunman armed with a handgun and an assault rifle entered Pulse Nightclub in Orlando, FL, at 2 AM and opened fire. Pulse, a gay nightclub, was hosting a Latin night on the evening of the shooting. Fifty people were killed and 53 were injured (Shapiro, 2016).

- **Harvest Festival: Las Vegas, NV (2017)**

On October 1, 2017, from his hotel room on the 32nd floor of the Mandalay Bay Hotel, a gunman opened fire on attendees of the Route 91 Harvest Music Festival on the Las Vegas Strip. Armed with more than 20 high-capacity assault rifles and a revolver, he fired more than 1,000 bullets in the span of 10 minutes, killing 60 people. The total number of injured victims was 867, with many injured during the resulting

panic among the festival crowd. This was the deadliest mass shooting committed by a single individual in US history (Belson et al., 2017).

- ***Walmart: El Paso, TX (2019)***

On August 3, 2019, a shooter walked into a Walmart in El Paso, TX, carrying an assault rifle and opened fire. He killed 23 people and injured 23 others (Aguilera, 2020).

- ***Allina Health Care Clinic: Buffalo, MN (2021)***

On February 9, 2021, a man entered Allina Health Care Clinic in Buffalo, MN, with a handgun. He opened fire and detonated two improvised explosive devices, killing one person and injuring four people. The shooter was unhappy with his healthcare, with reports citing that he was upset that his clinicians would not give him pain medication. All victims of the shooting were Allina Health employees (Andone et al., 2021).

- ***July 4th Parade: Highland Park, IL (2022)***

On July 4th, 2022, a gunman opened fire with an assault rifle at 10:14 AM into a July 4th parade in Highland Park, IL. Seven people were killed, and 48 others were injured (Grimm and Ramos, 2022).

- ***Robb Elementary School: Uvalde, TX (2022)***

On May 4, 2022, at about 11:30 AM, a gunman fatally shot 21 people (19 students and 2 teachers) and wounded 17 others in Robb Elementary School in Uvalde, TX. Described as a former student, this 18-year-old entered the school with an AR-15 style rifle and remained in the school for more than an hour before being neutralized. Uvalde is a Hispanic-majority city in South Texas, and Robb Elementary school's population was about 90% Hispanic, with 81% coming from economically disadvantaged backgrounds (New York Times, 2022).

- ***Additional Case Study: Apple Store Vehicle Collision: Hingham, MA (2022)***

On November 21, 2022, a man drove an SUV into an Apple store in Hingham, MA. One person was killed and 21 people were injured (Gavin, 2022).

C3. Interviews

I used semi-structured interviews to explore participants' experiences with mass shooting incidents and to understand their priorities and barriers to being prepared for future MCIs. I asked open-ended questions sectioned into topics based on the emergency management cycle framework (see Section VIII).

The interview guide (see *Appendix D*) was adapted into two versions: one for emergency managers and healthcare administrators (non-clinical), and one for clinicians or individuals working specifically in EDs during the mass shooting response (clinical). While I used the interview guide to provide direction and structure to the interview and to minimize bias, I adapted the topics and discussion based on concepts presented by the participant, allowing for organic discussion and exploration of concepts as they arose.

All interviews were conducted via Zoom and lasted 60–120 minutes. Prior to each interview, interviewees were provided with an informed consent form (see *Appendix C*) as well as a study overview and abbreviated interview guide.

C4. Analysis

Interview data were analyzed using a systematic process of transcribing interviews and coding transcripts with Dovetail, a qualitative analytical software package. Recordings or voice notes of interviews were transcribed using the Dovetail analytic online application, a program developed to code and synthesize interview data for qualitative customer research. One interview was not recorded by request of the interviewee; detailed notes served as the data for this interview.

I used a hybrid approach to analyze the data with both deductive and inductive thematic analyses. A deductive process emphasizes themes and explanations derived from established contexts, such as relevant literature, in the coding structure and analysis. An inductive process generates

interpretation and understanding that is primarily driven by the data. This flexible, study-specific combination is a hallmark of applied qualitative research to balance rigor, practical value, context, and available resources (Green and Thorogood, 2018). Ultimately, this approach, which is grounded in the emergency management cycle and informed by relevant guidance and literature, seeks to highlight practice and community-based expertise, contributing to existing literature and supporting integration of evidence into practice (Ramanadhan et al., 2021).

VIII. Grounding Framework: The Emergency Management Cycle



Figure 4: The Emergency Management Cycle

Emergency management is the specialty by which communities reduce hazard risks and manage disasters. While it can be argued that the function has been essential since emergencies started impacting communities, the field was not formalized in the US until 1978 with establishment of the Federal Emergency Management Agency (FEMA). The emergency management cycle is a useful representation of the functions in addressing an emergency, framing disasters in four phases: **preparedness, response, recovery, and mitigation** (Figure 4). This cycle has been referenced widely in the field of emergency management and humanitarian assistance and is a recognizable framework for

activities of an emergency management system, closely related to the core capabilities of FEMA's National Response Framework (Rose et al., 2017). Here, an addition to this notable framework is the "event" itself. This is included in additional detail to describe the mass shooting incident in question and how it affected each institution, as well as the context in which the incident occurred.

Preparedness is defined by FEMA as "a continuous cycle of planning, organizing, equipping, training, exercising, evaluating, and improving to ensure effective communication, coordination, and capability enhancement to prepare for emergencies" (US Homeland Security, n.d.). While preparedness activities occur before an event, lessons learned after an incident can and should be used to guide preparedness activities moving forward.

The response phase mobilizes identified emergency staff, ideally those who have been trained and are properly equipped, to an event that could impact the hospital or patient care. These activities should be detailed in plans created during the preparedness phase. Response to the incident will be directed through an established incident command system. While response activities vary based on incident, they generally involve notifying appropriate parties, communicating, sharing information, and coordinating incident objectives amongst stakeholders. These plans are constantly re-evaluated and updated regularly as well as after an event or exercise. An after-action review process then identifies improvement items, which are documented and operationalized.

Recovery focuses on restoring the affected institution or area back to its previous state.

Mitigation involves identifying risks, evaluating hazards, and minimizing damage. Mitigation activities can occur before, during, or after an event.

The emergency management framework takes an "all hazards" approach, considering a comprehensive scope when planning for emergencies. This approach is predicated on the fact that there are many threats that can affect an institution, and every emergency is unique. By focusing on

capabilities that are critical to preparedness in any event, this approach ensures that hospitals have the capacity to respond to a broad range of emergencies (U.S. Department of Homeland Security, 2021). The basis of the "all hazards" approach starts with a hazard vulnerability analysis (HVA). The HVA identifies disasters and other events from a technological, natural, man-made, and hazardous materials perspective, focusing on those most likely to impact a community, ranked by order of probability, severity, and greatest impact. The HVA is reviewed annually, or as required by leadership and the Emergency Management Committee. The HVA, including the top five or ten ranked disasters, is shared with community, government, and emergency response agencies, including offices of emergency management, offices of public health, EMS, police and fire departments, and medical examiners' offices.

IX. Results

This section provides a broad overview of findings, focusing primarily on themes drawn from interviews and supported by published guidance frequently cited during interviews. While the detailed results are organized according to the emergency management cycle framework, several overarching needs were identified:

- 1) *Renewed efforts to communicate the importance of MCI preparedness to the institution and region;*
- 2) *Data-driven and realistic departmental targets and initiatives for MCI preparedness;*
- 3) *Timely, transparent, and actionable communication that aggressively combats misinformation across the span of an event;*
- 4) *Rapid regional communication and coordination, particularly in implementation of family assistance and reunification services;*
- 5) *Robust and proactive mental health services tailored for all responding staff and available for patients;*

Coding and analyzing interviews revealed that interviewees commented on nearly 2,000 different aspects of the emergency management cycle. Interviewees focused most on the response phase of the cycle as they recounted their experiences, but they also commented on the other three phases as well (Figure 5).

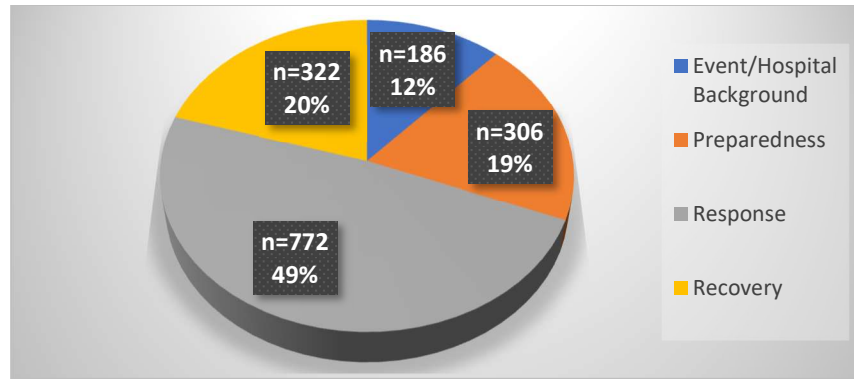


Figure 5: Frequency of Code Categories

While the emergency management cycle was a useful framework to guide the interview structure, it had some limitations. First, the cycle represents a sequential, cyclical approach to emergencies. However, many interviews were not time-bound in relation to the event and thus were not necessarily representative of the intended theme. For instance, when speaking of preparedness, respondents conceptualized many issues, including difficulties prioritizing MCI preparedness in the present tense in the context of ED overcrowding and a post-COVID-19 climate. This was regardless of whether their incident occurred before or after the onset of COVID-19 in the US. This indicates that learning or a posture of preparedness—as developed through trainings, exercises, and real-world events—is evolutionary, with individuals continuing to grow and learn over time. While attempts were made to distinguish preparedness before and after the actual event, many individuals considered overall preparedness and did not delineate responses based on the applied framework. In addition, emergency management is operational in nature, and the cycle did not encompass the level of detail of topics discussed. The framework also does not create a method to prioritize topics. While I attempted to address these limitations through the semi-structured nature of interviews, many interviews focused on details in response to the event and were limited by time constraints.

It should also be noted that, while these results exemplify the broad range of topics covered, interviews were exploratory and open-ended and were not intended to be exhaustive. Literature and

seminal guidance documents contain comprehensive overviews of factors to account for when preparing for and responding to an MCI. This study intends to capture experiences with applying these concepts, including unanticipated factors, perceptions of preparedness and effectiveness, and complexities around this important work.

A. Preparedness



Figure 6: Preparedness in the Emergency Management Cycle

Preparedness explores the landscape of mass shooting preparedness across the nation through commonly cited references as well as through the narrative of the selected interviews. This section begins with a general overview of resources frequently cited as guidance for MCI planning in the literature, in the interviews, and within the Mass General Brigham emergency preparedness community. The section then explores participants' perceptions of their hospital's MCI risk, as well as their preparedness priorities and resources prior to the mass shooting incident. An overview of preparedness results is presented in Box 1.

Box 1: Overview of Preparedness Results

- Respondents used regulatory requirements as their standards in preparedness. While they felt prepared for MCIs prior to the incident and valued planning, their planning assumptions made plans untenable during the actual response. They did not expect the size and severity of the incident, particularly with the use of semi-automatic weapons.
- There also was difficulty garnering investment from both leadership and staff in pushing beyond required standards to make MCI planning a priority and more valuable in real emergencies.
- The state of healthcare post-COVID-19 made planning particularly difficult. Developing trust and relationships before emergencies is the crux of effective emergency management, and interviewees mentioned how difficult this was in a new working environment in which many people work remotely. Furthermore, many training and exercise priorities were cancelled or not maintained due to ongoing COVID-19 response. Interviewees mentioned how difficult it was to plan for an MCI when hospitals are already pushed to the brink with ongoing capacity issues.
- Regional partnerships and healthcare coalitions are a vital resource in maintaining institutional preparedness, particularly for smaller hospitals. Most hospitals referenced a regional or state MCI exercise as a critical resource that interviewees felt made a difference during the actual event.

A1. Resources and Guidance in MCI Management

An MCI response requires a fundamental shift in approach to providing care. In regular day-to-day care, a facility aims to ensure the best outcome for each patient as an individual. However, in an MCI, where resources are by definition inadequate, the approach must shift to triage and providing treatment to those who most need and will most likely benefit from care (Greater New York Hospital Association, n.d.). This shift in approach is reflected in the elements of MCI planning and response, from the point of triage to the allocation of resources and treatment plans (Table 3). However, as this sudden shift in healthcare practice does not start and end in an ED, the implications of this shift also do not end at the front lines of an ED. Many challenges, difficulties, and ethical dilemmas are inherent in this unfamiliar approach to patient care and must be considered by the entire community that works together to address a sudden emergency.

Table 3: Healthcare Mindset Shift During an MCI (WHO Mass Casualty Management Toolkit) (Reynolds et al., n.d.)

Incident demand/resource imbalance increases			
Risk of morbidity/mortality to patients increases			
Facility Resources	Routine	Surge MCI	Surge disaster
Structure	Usual patient care space fully utilized	Patient care areas are repurposed	Expansion to non-patient care areas
Staff	Usual staff called in and utilized	Staff extension (brief deferrals of non-emergent service, supervision of broader group of patients, change in responsibilities)	Minimum staff required for maximal patient load (negative implications for patient care, safety practice)
Supplies	Usual stock and supplies used	Mobilization of pre-prepared kits	Possible relocation of life sustaining resources
Recovery			

To use the existing literature and guidance for MCI response, I conducted an environmental scan of frameworks for whole-hospital MCI preparedness (see *Appendix A*). To identify these resources, I asked practitioners and interviewees about the references they used to develop their own plans. While these references serve as comprehensive MCI planning guides for healthcare and emergency preparedness professionals, many are targeted at clinicians and focus on the immediate response to a sudden influx of patients. Furthermore, subject matter experts referenced in many of these seminal pieces focus their recommendations and planning assumptions on level-I trauma centers with robust trauma resources.

A2. MCI Preparedness in Interviewees’ Hospitals

Conversations began with discussions of organizational preparedness for each institution. Interviewees discussed the resources available to and provided by the hospital and healthcare systems (where applicable), as well as how they thought about their own hospital’s risk for responding to an MCI prior to the shooting.

1) Threat/Risk Perception

In these discussions, a key focus of preparedness was identifying the most pressing risks, communicating them to colleagues and leaders, and then engaging in preparedness. Several individuals referenced the HVA, an annual or bi-annual process to identify a hospital's vulnerabilities to different types of hazards and their effects. One interviewee mentioned that MCIs were amongst the top-ranking hazard on their annual HVA. Despite this, several interviewees mentioned that after the event occurred, they realized that they did not really think it could happen to them. One said:

I remember when it happened, the first thing that people said is if it happens here, it can happen anywhere. I think there's almost a sense of security that some hospitals have, because I'm a rural site, it won't happen here. We are a very tight-knit community and if it can happen here, I think all of us need to be prepared for it to [happen at] their facility too.

While several interviewees felt that they were prepared for an MCI event prior to the incident, as they were "used to dealing with multiple traumas at a time," they did not expect the size and severity of the incident. In particular, use of semi-automatic weapons not only injured more people but created more severe injuries than staff were used to seeing. One clinician stated, "I think most of us felt prepared and felt as though we could take adequate care of these people. It was just doing it at a greater speed and doing it with less resources." Despite no interviewee feeling that their institution was unprepared for the event, a common theme was that, while the practice of planning was useful, plans used assumptions that significantly underestimated the size and severity of the actual event. Interviewees expressed that first responders and hospital leaders assumed disasters were a mere increase in volume but did not fully recognize the complexity of scale, including clinical pathology and increased case presentations in a short time period, with more fragmented pre-arrival communication and coordination.

Several interviewees referenced regional MCI exercises that helped their institutions develop policies and procedures. While useful, however, the exercises did not prepare hospitals for the size of the event, as planning assumptions “never had them come in droves of 20 or 30 at a time.”

Our emergency operations plan said that the labor pool will be here and people will check in there in a nice calm planned out response. I didn't have this. We did plan with [our] Healthcare Coalition. We're an active part of that and we did plan for MCI events, but always with the caveat that the fire department was going to be there and triage everybody...and level load according to the way that we wrote it all down on paper. Because nobody's just going to show up at the hospital, are they? Well, they did.

In addition, two interviewees indicated their institutions did not account for the capacity status of their hospitals or EDs in planning for MCIs and were forced to adapt when the incident occurred. One administrator described:

At the time that we were notified of the active shooter, we already had all but two beds full [in our ED]. But you talk about EDs and chaos and the unexpected in things like a mass casualty, they're never going to be when your best-case scenario is happening in your ED. Expect it on the worst day.

2) Investment in/Experience with Preparedness

Hospitals are required to conduct a regular HVA in compliance with emergency management standards of accrediting organizations such as the Joint Commission. All interviewees referenced meeting regulatory requirements for their hospital's emergency management programs and using those to guide their planning priorities. The difficulty was not necessarily in meeting these requirements but rather gaining the investment to push beyond required standards to operationalize goals in MCI response—ultimately empowering staff to have the knowledge and resources to respond despite time limitations.

We did standard response training, which usually resulted in people like, I don't have time for this. I can't do this right now. After the shooting, a lot of the staff are like, why aren't we training for this? Seriously, you want to ask me that now?

While robust structures and processes were in place for MCI and overall emergency preparedness, and these were prioritized by the emergency manager and those invested in preparedness, other staff and leadership did not necessarily prioritize these topics. Interviewees expressed difficulty not only with providing adequate training for emergencies but in convincing leadership and other hospital staff to be invested, particularly during current health systems challenges of staff shortages.

But very few people went beyond [required general trainings], and it's such a time commitment.... turnover is so high that it's hard to tell if anybody remembers anything they've been trained on, and they don't see the benefit in it. So they don't make time for it.

Other individuals cited the importance of real-world responses in keeping “muscle memory” in communication and coordination of an emergency response.

We have activated for riots at the system level, having that actual real-world experience was huge for us. We have not had an MCI activation at any of our regionals since before I've started. While we've had some leaders do great in terms of incident command response, there were a lot who said, I don't know what that is...they did not feel comfortable in their roles.

3) Constraints Prior to Event

All interviewees described the difficulty of maintaining preparedness in the current state of healthcare and with the unique changes of working in a post-COVID-19 environment.

One point of particular concern was that many healthcare administrators now work virtually. This not only affects the ability to create or maintain working relationships but also manifests in activating incident command to oversee hospital response. The crux of emergency management is to coordinate various experts and resources in an emergency, and changes to these relationships tremendously impact institutional preparedness.

I don't want to be a crisis only person, so relationships are huge. One of the drawbacks of COVID-19 was not meeting in person anymore and losing those relationships. It's hard to get people off

Zoom. Now they don't want to leave their office because it's a time suck and everybody's got so much to do. But you've got to, because you've got to know who people are, the face behind the phone number. You've got to be able to see people and talk to them and read their body language and see if they get what you're saying. Relationships are huge. Huge.

Another limitation to the ability to prepare for MCIs was ongoing patient capacity issues within hospitals. One individual said that patient surge, or having a marked increase in patients, had been ongoing for years, thus requiring new definitions. "We call it an MCI because we live in surge and we're in a disaster every day. So calling it a disaster doesn't mean anything to anybody. Or they'll be like, what else is new? Surge is meaningless." Another individual commented, "We're in a disaster every day, so we keep building hallway space."

The COVID-19 pandemic, which began to affect the US in early 2020, continues to affect our hospitals and health systems today. Over the course of several years, the focus of many hospitals pivoted to responding to the pandemic, including providing care to patients, augmenting capacity to care for an increase of patients, implementing social distancing policies, supporting vaccination efforts, and dealing with staffing shortages. As a result, other non-emergent priorities were not addressed, including planning for other types of emergencies and conducting exercises. In regard to preparing for MCIs, one individual mentioned that scheduled exercises were canceled or not scheduled due to COVID-19. Others mentioned that responding to COVID-19 in lieu of conducting an exercise met regulatory requirements, thus preparedness was not prioritized during COVID-19. While this was indeed a concern across interviews, one participant mentioned that COVID-19 has been a useful avenue to obtain buy-in to their work by showing the value of emergency management during the pandemic, and thereby an avenue to build relationships.

We've been through a disaster for the last three years, and just the collaboration in our medical staff and teams coming together... We do the drills and I'm like, get your patient now and sure enough they got 'em. They did their jobs and that's what we all need to do.

Despite difficulty maintaining preparedness during and after COVID-19, some hospitals found innovative ways to use real-life scenarios, or institutional priorities, to engage in MCI planning.

They would practice using real trauma cases that had come in previously that may not have gone the way they wanted them to, they would do that multiple times every month. With that, they would bring in mannequins or actors [for] a handoff from EMS to air care, bring him all the way to the trauma center. The whole entire team responded to it and practiced. So those simulations, the full-scale exercise, the plans that we did, all that helped.

In every interview, the importance of regional partnerships, coalitions, and interpersonal relationships was a resounding theme in all aspects of the emergency management cycle. This was especially true for community hospitals in maintaining institutional preparedness. Several interviewees expressed their region's priorities integrating community hospitals in their exercises.

Every region's a little different in terms of how hands-on they are, and our metro region is probably the strongest. There's 32 hospitals with different resources and I think they do a pretty good job of ensuring that all facilities are feeling prepared. When we do these surge exercises that are required from the coalitions every year, it'd be easy to focus on large level-I trauma centers, but they actually integrate the exercise at all facilities, which is really important.

All but one interviewee mentioned mass shooting or MCI preparedness being a regional priority, and several cited a specific exercise or regional resource as critical to preparedness when the actual event happened.

You're involved in multiple committees at the hospital level, but also at the regional level. You're always tapping into those resources and expertise that are available to you. All our meetings that we have in the region, you get to know these people and you work very closely with them.

Despite the inherent difficulty with planning and creating realistic simulations, the majority of interviewees remarked that they had engaged in or planned an MCI drill within a year before the actual event, remarking on the good fortune and importance of the particular exercise. One ED had conducted an MCI drill the week before it experienced a shooting event. Another had participated in a regional exercise with several other hospitals in the region three months prior to the event. They noted:

It was a full-scale community exercise, and the scenario that year was an active shooter incident in a public middle school. With that, we had two waves of patients that were brought into the hospitals. If you move forward about three months, we had the real incident occur, and we had staff in the same place for both the exercise and the real incident. They filled the same kind of role they did during that full-scale community exercise. I had doctors, administrators, and others tell me that the efforts that we took helped save lives. That was very humbling, and it really proves the worth and benefit of these exercises.

Individuals noted not only variation in involved organizations and partnerships but also the specific scenario and the type of drill were important to make them realistic and useful. “We've done everything from multiple tabletop drills associated with these to actual movement of patients...We even run a hazard materials response team course four times a year.”

Interviews also highlighted the presence of unique geographic partnerships in addition to local institution-specific approaches. Hospitals partnered with nearby military bases, paramedic training academies, universities, regional airports, and local police and fire departments to engage whole-community responses. While all interviewees mentioned their regional healthcare coalitions, two interviewees also mentioned that partnering with other regions resulted from a consolidated healthcare system emergency management approach.

The state had done a statewide shooter exercise in October of the year before. They ran it simultaneously at multiple hospitals to be able to exercise the higher levels of command and control. We had found that to be very beneficial. And this exercise ran late at night so that you could effectively implement this in other parts of the hospital. The CEO also gave us permission to call people back, so we actually did a recall. The whole admin[istrative] suite came in, they set up the emergency operations center for real, and we brought people into the various parts of the hospital.

B. Event: Mass Shooting Incident



Figure 7: Event in the Emergency Management Cycle

This section explores the mass shooting events that happened and how certain characteristics of these events contributed to hospitals’ needs during response. This includes factors such as time of the event, what was occurring on scene and how hospitals were notified, and the clinical needs of patients. The context of the event also describes how the location and characteristics of the hospital affected response and recovery. An overview of event context results is in Box 2.

Box 2: Overview of Event Context Results

- Hospitals interviewed were very close to the mass shooting incident (average: 2.27 miles; range: 3 blocks–4 miles).
- In three events, patients arrived by ambulance only. In two events, hospitals received notice of the event 5–10 minutes prior to patient arrival. One hospital did not disclose time of patient arrival.
- In four events, patients arrived by multiple modalities. In all four events, interviewees reported that hospitals received patients before getting any formal notification of the mass shooting event.
- The response and needs of an event were significantly determined by the context in which the mass shooting occurred, including time, location, population affected, and proximity to other hospitals. Some specific circumstances arose for events that occurred late at night, including low staffing levels, limited supplies, and safety concerns.
- Because level-I trauma centers are the expected destinations of the most complex victims in a mass shooting event, they also get the most resources in training and preparedness. Many interviewees from level-II and -III trauma centers felt that because they were not a level-I trauma center they were less equipped to respond to the event, less informed of the event’s progression, and less accustomed to caring for trauma cases, ultimately putting an immense toll on staff and affecting patient outcomes.

On average, hospitals where interviewees worked were 2.3 miles away from the mass shooting event discussed, with the distance ranging from being three blocks to four miles away (Table 4). Hospitals also ranged from being next door to 90 miles away from the nearest hospital. On average, formal notifications to hospitals were sent 14 minutes after a mass shooting incident occurred, with the most rapid notifications occurring at hospitals that monitored other situational awareness platforms such as regional police radio activity.

Table 4: Characteristics of Mass Shooting Events Experienced by Interviewees

Distance from Event	Events (n=7), n(%)
<1 mile	2 (29%)
1–3 miles	3 (43%)
3–5 miles	2 (29%)
Time Between Event and Notification to Hospital	
5–10 minutes	3 (43%)
10–20 minutes	1 (14%)
20–30 minutes	3 (43%)
Not disclosed	1 (14%)
Time Between Notification and Patient Arrival	
Patients arrived before notification	4 (57%)
5–10 minutes	2 (29%)
Not disclosed	1 (14%)
Patient Characteristics	
Pediatric	3 (43%)
Language considerations (Spanish-speaking)	3 (43%)

Of note, two hospitals discussed receiving informal notification of the event before receiving formal notification, which occurred after receiving their first patient. One institution had a subscription to Breaking News Network, a cross-jurisdictional incident notification system that gathers information by monitoring police, fire, and EMS communications systems. This hospital received notification through this platform eight minutes after the event and approximately 12 minutes before the first patient arrived. In a different event, another hospital received its first notification of a shooting event two

minutes after it occurred by monitoring local police radio. The first patient arrived at the hospital about 12 minutes after this notification.

Four hospitals discussed patients arriving before any notification of or formal knowledge of the mass shooting incident. Of note, hospitals that received patients primarily by ambulance were the institutions that received formal prior notification of the event. Even among events in which patients arrived only by ambulance, interviewees reported having less than 10 minutes to prepare after receiving formal notification. These experiences are consistent with guidance and literature on the epidemiology of MCIs (Basavaraju et al., 2010).

Reported types of transportation included patients walking or running to the ED, driving themselves or finding a ride, or calling rideshares; police transporting victims to hospitals by vehicle; and buses transporting several patients at once. Interviewees often mentioned critical patients being medically evacuated by helicopter straight to trauma centers from the site of the shooting.

1) Time of Event

The response and needs of an event were significantly determined by the context in which the mass shooting occurred, including the time, location, and population affected. Several interviewees' comments focused on the unique timing of the event. Most events occurred in the morning or late at night. Interviewees who experienced events in the evening noted specific circumstances around the time of the event, including low staffing levels, limited supplies, safety concerns, and minimal traffic to get to the hospital.

It was a typical day for us, the ED was relatively slow and about half of the ED beds were full. At 1:30 AM on Sunday, we had a lot of staff start asking, 'Hey, it's really quiet, can I go home?' Somehow, they stayed at work and we are very happy about that. Because at about 2:00 AM the first shots rang out.

2) Security Concerns

The nature of the shooting and resources on scene were major factors in hospital response. Rapid presence of security on the scene of the shooting provided more situational awareness for hospitals. However, unconfirmed security threats, such as a potential second shooter “finishing the job” or reported explosive devices, prolonged the pre-hospital response and information sharing.

The terrorist called 911 from inside while he was shooting. He was making additional threats, saying he had a bomb on him and in his vehicle in the parking lot. He also said that he had hostages. It really escalates the response, and it requires new tactical teams to respond to it.

3) Location of Hospital

One particularly important note was how close all these events were to the interviewees’ hospitals (Table 4). All hospitals were within five miles of their respective shootings, with one event happening just three blocks away from a receiving hospital. Due to the proximity of these events, there was little to no notice for hospitals to prepare for a sudden influx of patients. One interviewee stated, “We had people showing up at our facility before anybody knew what was going on because we were the physically closest facility to the venue.”

This is discussed in further detail in the following section of the results (see Section C: Response), but the point cannot be overstated—regardless of the capabilities of the hospital to handle an MCI, patients arrived at the closest ED they could find in any feasible mode of transportation, within minutes of event onset (Table 5). It is well-known that in emergencies those who are worried seek care at the closest ED, so the nearest healthcare sites often receive a large number of patients during an MCI (Bullock et al., 2018).

Because of our proximity to the shooting, we actually received them by multiple modalities, the least of which was [ambulance]. We received patients that were carried down the sidewalk to us. We received patients that ran to us. We also had a police pickup truck that loaded people on the bed of the truck and brought to us. Police cruisers brought us patients.

Table 5: Patient Arrival Characteristics

Event	Rate of Patient Arrival	Type of Arrival
1	36 patients in 36 minutes (total 38 in 67 minutes)	Multiple modalities (least ambulance)
2	Not disclosed	Self-transport, ambulance
3	Immediate	Ambulance
4	Sudden onset	Ambulance
5	Not disclosed	Ambulance
6	17 patients in 45 minutes (18 in 1 hour)	Self-transport, ambulance
7	4 waves of patients; 105 patients within 3 hours	Multiple modalities, most self-transport, 11 by ambulance

Participants unanimously described their locations as close to the event, with one respondent mentioning that, despite not being a level-I trauma center, their hospital is “off a major road” and “since we are a trauma center in the region, we get quite a bit of trauma that comes in here every day.” This is particularly true for critical access hospitals in rural areas that are more than an hour drive from the nearest healthcare facilities. The location in relation to other hospitals also was a major emphasis to contextualize response to the event. One respondent described the condition of their ED the day of the mass shooting incident.

That day we were already 16 deep. I've only got five nurses on and one physician. We had a patient who we had just finished intubating in one of the rooms, and a minor who had come in for suicide in another room with a one-on-one. We had another patient who was a diagnosed, dissected aortic aneurysm. We're 90 miles from definitive care. No amount of blood can be stopped in a rural facility that is going to save this.

Despite limited resources and the rural location, interviewees noted that the needs at these community hospitals were not diminished.

I mean, small hospital, middle of nowhere, you have to resort to what you have. But also looking at the specialty of emergency care, it takes a very highly trained individual and a special type of personality to do this kind of work.

Another interviewee mentioned the fortune of having their hospital close to where many clinicians live, and the number of specialists who self-deployed to respond to the event.

We happen to have a lot of physicians that live in our greater patient service area, so we had a lot of physicians show up: pulmonary critical care, anesthesia, cardiology, trauma. We activated the trauma notification, and then the trauma surgeons started doing their communication to get more hands here for evaluation. Eventually we had four trauma surgeons there, which is unusual. So that means they were pulled from other facilities.

Another factor in ability to respond was whether the hospital was integrated with or part of a larger healthcare system. Individuals described responding at the local level on behalf of their health system, or ways in which their respective enterprise supported response to the event. For instance, one system was able to conduct internal transfers of patients between member hospitals and had a trauma team floating between hospitals in the region to care for patients.

We had three hospitals [in our system] that received the patients. We had a trauma team move between hospitals, we had operating rooms on standby at several hospitals. We farmed out patients based on the type of injuries they had to be able to get taken care of by specialists where they would get the best care. By and large, we have resources that we have plans in place to move around.

4) Size and Type of Hospital

The final, and perhaps most significant, factor for context was the self-described type of hospital and the perceived resources, including trauma-focused resources, disaster- and event-focused communication systems with first responders, and human resources (e.g., number of clinicians to provide care for such an event).

American Association of Medical Colleges-affiliated teaching hospitals account for only 5% of all hospitals. However, they provide most regional standby specialized care, such as the services offered by a level-I trauma center. Interviewees distinguished between community hospitals and academic medical centers in terms of capability to respond to mass shooting incidents. Academic medical centers, which

are typically level-I trauma centers, are often characterized as resource-rich, capable of handling a large number of very critical patients. The abilities and characterizations of community hospitals vary.

One individual remarked that because trauma centers are the expected destinations of the most complex victims, they also get the most resources in training and preparedness. “When there’s so many hospitals, it’s hard to include everyone. I get why the trauma center didn’t share that information with community hospitals. You can’t have everybody.” Trauma centers were also cited as receiving the most situational awareness when an event occurs, regardless of where patients seek care.

The thing that would've been nice, which the trauma centers have but community hospitals don't have, are radios with our police department. They just knew before we did that the shooter had gone in and they knew before we did that the shooter was down. It took us a little longer to get the information. It just would've been nice to been in that communication loop.

Others expressed difficulties with responding to the shooting because of their limited capabilities and resources as a community hospital. One interviewee explained:

We had one physician on that morning, which is pretty typical. It's not a high-volume emergency room, it's a high-acuity emergency room from a medical standpoint because it sees a pretty high percentage of patients with a lot of chronic comorbidities. But it's not a trauma hospital. That means there are not a lot of resources.

Because their hospitals were not frequently exposed to trauma cases, taking care of critical patients after a large mass shooting was not only beyond what their providers were trained to do but also put an immense toll on staff for an event that they never imagined responding to.

One of the difficulties with the shooting was because we're a community hospital and we don't do trauma. I had a lot of young staff that had never seen a traumatic injury. We probably lost probably a third of our staff over the course of the next year.

C. Response

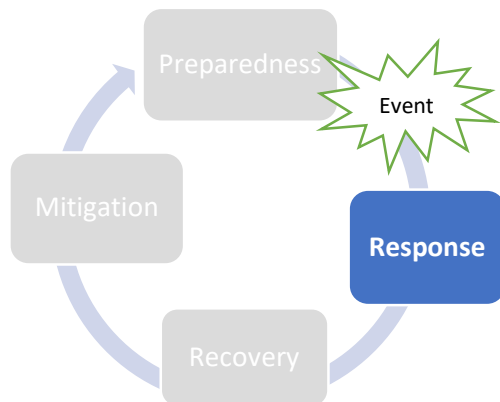


Figure 8: Response in the Emergency Management Cycle

Response was by far the most discussed topic during interviews. Participants recalled what happened in response to the event in great detail, recounting successes, difficulties, how they felt during the event, and lessons learned. Operational details and considerations during the event are important to consider in other aspects of the framework (e.g., preparedness), so this section explores select topics in detail. An overview of response results is in Box 3.

Box 3: Overview of Response Results

Situational Awareness and Knowledge of Internal Resources:

- Hospitals expressed difficulty in obtaining actionable situational awareness of what was occurring. Simply knowing there was a mass shooting event was not enough to prepare hospitals to accept patients. Interviewees expressed the need to know the number of potential victims arriving to their hospital, the location of the shooting and whether it was an enclosed space, the age group affected, and the type of weapon used.
- Upon actionable information, the immediate first steps for most hospitals were to create space to receive patients within the ED, notify the operating room to stop all new cases, and garner as many supplies as possible from across the entire hospital.
- Interviewees discussed the importance of relationships and staff expertise and knowledge to quickly act, adapt, and respond to the needs of the event during the first critical moments before patients arrived.

Patient Arrival and Presentation:

- Sudden and rapid arrival of multiple patients was a common theme throughout all interviews. Hospitals that handled a larger volume of patients also mentioned the difficulty in handling multiple waves of patients, depending on the type of transportation victims used to arrive at the hospitals

Box 3 (Continued): Overview of Response Results

Triage and Types of Patient Injuries:

- Despite being trained in a specific triage method as a best practice, interviewees reported not using these methods during these chaotic and rapidly evolving events. What was cited as a critical operation was creating a triage area, assigning an experienced clinician to triage at entry, and watching patients carefully and continuing to triage as their conditions changed.

Clinical Needs–Trauma:

Because of the time-sensitive need of highly specialized trauma surgeons in these events, healthcare systems used trauma teams to service multiple hospitals and allocate patients based on hospital resources.

Use of Physical Space:

- Individuals expressed needing to quickly adapt their physical space to handle a sudden influx of patients, as well as the need to be dynamic in accessing various physical locations based on needs of the event. It was important to have a larger open space that was properly resourced to allow senior clinicians to provide guidance. In addition, coordination and communication as they used these spaces were critical. Mass shooting incidents that had a large number of patients were forced to constantly adapt the space needed to the shifting numbers and types of patients that presented in several waves.

Leadership and Staff, and Adaptability of Staff:

- Individuals described creating teams that were assigned to each room and signing in and accounting for all staff. Patients were moved through this system based on need, with staff staying in place.
- Interviewees described the importance of both physician and allied staff services in responding to mass shooting incidents, particularly in creating robust teams assigned to pre-identified spaces
- Interviewees described the large number of staff that showed up to assist, whether they were formally requested or not. Many individuals described a large number of unanticipated staff presenting to the hospital to assist.
- All hospitals felt comfortable with the staff they had to handle the event, but many discussed creating better methods to manage staff, particularly accounting for operational periods in a prolonged event. Interviewees also expressed the importance of expectation setting of roles and immediate needs.

Supplies and Other Critical Considerations:

- Several hospitals that do not typically treat pediatric patients had children present to the hospital during these mass shooting incidents. Interviewees emphasized that the availability of pediatric-specific equipment was limited and many needed to adapt adult trauma supplies for a pediatric population.
- Interviewees described running out of many supplies, including surgical supplies, chest tubes, IV tubing, dressings, saline, monitor cables, and triage tags. Many hospitals had agreements or relationships in place with nearby hospitals and sent runners to garner more supplies. Other interviewees described that the relationships they had with other hospitals enabled them to request supplies and staff ad hoc.

Box 3 (Continued): Overview of Response Results

- The location in which trauma supplies were stored was a particular concern due to lack of immediate availability, and interviewees described the benefit of developing carts for rapid deployment during mass casualty incidents.
- Interviewees described the importance of having department-specific MCI plans across the institution. Clear and robust blood bank and emergency radiology protocols were critical in effective response.

Maintaining Normal Operations:

- It was critical to maintain operations and stay open to provide ongoing patient care while responding to the event. While many resources were suddenly diverted to the mass shooting, individuals did not stop coming into the ED for care and the needs of existing patients did not diminish, particularly for hospitals in rural areas. This emphasized the need of leadership to fully understand and plan for the long-term effects of MCIs on an entire hospital. While many are focused on immediate clinical needs and clinical providers are supporting victim care, there is the concern of using too many staff at the onset of an incident and not being able to provide quality care to patients after the first operational period of the event.

Security Needs:

- A rapid response involving increasing security staff, securing the perimeter, and communicating with staff and patients about the emergency and what actions have been taken to ensure their safety is critical during mass shooting incidents.

Managing Internal and External Communications:

- While hospitals had developed plans to manage media and conduct press briefings, interviewees described being surprised by both the number of reporters who arrived at the hospital and how quickly they arrived. Interviewees mentioned how difficult it was to coordinate and maintain consistent messaging between hospitals and the region alongside how rapidly they were urged to communicate with the press.

Family Reunification and Support:

- Providing necessary support for the family of victims was consistently one of the most difficult aspects of MCI response. Creating and maintaining adequate reunification operations was cited as a major area of improvement across interviews. While considerations vary based on the event, a space, resources, and a phone bank need to be provided for family and friends searching for loved ones at hospitals to provide support as well as to maintain security and crowd control and not impact clinical care.
- While hospitals should have plans to transition from a local family reunification center to a regional family assistance center as soon as it is established, early development of a regional center should not be a planning assumption. Many interviewees described the enormous toll of managing the needs of family and loved ones with little support from the region.
- Several interviewees described frustration with the lack of an agile or coordinated response in family reunification from their governments during these events, ultimately requiring hospitals to support family members with resources that were not anticipated or equipped to handle. This caused immense strain on hospitals by diverting resources from ensuring patient care and safety. Hospitals also incurred significant costs that were not reimbursed.

1) ***Situational Awareness and Knowledge of Internal Resources***

Interviewees expressed difficulty obtaining actionable situational awareness of what was occurring through formal methods, such as regional notifications. Many interviewees mentioned that situational awareness was obtained through various channels outside of protocols and standards. This situational awareness aligned with context-specific internal resources, resulting in interviewees describing target actions that occurred. One interviewee noted the perception of positively affecting lives. Another interviewee was in a unique scenario in which the hospital had its own emergency medical services on site and was able to get real-time information from the scene. They were able to coordinate with these providers to ensure that the most critical patients were transferred first and taken immediately to operating rooms.

You're taking care of people that need to go to the operating room, but your operating room [is] full and now you get the sickest patients. Since we controlled the scene with EMS, once we moved the green patients [walking wounded] out of the way, we could also make sure that our sickest patients got in as fast [as possible]. It saved lives by the fact that we became that casualty collection place and we were able to take the patients we could.

All interviewees discussed the importance of relationships in quickly bringing in providers or making space for a sudden influx of patients.

She didn't wait for it to come from the incident command system...she went right back and she didn't hesitate [to clear her operating rooms]. When the respiratory manager said, what do you need? I need you to call every Respiratory Therapist you have in right now. She had an RT who was 80 miles away [and offered additional help]. Everyone knew that this wasn't something to sit around and wait for direction on.

Interviewees also expressed the ability of staff to meet the needs of the moment based on training, knowledge, clear internal communication, and adaptability.

This is the kind of relationship that in this region has been developed. We work closely, we're from this area, we are vested in what we do, that we genuinely care about our emergency system, and we work toward improving it. And I think on that day, every relationship showed...because everyone went into action.

One individual expressed the importance of proactively acting despite limited information from the scene of the incident.

But what we also had made as part of our plan was that if the MCI wasn't declared at the scene, we would declare it ourselves internally. I always say it's like a cruise ship trying to not hit the iceberg. You're full, you're busy, you can't turn that ship quickly. So how do we get as much advanced notice as we can and then also inform people if we need to, to know that there's something going on?

2) Patient Arrival and Presentation

As mentioned in many MCI guidance staples, there are tremendous concerns around rapid arrival of patients who have significant clinical needs. Described as rapid and chaotic, one interviewee commented, “They just came so fast, we ran out of triage tags.” Several interviewees described the rate of patients arriving as one patient per minute for at least half an hour. In five events, patients arrived through their own methods of transportation prior to the hospital being notified of the event (Table 5).

We received 38 patients during the first wave in 67 minutes. We actually received 36 patients in 36 minutes. One patient per minute, 36 minutes straight. And most of those were, you know, red trauma alert patients...We did not have time to prepare for this. We began to receive the second wave of patients [about] one hour later.

Another common theme of mass shooting incidents with large numbers of victims was that they arrived in waves, depending on the type of transportation used by the victims. One interviewee described the hospital’s experience handling 105 patients in four waves, with only 11 arriving by ambulance:

Almost everybody came by private vehicles and public transportation with no forewarning at all. The first wave of patients were the ones that could get out the fastest and get down to us as quickly as they came. They were the least injured, but we had no information and are a non-trauma facility, so those bloody patients were frightening. We got them in beds right away and probably within another 30 minutes, a second wave of patients far more critically injured came. We had issue of where are we going put these people? Because now we've got people that can't walk that have been wounded severely.

The individual expressed the difficulty finding physical space for all patients and making sure that resources were diverted to the most critical patients who arrived later. They described another wave of patients arriving 30 minutes later that consisted of less critical patients who had transported other patients in their vehicles. Finally, she described the last wave of patients:

The fourth wave was the most surprising wave of all, came when we thought it was all over. Two hours after the event started, we had a public transportation bus drop off 27 patients. They'd been huddled in the bus all this time waiting until it was safe to leave. It was overwhelming when those guys came walking in.

3) Triage and Types of Patient Injuries

Triage is a system that enables clinical providers to divide emergency victims into categories based on their injuries. This is particularly important when there is a need for emergent treatment and in an MCI, where by definition there are not enough resources immediately available to address the needs of the event. There are various triage models, the most well-known of which are Simple Triage And Rapid Treatment (START); Sort, Assess, Lifesaving Interventions and Treatment/Transport (SALT); and Rapid Assessment of Mentation and Pulse (RAMP).

A significant finding from this study was that, despite being trained in a specific triage method as a best practice, interviewees reported not using these methods during their mass shooting events. One clinician explained, "So we didn't really use any sort of trained triage. We just moved along, did the best we could using almost common sense." Another individual described:

The more critical patients that came in, triage as we like to practice it and teach it basically went out the window. It was more medical decision-making from a[n assigned] triage nurse and physician... We didn't do the official green, yellow, red kind of thing. Triage went on constantly.

Interviewees explained that complicated systems such as standard triage were difficult to put in place in a chaotic, rapidly evolving scenario with minimal situational awareness. However, setting up a

triage area and assigning an experienced clinician in the role of triage at entry was critical, as was having staff assigned to watch patients carefully and continue to triage as their conditions changed. One individual described their process in their initial role in triage:

We just don't have [experience with] that many large-scale traumas. So having designated spots for each of the responders was important. The charge nurse stands here, the recorder stands here. They said that's made a huge difference for them, especially when you have more than [one patient] going in at once. They didn't have enough staff; they were just kind of all over each other.

4) Clinical Needs—Trauma

The presence of skilled and experienced trauma experts is especially important in mass shooting incidents with high-powered weapons. Upon seeing the first victim and receiving notification of the event, one interviewee described, “At that point we knew we were having multiple patients with gunshot wounds to the abdomen. This is a big operating room mass casualty.” Another interviewee described the event:

As patients started coming in, I met them at the door and triaged them, just in case somebody was not a priority patient who arrived early. But I remember the very first patient who arrived had a gunshot wound to the upper arm that was limb threatening. I remember looking at that wound and thinking, this is a high-powered weapon. Seeing enough trauma, this is not standard, this is a high-powered weapon and we're going to see bad wounds.

The interviewee explained differentiation between types of MCIs and assessing clinical needs based on information from the scene, such as multiple fatalities and the enclosed location of the shooting, meaning that there is high likelihood of high-caliber weapons and a high preponderance of general surgery cases. This information was important to discern the severity of traumatic injuries, whether blunt or penetrating, as well as the resources necessary to manage these clinical conditions.

You've got medical mass casualties, like if everybody's exposed to a gas, that won't be surgical. Then surgical mass casualties, like collisions and explosions, are heavy in orthopedics or neurosurgery. Those patients are heavily dependent upon imaging before things happen, getting

CT scans of the head, abdomen, and X-rays of lots of extremities. Relatively speaking, from the time that patient arrives until the time they go to the operating room, there's a bigger time interval [for those] than these penetrating injuries, these gunshot wounds. For a gunshot wound to the abdomen, there's no other intervening steps other than getting them stabilized if you can. You're not doing imaging studies or things that take a lot of time. It's heavily weighted towards a general surgeon operating on them.

In the process of preparing their hospitals to receive patients, all interviewees mentioned alerting their trauma teams and making space in their operating rooms for potential surgeries. One individual recounted:

What they did do is make an overhead announcement on the PA system initially that all trauma clinicians respond to the trauma center immediately. And after that there was another call for anyone available to come to the ED to support. So those two efforts did matter and they did help.

Because of the time-sensitive need for highly specialized trauma surgeons in these events, healthcare systems used trauma teams to service multiple hospitals and allocate patients based on hospital resources. Another hospital worked with other trauma providers across the region to ensure continuity of care.

I called my partner in, thinking if their hospital will be one of my backup centers, I don't want to take a surgeon away from a place that's going to be getting other casualties. What I decided was that we would use our mass casualty plan to bring in other surgeons to backfill him. I had more high-priority patients [at my hospital]. By that time, I knew where these injuries were and they were much closer to us. We also had a couple military surgeons who had been practicing with us doing some shifts every now and then. There [ended up being] five surgeons who could operate in the chest and abdomen.

5) Use of Physical Space

Before arrival of patients, hospitals need to make space in their EDs, operating rooms, and inpatient and ICU beds, as well as expand non-traditional spaces in response, such as adapting ambulance bays to triage patients. Within the ED, staff need to ensure that they have the appropriately resourced beds and rooms to receive patients. Individuals described quickly creating spaces specific to

victims of the mass shooting incident, adapting and reorganizing their physical space immediately to handle a rapid influx of patients with matched teams of clinical staff. One interviewee described readjusting patient locations at the onset of the event, then setting up 10 resuscitation stations in the ED. Another hospital also adapted, with the interviewee stating, “We have two trauma rooms in our ED, but we decided to do trauma in any room.” Another interviewee explained:

Luckily we did have space, but we mostly cared for the patients in the trauma bay because that's where all of our resources are. As they came into the trauma bay, we would assess them; if they were pulseless, they would be moved back to the ambulance bay, which was kind of our makeshift morgue at the time. If they needed to go to the operating room, we would intubate and send them up to the operating room if they were stable.

Several interviewees expressed that they were lucky to have space available to either receive patients or move existing patients. In the same vein, they expressed concern about the current state of their hospital bed capacity, as they have experienced ED overcrowding and are “operating at 100% bed capacity everyday”. Despite these constraints, staff were able to find some adaptable spaces to treat patients. An interviewee explained using their hospital’s expansion plans to create space for patients who were not critically injured:

Our mass casualty plan is to expand into our day surgery rooms because they're set up like an ED exam room and you have the ability to treat patients there as well. We did expand into that location. Greens that were being treated there went with a team of physicians, nursing staff, runners, radiology, and support services to try to reunite the patients with their family members.

Another interviewee expressed how normal trauma spaces have deficiencies in the event of a mass casualty:

We have our go-to resuscitation bay that can only hold two patients and there's another smaller room that holds five patients, but it's separate from the two-patient room. In the future when we get these, we're doing it in a much bigger, more open area of the emergency room where you can have six or seven patients side-by-side. Because that facilitates your senior surgeon being able to have eyes on multiple patients and give guidance to multiple people.

Another consistent theme with mass shooting incidents that had many patients was that they were forced to adapt the space needed to the shifting numbers and types of patients that presented in several waves.

There were several patients that had made it into the waiting room, and we just started to get more. So I immediately huddled everybody that was there and assigned people to rooms and moved any patients that were there for medical evaluation into a separate area. We made sure they were all stable and then we moved them down the hall to interventional radiology and commandeered that space. We [eventually] turned the entire emergency room into a receiving trauma bay. We had 22 rooms that were available and we'd only be seeing traumas there. Then we sent some of our [physician assistants and nurse practitioners] that were there down the hall with the medical patients to finish up some of those.

Those who received an overwhelming number of patients expressed limitations of adapting hospital space.

It worked well in the beginning. We removed a lot of the first-wave patients out of the beds into chairs in the ED or back out to the waiting room. But, after a while, there was no place else to go.

Another individual described the need for coordination and communication when activating these surge spaces for care. During the mass shooting response at her hospital, receiving areas were not clear to EMS due to miscommunication related to hospital construction.

Initially we had two emergency room nurses at the front lobby area entrance. Then we quickly learned, our first ambulance showed up to the very front of the hospital [with] a red and a black, the black was not offloaded. Their EMS person was a driver who wasn't from here. Of course [it was] chaos on scene, everyone's jumping into an ambulance and going. So they had pulled up to the front of the hospital, they offloaded the reds to quickly get them in and get them treated, but we had a lot of community members looking for people at the front of the hospital.

Finally, interviewees described ways in which they collaborated across multiple departments, including the operating room, internal medicine, and ICUs, to support patient care.

The operating room charge nurse made herself a roamer. She knew the kind of cases and that helped for her to say, this is what I got here, this one's going to probably need this as patients

are rolling in. And that really was something that we think is a best practice for us and we really like that.

6) Leadership and Staff

Since community hospitals are rarely equipped with the necessary staff to provide emergency care to a large number of mass shooting victims, hospitals have various methods to call in support in a moment's notice and utilize the skills and leadership of emergency medicine clinicians to guide and manage dynamic teams in patient care. A particularly interesting finding from interviews was that there were no staffing shortages during response, regardless of hospitals being concerned about not having enough staff working during the time of the event. One interviewee remarked about the speed of information sharing during this event, "We had a lot of people, people wasn't our problem. Everybody knew and everybody came. It's impressive the speed of information in social media." The perception of staff showing up and the interviewee not knowing how they were notified to come in was consistent across many interviews.

I made my way to the hospital and was there within about 15 minutes of when the shooting happened. By then there were three or four physicians who were there. One of our trauma surgeons happened to be in house. We had so many physicians that live in this community that all just came to the hospital. People started showing up.

Many interviewees also expressed confidence with their hospital being able to notify many staff rapidly in an MCI:

But when they call and say we're on the scene of a large-scale event with two dozen people who have been injured in a mass shooting, the person on the other end knows I've got buttons to push to notify all of the system and healthcare providers and support staff.

Although staff with general clinical knowledge were abundant, in theory there could be concern about having the appropriate specialists and experts involved in response. In the events experienced by interviewees, this was not the case. One interviewee mentioned, "Eventually we had four trauma

surgeons there, which is unusual. That means they were pulled from other facilities.” One interviewee mentioned using pre-existing collaborative channels to request assistance from specialists across the region:

We had six emergency medicine physicians show up when we sent out messaging through some secured channels that we have. We happen to use WhatsApp for some of these internal channels. They're good, they're closed and secure, and we've been using a lot of these and for a while now, so it was a good way to just burst out some information.

Once staff arrived, EDs rapidly created roles, teams, and structures to organize and manage staff appropriately. This frequently happened alongside creating physical space to receive patients. It was important to have specialists who were most familiar with the ED serve as advisors and leaders to those supporting clinical care.

I needed as many emergency nurses as I could get in here because you have to have that person who is comfortable in the setting who can take that leadership role and guide the rest of the team that's caring for an assigned patient. We had physicians in primary care practices that also have privileges here at the hospital come right over to the hospital and said, what do you need me to do? It was amazing how it worked because even though we had those physicians assigned, our ED physician always was the final say and went room to room, checking on what had been done.

Many interviewees assumed the role of managing and organizing clinical staff. One individual described their initial role as, “I took over in the emergency room and assigned different physicians to different rooms. We assigned staff to different rooms and made sure everybody was signed in.” Similarly, in another scenario, an interviewee assigned staff to separate rooms and served in a supervisory and guidance capacity:

The way I was always trained is that the most experienced clinician should be not directly engaged with patients. I tried to keep myself separate from direct care and simply managed the other teams who are taking care of people. I coached the emergency room folks to put people on a board so that we know who was where, which surgeon was assigned, and where they were going. I walked from bed to bed to help people think about their care of that particular patient.

One interviewee described how their hospital used a team to continuously triage the waiting area to concurrently assess less critical patients and address the potential for decompensation.

We also sent an emergency room physician, a hospitalist, and a nurse out to the waiting room to [pull] people into triage rooms and assess them as fast as they could so that we could identify if there were anybody who was gravely ill that needed to get out of the waiting room.

Another individual described the ways in which staff were divided into teams to ensure continuity past the ED to operating rooms for specialized care.

We freed up eight operating rooms and were able to develop a team that could take each patient as they came in the door. We thought we were going to get 8–10 and then they just kept coming, we cleared out bays to put patients in. We had operating room staff coming in and we had four trauma surgeons. We had a neurosurgeon, orthopedic surgeons, we had pretty much whatever we needed. The pediatric chief was down there. So we ended up developing teams as the patients came through.

Another individual described recognizing the ongoing nature of the event and their methods for establishing operational periods and coverage.

We came up with a sleep cycle. I called some off-duty folks who were at home and wouldn't be working. I was like, can you come in tomorrow and be an extra person? The hospital nurses started to be prepared to not tell their nurses to come in immediately. We don't need them now. I need them to be rested because this is going to go on.

7) Adaptability of Staff

While there were no reported issues in availability of clinical staff, most interviewees described the adaptability of available staff to handle a surge in patients and the need for these individuals to use their expertise in a new context. Interviewees also spoke to staff exhibiting leadership and management in uncertain, uncontrolled and dynamic settings in the physical space for which their roles are culturally identified.

We pulled people down from the floors and the ICU and pulled them into jobs and roles that they didn't normally occupy. Everyone has been through our annual required education and we gave

them a just in time [training] and would put them with patients that we didn't think were critical. The more seasoned ED staff were with the sickest patients.

In one hospital, hospitalists were able to help decompress the ED and address care for patients who were already in the ED before the event occurred. In another hospital, an interviewee described the all-hands approach of departments, with pharmacists as an example.

Pharmacy decided to pre-position pharmacists to places they have never been, like the operating room, helping make sure that everybody's getting the drugs that they need.

Other interviewees described the assistance they received from individuals who were not hospital employees. In one event, a pediatric surgeon from a neighboring hospital was also certified in adult trauma and, due to his proximity, could assist on surgeries. In another scenario, a close relationship with a vendor was crucial when a hospital needed supplies.

An equipment rep filled his trunk with stuff and came so that we would have extra wound care equipment. Our supply guy knew what to do. He's moving supplies around and prepping stuff and getting stuff out of the warehouse.

Despite the abundance of dedicated and skilled staff, several hospitals encountered opportunities to improve future staff management. The importance of developing a staff tracking mechanism was emphasized to both ensure continuity of care and reduce redundancy. One individual mentioned problems with physical access in the hospital, especially for staff who were working in spaces they had not worked in the past.

NICU nurses couldn't even get into the ICU. One of the things that we had to fix [was that] all our doors have badge access and if your badge isn't coded to get in, you don't get in. Now we have a mass casualty and everybody's trying to get to places they don't normally go.

A persistent theme through these interviews was that hospital and department leadership tried to plan for long-term staffing needs as individuals were eager to respond immediately to the emergent event. This came into conflict as staff self-deployed or tried to assist with the immediate response.

We were in battle mode, whatever came in had immediate help. One good thing about not having a mass notification system is a lot of people saying, why didn't you call me? I want to come in to help. Our message to everybody was, we don't need your help now because we've got it, we need your help for the ensuing days because this is going to last.

One individual described frustration from staff as they were told to hold off on coming in and assisting with the event.

A lot of people showed up and came to help and just jumped right in, but we didn't have them sign in and sign out. Those that texted me, do you want me to come in? I was like, no, I don't want you to come in because I don't know how long this is going to last. The anger that those people experienced by not getting to come and be part of the glory team was understandable, but we're a 24-hour business. Not everybody gets to be on TV.

8) Supplies

All interviewees described either the anticipation of running out of supplies or actually running out of supplies during response to the event. Hospitals that needed to care for pediatric victims described the need to adapt supplies for this specific population. Smaller hospitals in particular experienced shortages in basic clinical supplies such as IV tubing, dressings, and saline. Other hospitals described running out of equipment specific for emergency or trauma care, including surgical supplies, chest tubes, and even triage tags. When this was recognized, response leads such as the interviewees identified individuals who were willing to help serve as runners to retrieve additional supplies from other departments or other hospitals.

We don't have a warehouse; we don't have any extra storage. We ran out of some major things. We ran out of saline, we ran out of IV tubing, we ran out of dressings. We have a long-term acute care hospital across the street from us. I just called up their CEO telling them, I need a case of saline. She brought the saline over and brought tubing to go with it over to us. I called my assistant chief nursing officer who was at our sister facility, and I asked her to go up to my office there and to grab some stuff and to go to their warehouse and get us some dressings.

In two events, interviewees noted that hospital executives served as runners to get necessary supplies as examples of the cooperation of these leaders. One individual remarked on how much trust

and confidence their leadership had in emergency management that they offered to take on a supporting role of equipment and supply runner.

We did find that we needed extra monitor cables, chest tubes, and general surgical supplies. Our president and CEO actually ran across the street to [another] hospital and pulled some of these supplies himself and ran them back to the ED.

This was also mentioned as an area in which careful planning is crucial. Many hospitals had agreements or relationships in place with nearby hospitals and sent runners to garner more supplies. This proved crucial in this emergency as well as in past emergencies that have affected their regions.

The one thing that we have through our Hospital Association is the master mutual aid agreement. In a time of crisis, you can borrow from the next facility regardless of if they're a competitor or part of your system or not and pay for them or return them after the emergency. It eliminates paperwork. We instituted that to help support each other because it wasn't just our hospital that was overwhelmed, the trauma center down the street was too.

Lack of specialized supplies was a particularly salient concern for non-pediatric hospitals that had to handle a mass shooting incident with pediatric victims. These interviewees described trying to find pediatric equipment across the hospital and needing to nimbly and expertly adapt adult supplies for pediatric victims when necessary.

We had every pediatric cart from every unit throughout the hospital. We raided central supply, we had every tourniquet, every pressure bag, every IV. You name it, we got everything downstairs closest to the ER and had it ready to go.

Finally, two interviewees mentioned difficulty accessing trauma supplies for a large number of patients. Both interviewees mentioned the importance of modular supply design to address the risk of running out of critical supplies. This included creating robust mass casualty carts, inclusive of supplies for special populations, and having them easily accessible within the ED floor as a critical lesson learned.

All the trauma supplies that we needed were focused on just one or two rooms. When you're running that many trauma patients, trying to get supplies was not easy. And things have changed over the last decade where there aren't as many supplies in the room, that's a Joint

Commission issue...if you need advanced airway stuff, there's only so many rooms that you can store that nearby. We have a bunch of mass casualty carts already stored in a cage downstairs and pulled those up. But now we're going to store a couple of those upstairs so that you could pull those into a couple of rooms while the other ones are being brought up.

9) Other Critical Considerations

While the immediate clinical needs of a mass shooting incident focus on trauma and the ED, individuals cited how critical it is for everyone in the hospital to be prepared, and for each department to be invested in their own MCI planning. The most-referenced department-specific responses included admitting, blood bank, radiology, pathology, and pharmacy (see *Appendix F*).

10) Maintaining Normal Operations

Interviewees also discussed how difficult it was to respond to these events while continuing to provide ongoing patient care. While many resources were suddenly diverted to the mass shooting, other patients did not stop coming to the ED for care, and existing patients still needed care. One individual described the scenario at their hospital during the first 24 hours of responding to the mass shooting incident.

Our surgeons performed 13 surgeries on Sunday, not related to the event. A lot of people think you can just close when this stuff happens. We had to remain open. At about 9:35 that morning, we received our first trauma patient after the shooting; it was for a vehicle crash.

As several interviewees worked at facilities that were the only hospitals in their area providing emergency care, they emphasized that regardless of the severity of a disaster it is crucial to stay open to the public and provide care.

We were making sure we weren't missing anything because you're still going to have your other emergencies. You're not just going to have to deal with this one event. You still have to deal with anything else that walks through your doors. You can't afford to have a lapse in services of any kind.

This emphasized hospital leadership's need to fully understand and plan for the long-term effects of MCIs on an entire hospital. While many focus on immediate clinical needs and clinical providers support care of victims, there is the concern of using too many staff at the onset of an incident and not being able to provide quality care to patients after the first operational period of the event. One individual stated, "[People are still going to] show up with appendicitis and everything else, and we're going to need some additional support. We now have to put ourselves on a rotation."

One way that a few hospitals addressed this was by using non-traditional staff in various departments, shifting traditional roles in order to adapt to the needs of the response. Planning for the use of internal medicine during major surge events has been cited as a best practice (Persoff et al., 2018). One interviewee described the way in which he involved hospitalists into the mass shooting response to ensure that nothing was overlooked in any department.

My team, two surgeons and a physician assistant, are all fully engaged with these acute casualties, which means that all of my inpatients are not being taken care of. I had a critically ill patient in the ICU who was not going to get any attention from me at this point. I sent one of the internal medicine doctors up to take care of the ICU patient. The emergency room doctors were also all committed to doing acute resuscitations and evaluations, and the general emergency room was not being seen as it should be. So, we brought the hospitalists down and had them take care of the regular emergency room patients as well as the surgical floors.

11) Security Needs

As soon as the hospital is notified of a mass shooting incident, security is a major concern. If there is verified information about arrival of a large number of patients, the facility should begin planning to decrease the number of entry points into the hospital and increase the number of security personnel on site. This is especially important when responding to an active shooter scenario. Often in these scenarios, the shooter is not apprehended, and it is unclear whether there could be targeted attacks in other areas such as hospitals. One interviewee described:

There was potentially a shooter at large, but no evidence that individual was on our property. But given that it happened within a mile or so of where the hospital was, we wanted to make sure that was not an issue. It also meant that when we discharged patients, we held them in the emergency room even if they were ready to go, until we knew that it was cleared and safe by local police authorities.

Another point of concern during these events is how many people will be traveling to the hospital besides patients needing immediate care. One issue that was discussed was self-deployment of community volunteers during the mass shooting, potentially placing them in harm's way.

The shooter was still at large. We had a lot of people in the community who were calling or showed up to help. We had to turn them away because we didn't want people out and about with an active shooter in the vicinity.

Pre-identifying these individuals and guiding them to spaces and designated areas is critical to keep visitors safe and to not impede clinical care or event response.

We had a lot of community members, people looking for their child or their person. So we had a crowd to deal with up at the front of the hospital, the emergency room lobby, our chapel. Then we had a school bus bringing the majority of our patients pull up to the front of the hospital. We had to quickly restructure there and deploy more resources up at the front, divvy up our triage system and have additional resources up at the front.

A rapid response involving securing the perimeter is critical in these scenarios, as well as communicating with staff and patients about the emergency and what actions have been taken to ensure their safety.

We have really good security that had locked everything down early on and kept press from [getting] in. So that was all handled very quickly and seamlessly. But we found out that everybody inside the building was concerned about their safety. There's a guy out there with a gun and they just didn't know that we were secure.

Hospitals communicated with concerned individuals through a variety of methods. One hospital paged a notification, and then hospital leadership and security teams rounded the entire hospital to

explain what was happening to patients. Another effective and efficient method was an employee mass notification system, instructing staff which employee entrances to use.

We pulled everybody who was outside of the hospital inside into a conference room that was away from the ED. Everyone who came in got screened to make sure that they did not have any weapons. We did that as quickly as possible. We shut down every egress and ingress to the hospital. The employee entrance was still open via badge reader. We sent out some messages through our mass communication system to all of our employees.

Security is seen as providing an actual and perceived safe environment in an uncertain broader environmental area of risk for staff and patients arriving and leaving the hospital area. Crowd control also played a role in these activities, as well as collaboration with local law enforcement. Most hospitals commented on their skilled but limited-resource hospital security professionals. Many security teams augmented staff by working with other departments inside their hospitals, including facilities or engineering teams to maintain a perimeter during lockdown. One individual explained:

We immediately contacted security internally. Now you're in a critical access hospital, so those resources are extremely limited. We needed to make sure that our unit and our entrances were secure because we didn't know how this event could shift. You have to think in terms of safety and preparing to render aid to an unknown amount of people. They were calling upon additional resources from law enforcement who later came to the hospital and helped out with crowd control as well.

Many interviewees discussed the importance of communicating with law enforcement. One individual mentioned creating a police liaison role to ensure that the hospital was working appropriately with police as they entered the facility and did not cause more chaos in clinical areas. Another interviewee explained how law enforcement helped alleviate concerns and provide help to hospital security during the event.

We ended up getting a SWAT team that came in because we were so close to the event. Someone in the waiting room thought that they had heard a gunshot, so there was a concern at one point that there was an active shooter in the hospital. Law enforcement did send over reinforcements for us there.

Ultimately, security is an enormous concern during a mass shooting incident. Robust planning is vital to protect the hospital, coordinate with law enforcement, and keep staff and patients safe.

They were coordinating with the external law enforcement agencies, of which there were many. When we had to have the hospital searched by the bomb squad, they helped lead that. They helped calm down staff who were very nervous and were very good emotional calmers during that incident. The lockdown stayed for about eight hours or so until they were able to complete the search of the facility.

12) Managing Internal and External Communications

While hospitals had developed plans to manage media and conduct press briefings, interviewees described being surprised by both the number of reporters who arrived at the hospital and how quickly they arrived.

The media response was significant, we had CNN first, we had international media. We're incredibly lucky to have a system communications department, [who] sent somebody to respond and they just coordinated things absolutely beautifully. There were over 600 stories over the first month. Luckily they weren't at the hospital, which is really good to be able to keep them separate from any staff who were there or any other patients or visitors.

Interviewees described the importance of a public information officer or communications team, as well as senior leadership being involved in communications. One individual expressed, "The thing I needed from [my leadership] was not to help me, but to go take care of the press and the politics." One interviewee emphasized how important it was for their hospital president to send communications to staff.

Within four hours, we were doing internal communications to our team members. Later that morning our president sent an email to the hospital board, letting them know what happened. A few minutes later, he sent an update to all staff. That's important because anytime we have something big happen here, a senior leader is required to send a message to staff about what happened. For senior leadership, clarity and visibility with staff is very important.

Another individual mentioned how important it was for their communications team to be on site and integrated into the command center, with access to cable TV and the ability to monitor news in

real time. Another described the operations their communications teams needed to work on proactively in this type of event.

We learned in other events that you need to come on site to put up our media staging area. Then we activated phone lines so that our media and our families and our staff can call into that.

Several interviewees remarked on how important social media updates were, and how difficult it was to coordinate messaging between hospitals and the region. Individuals mentioned how quickly hospital leadership wanted to speak to the press, and how difficult it was to maintain consistent messaging with other hospitals, stating the need for a unified media strategy with public information officers from other affected hospitals. Other individuals expressed the need for a joint information center with regional government.

There's been a lot of meetings that we've had on a city level since. They had their own communication going on right outside of the hospital. The city was posting stuff and sending things through their channels and their communication. We're looking at how we can all at least have access to some of the communication just to get a little more info. I've talked with many public officials about communication strategies.

Finally, although media needs occurred rapidly, they were ongoing for several days to months. While many leaders needed to prepare for press briefings within hours of the event, hospitals also needed to plan for ongoing briefings and visits from reporters and government officials.

It turned from news coverage to investigative stories after the first month, which was definitely difficult for staff to see that on the news constantly for the next couple months. We did hold a press conference with the sheriff's department and police department less than four hours later. We were already giving press conferences at that time.

13) Family Reunification and Support

Providing necessary support for victims' families was consistently one of the most difficult aspects of MCI response. Creating and maintaining adequate reunification operations was cited as a

major area of improvement across interviews and was described as an issue that is often overlooked. While considerations vary based on the event, literature citing large MCIs refers to the arrival of loved ones as a “second surge,” with an average of four to six people arriving at hospitals to search for each victim, necessitating planning for crowd control (Greater New York Hospital Association, n.d.). One interviewee described the needs at the beginning of the shooting event:

This was a huge issue for our entire area. Following the event, there was a working group for a family reunification plan that the entire area is now using because it was so bad during this. When I got to the hospital an hour into the event, there were already people outside on the ground, standing, crying, looking for their loved ones. And that's when it began, way early hours. We used some of our conference rooms and we had about 70 people there already about five hours later. It only escalated from that point forward and we had to look for other options.

It is imperative that hospitals have family assistance plans that can be leveraged quickly in an MCI. In an emergency, family and friends will arrive at local hospitals to search for their loved ones; a space and resources need to be provided for them to maintain security and crowd control and to not impact clinical care.

You look at the scenario that day and the space we have because of how much we've been surging every day. We opened our lobby for families and translated our plans into that area. That's where leadership helped to communicate with families and folks that arrived. We just bolstered that area to have the family information and reunification area.

Not only did many hospitals have senior leaders present in these spaces, they also expressed the importance of having the right resources readily available. Social workers and chaplains were among the many staff that hospitals leveraged to staff these centers. In addition, hospitals needed to pay particular attention to the affected community and ensure they had appropriate translational and culturally competent resources.

Once we had cleared people and it was okay, we would bring them to the ED and let them be in the room with the patient. If they weren't there, then we would tell them where their loved one was. But until we got the all clear from local authorities, we would just tell them [to wait], but tell them what was going on. One challenge is that there was a mostly Spanish-speaking

population and we probably could have brought down one of our translation robots a little bit faster.

Interviewees noted needing to rapidly manage increased call volume while identifying physical space for family reunification.

We had 250 people that were looking for their loved ones. We received 6,000 phone calls within four hours. That's even with the county activating a hotline to try and help. So that's a huge impact. The next day we had 5,000 phone calls.

Interviewees mentioned referring individuals to a phone number supported by the hospital or local government, describing it as an important resource that decreased the physical footprint of the on-site family reunification center.

Communications went down for a short period of time because so many people were on the cells, looking for loved ones, trying to call doctors. The county set up a family reunification center very quickly and had a number to call. We posted that number on our triage desk because there were 800 victims and you add all their family members and friends that are looking for them. One hospital can't take care of [this].

While hospitals had plans to transition from their own family reunification center to a regional family assistance center, many interviewees described the enormous toll of managing the needs of family and loved ones with little support from the region.

We contacted the hotel asking if they'd be willing to help with this situation and they said yes. They're probably never going to work with us again. We had 300 people that descended upon the hotel and there was utter chaos, with two police officers and no control, media everywhere. Our staff were coming back bawling, needing help because it was so stressful for them.

One interviewee in particular discussed the catastrophic needs of managing the family reunification center with the delay in local operations. As the number of individuals increased exponentially, the physical space and resources planned for the family reunification center were not adequate.

The family reunification family assistance piece changed locations five times. The families that we were trying to help moved over to a nearby hotel. [A few hours later,] the families moved for the third time to a nearby community center. The crowd had gotten so large that they wanted to try and better manage it. A lot of that is because I kept pushing back saying, we need help. It's not right for one hospital to have to manage this for the entire community.

It is immensely important for every jurisdiction to ensure there is effective planning and detailed coordination to quickly build and maintain family assistance centers, alongside the support and advisement of community organizations and leaders. Several interviewees discussed disappointment with the delay in regional response in establishing family assistance centers. As a result, the responsibility to support families fell upon hospitals for several days, which diverted resources such as hospital leadership, security, and clinical staff from ensuring patient care and safety.

So the county set up in a physical building so that the families wouldn't overload the hospital to try and find their loved one. So they set up a space where the hospital chaplain was, they had translators and the medical examiner's office trying to identify the deceased. They had private resources so that the families could have food, shelter, things like that. That was a use of external resources so that the hospital could focus purely on the medical care.

Several interviewees described their frustration with the lack of coordinated response from their governments with family reunification. Hospitals reported incurring significant costs that were never reimbursed, with one hospital spending \$5.5 million on family reunification and assistance operations. One individual stated, “we actually spent \$500 just on cell phone chargers for families.” One striking point was that the communities served by the hospitals matter and are an important consideration when planning for MCIs. Multiple hospitals explained that families and friends arrived as quickly as possible to the hospitals with nothing in their possession, speaking limited English, and with a significant mistrust of government resources. One interviewee described the complex and heartbreaking scenario that their hospital managed:

When families come for these types of situations, it's so traumatic to not only the patient but the family. They would come to us from all over the world, a lot of them had no money at all, no change of clothes, food, or water. They had no return tickets to get home or hotel rooms. So we

ended up helping with a lot of that. The cost of labor is another big piece of that. The overall staff time to respond to this properly, the resources that we used to help care for all the patients, the list goes on and on. It was about \$9 million, including patient care. Cause there are people that just can't afford this. They don't have insurance. We had people that were illegal aliens, so they did not want to be known. It was just a myriad. They weren't going to be looking for government resources as a result. A lot of it really came back to us to help pay for everything.

D. Recovery

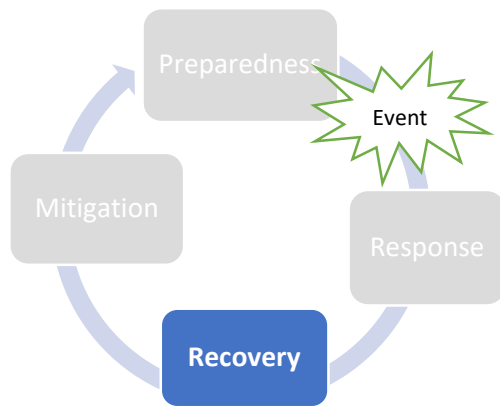


Figure 9: Recovery in the Emergency Management Cycle

This section includes the demobilization of response and transition to “post-event,” despite ongoing long-term needs. Much of this section focuses on the mental health needs of hospital staff as they returned back to a new normal within these hospitals. An overview of recovery results is in Box 4.

Box 4: Overview of Recovery Results

- Several interviewees spoke about the extended timeframes to bring their operating rooms back to normal, as well as the need for continued care of patients after these mass shooting incidents.
- Ongoing media coverage and investigation of the shooting caused prolonged trauma and inability to move on from the event. Four interviewees described needing to coordinate and manage, among other things, security, logistics, media, and internal communications around unplanned visits from elected officials, celebrities, or CEOs to their respective hospitals.

Box 4 (Continued): Overview of Recovery Results

- The general topic of mental health was emphasized by every interviewee and was frequently cited as an overlooked topic in MCI guidance. Participants spoke of the emotional and shocking impact of these mass shooting incidents, and how staff in their hospitals were forced to respond, with little preparation and assistance. Describing the scene and needs as “overwhelming,” “chaotic,” and “too much to handle,” many individuals described staff being unable to continue working at their place of employment after the event. Some individuals spoke of their surprise at how much the mass shooting incident personally affected them.
- Interviewees described the ways in which their hospitals tried to support staff during and after the event, including bringing in staff to replace those who responded immediately to the event as soon as possible, and outreach to ED staff within 1–2 hours of the event. Hospitals used their employee assistance programs, social workers and staff that were part of their clinical and psychology programs, spiritual care and chaplains, and therapy dogs to support staff, particularly in long-term recovery.
- Ultimately, while many of these resources were helpful, the hospital or health system alone could not provide all the necessary resources to staff who needed care. All individuals expressed their reliance on other organizations, government resources, or other health systems to support this work.

1) *Recovery Timeframe*

Several interviewees spoke about the extended timeframe needed to bring their operating rooms back to normal. From this experience, they have developed new best practices to deploy staff. In addition, most interviewees mentioned the need to continue caring for patients after mass shooting incidents. One mentioned that the event continued for “at least three weeks just taking care of patients,” while another described the extensive process of the patients “being followed by home care teams and mobile integrated health teams...for weeks.” Another individual recounted that their hospital had to perform 76 surgeries immediately, but the total was “well over that now. We had to rebuild bones in these patients for over three years.” Even in immediate patient care, keeping critical patients stable took much more time than anticipated.

We had patient rooms in the ICU and [patients were] next to the other. That was just crazy for the next 10 hours. All patients were critical and need ongoing resuscitation postoperatively.

Several interviewees mentioned how important it was to collectively debrief the event with other responders and take time to gain closure and acknowledge their tremendous achievements.

I look back and it's just amazing how well the response came together in a very short timeframe under the circumstances that we were under and the work that we were able to do. For a long time, I don't think any of us could really accept how well we handled everything. But through talking, follow-up, and going through the process of grieving, you look back and you think about the things that went well.

One interviewee also mentioned the importance of bringing everyone who responded to the event together for an “internal reset” and to “begin to digest some of what we had just experienced” to collectively process what had happened and what was still needed. This effective transition from immediate response to recovery also helped staff shift mindsets and plan for long-term needs.

The operating room schedules decreased [during the time of the MCI], other than emergencies. [MCIs are] something that we're pretty nimble on. I think it's making sure we're thinking about those operating room schedules and taking in consideration of the staff moving forward.

Several others discussed external factors that prolonged the event. Ongoing media coverage and investigation of the shooting caused prolonged trauma and inability to move on from the event. Four interviewees described needing to coordinate and manage security, logistics, media, and internal communications, among other things, around unplanned visits from elected officials, celebrities, or CEOs to their respective hospitals. While these visits provided comfort and support to victims and the community, they strained hospital staff who were already responding to a very stressful emergency.

[A VIP] decided to visit us. So not only does the event go for three weeks just taking care of patients, but then you've still got lots of calls and the media staying outside the ED for days.

The transition to recovery was especially difficult for some hospitals that continued to receive notifications of other MCIs occurring in the days and weeks following their original event.

We got word of an active shooter situation and a second potential shooter at a local hotel. We're like, this cannot be real, lightning doesn't strike the same place twice... It was like reliving it all over again in that instant. Just because it happened once doesn't mean it won't happen again.

This ties into the mental health issue as well. First responders are notorious for neglecting our mental health and you're dealing again with gun violence. You have emergency room nurses still not even beginning to heal from what we just went through and now you're piling on event after traumatic event. We've dealt with a lot. People think that because [we're] a small hospital in the middle of nowhere, there's [little] activity. That is not the case at all.

2) Mental Health

The general topic of mental health was emphasized by every interviewee and was frequently cited as an overlooked topic in MCI research.

I think the hospital could have done a better job with dealing with the mental health effects for staff members. That was the biggest deficit...and the one thing that was overlooked. They offered a counselor to the physicians, but the nurses were not offered that. Some did reach out to the hospital counselor that was available, some did not. It was a significant life event that stuck with all of us and our medical community pretty deeply. I wish that that had been taken a little more seriously in the beginning.

Participants spoke of the emotional and shocking impact of these mass shooting incidents, and how staff in their hospitals were forced to respond with little preparation and assistance. Describing the scene and needs as “overwhelming,” “chaotic,” and “too much to handle,” many individuals described staff being unable to continue working at their place of employment after the event. One person described, “Our triage nurse that night was an experienced emergency nurse who retired two weeks later.” Another individual explained that clinical staff responding to the event knew the people who came to seek care, causing significant emotional harm. “So we ended up bringing in some staff to replace those who responded for that day.”

One individual explained the complexity of being a first responder during those initial moments, particularly in a small community. Providing clinical care to those whom they knew, or working with individuals who were searching for their loved ones was difficult, as well as working within patient and family reunification centers, trying to help individuals find their loved ones.

In attempts to reunify some of these patients, a picture of a happy child did not look anything like what we were receiving. That was very difficult. Our emergency room nurse lost her granddaughter, and she was sending me pictures of her, pleading to find her. Aside from all of this chaos, you're also dealing personally, wondering about your own children. Your mind is everywhere, thinking what else? Do I remain here? What do you do?

Other hospitals spoke of the ongoing toll of seeing the event on the news after the incident was over, expressing difficulty with returning to a new normal.

3) *Interwoven Community*

When speaking of the emotional impact of this event, interviewees unanimously cited the interwoven communities of their hospitals. Regardless of the size of the city or county, interviewees spoke of “close relationships” to those affected, the “small community”, and how all individuals knew one person directly affected by the mass shooting. “Two degrees of separation is how we describe it. You can't look any direction without knowing that somebody was affected somehow.” An interviewee explained:

Every single person in this community was affected by this in one way or another. You did not have to be present or directly involved in the response. You can bet that this is something that they are still dealing with to this day and it's a long road ahead. If I had to [describe our] trauma system, I'd say, based on experience and these mass shooting scenarios that keep happening, there are learning opportunities. Do we have to really invest in our trauma system at this point? Maybe. But if you ask me, where we really have got to make huge progress in [is to] invest in mental health.

Some individuals spoke of their surprise at how much the mass shooting incident personally affected them, describing this as a lesson learned. “This stuff you may think may not affect you, but it does one way or another. And that was a big aha in learning for us.” They described not only the difficulty in responding to the incident, but the time it took to grieve and process in the aftermath of the shooting.

What was really surprising is how much this impacted all of us, even me. I had to go to an open casket funeral for somebody's grandson who was shot and ended up at our hospital. I talked to

his grandfather [during the response]. Do you know where he is? Talk about stressful. I had a feeling he was deceased, but I couldn't just tell him that. Who would ever think in all [jurisdiction] that this would affect me that much?

I was a few blocks away; I know how traumatic this was. We had some acquaintances that were killed and friends that were injured. My wife was really affected and went to vigils and things that were done, which are all important parts of healing. My wife recently met with this young boy and his mom, who I took care of in the emergency room. It's going to take some time for people to heal.

4) Resources for Support

Interviewees described the ways in which their hospitals tried to support staff during and after the event, including bringing in staff to replace those who responded immediately to the event as soon as possible, and outreach to ED staff within one to two hours of the event. Hospitals used their employee assistance programs, as well as social workers and staff that were part of their clinical and psychology programs. One interviewee mentioned that their hospital had more than 1,200 individual encounters through their employee assistance program related to the mass shooting event. Another noted the use of spiritual care and chaplains as a crucial resource in immediate psychological care. Many programs used therapy dogs to support staff, particularly in long-term recovery.

Psychological first aid for the staff was something that we activated very fast. We had a debrief right after the event to wrap our arms around what we were doing. We had to jump back into the real world. Our EMS staff had visits that day from our wellness team including our therapy dog that comes on site. That's something that we've learned over the years, that supporting our staff and their mental health and wellness is a really important piece.

Therapy dogs were cited an important resource for both staff and patients, bringing them “moments of joy” and creating “a new normal.” One individual stated, “Pet therapy is a huge deal and it really shouldn't be frowned upon or laughed at. It really did help people immensely.” A strategy mentioned by multiple interviewees was to line therapy pets outside of hospital entrances daily during shift changes to greet patients, families, and staff. Another interviewee emphasized the need to support the mental health of patients in the hospital and not just staff.

We had to get psychological support ad hoc that week for the patients also; it's something that is part of the newest trauma standards. This event happened on a Monday, and on Tuesday we identified that we needed to do more for the patients and their mental health. We pulled together resources, and we were able to offer support services in-house and then even as people went home, they needed psychological first aid for the folks that were in those events.

Many individuals expressed the importance of being proactive in getting staff the help they needed, rather than just having resources available. One strategy was to place mental health experts inside of areas in which people were actively responding, such as the emergency operations center.

He was talking with us in the command center asking if we have what we need. Go take a break, go take a walk. Because when we got the news that one of our teammates had died, it was very emotional. We were all crying. Just having that mental health resource there to be able to talk to, to remind you to go take a break, that was really important long-term. What they've done since is developed websites with a ton of resources.

Others mentioned the stigma associated with seeking therapy or care, as well as the tendency for first responders to put their own needs last. They mentioned that staff in a small community fear that what they share will be disclosed with others, and fear repercussions of opening up to therapists.

We had a lot of staff that were very affected by this. We brought in social workers that were part of our clinical psychology and psychiatry programs and made them available for staff to be able to spend time on and off the clock for debriefings. We offered a lot of support through our employee assistance program, and offered people time off if we felt like they needed time off. And I think that's very important.

One individual mentioned that they used lessons learned from the event to create rapidly deployable resources to assist in future events.

We now have a critical incident response plan and team that responds to psychological issues. If we have an incident that occurs, my team can activate this team of at least 30 people that are trained to go and help support our staff. We're building that out.

Ultimately, while many of these resources were helpful, the hospital or health system alone could not provide all the necessary resources to staff who needed care. All individuals expressed their reliance on other organizations, government resources, or other health systems to support this work.

There's just not enough resources in hospitals to support all the mental health [needs], so we have to really rely on external agencies, whether they be government funded, private, grant-funded, or people that are just in the community. We've got to work with everyone to make resources available.

Most hospitals were offered valuable resources from across their respective communities to support staff, both informally and formally. One individual mentioned the informal network of emergency managers they had worked with for years in the community reached out to offer support.

I had many of my colleagues texting me, calling me, making sure that I was taking time for myself afterwards. And just having that support is, I mean, incredible.

Individuals mentioned tapping into clinical psychology networks within the state, as well as neighboring states, to support local programs. Hospitals worked with community agencies and nonprofits to provide opportunities for staff to memorialize the event and feel appreciated for their heroic efforts. Another hospital partnered with a local Veterans Affairs hospital on an innovative resource for staff.

Our Veterans Affairs partners were probably the best thing that ever happened to us because they got their PTSD vans, guys that have seen wartime injuries, which is what these were. They came to three different hospitals 12 hours a day for a week. I escorted more than one of my coworkers out to the van to go talk [to them].

E. Mitigation



Figure 10: Mitigation in the Emergency Management Cycle

This section focuses on the current state of healthcare and constraints that may exacerbate the impact of future mass shooting incidents on hospitals. Several concerns about the current state of hospitals arose during the interviews, including resource constraints, staff turnover, overcrowded Eds, and regional needs. An overview of mitigation results is in Box 5.

Box 5: Overview of Mitigation Results

- Individuals expressed concern about current healthcare constraints, including staff turnover, loss of institutional knowledge, and availability of bed space in the event of larger MCIs.
- The perception of being “lucky” was a recurring theme in every interview. Whether the ED was uncharacteristically empty, or the event happened before COVID-19, or the right people happened to be in the hospital at the time of the event, all interviewees expressed some sense of irony or luck at the way the scenario unfolded.
- Some interviewees discussed that one of the more surprising lessons learned for them was that, even after a major emergency, their leadership did not allocate resources for emergency management. One individual mentioned the culture of healthcare as an attributing factor, with the norm of individuals doing multiple jobs and emergencies being an afterthought. They expressed the need for hospital leaders to invest in preparedness before an event happens.

1) *Current Constraints*

A major concern amongst interviewees was staff turnover and the consequential loss of institutional knowledge. One interviewee in a particularly tight-knit community indicated that turnover is not a concern at their hospital, remarking that no staff have left their positions due to dedication and commitment to the community and to each other. They further described the impact of the event on the dedication of nursing staff.

When we look back, every single one that came to us who had a chance made it. And for us, that has been the biggest motivator to continue the work that we do. Every single one of the nurses who was here that day has continued in the department.

Other hospitals expressed immense difficulties with staff turnover, particularly upon dealing with trauma of the event. Several individuals mentioned that the aftermath was so difficult to handle that many individuals moved on to other careers or retired early.

I think that if something bad happens, the people will step up and meet the needs of the patients. The aftermath of that may not be good, because people are at their peak tolerance. How that affects their desire to stay in medicine after that, that concerns me. You know, just as it concerns me if we have another COVID variant or anything more that stresses the system there. I just don't see that the system has much tolerance to be pushed anymore.

One interviewee estimated loss of a third of all staff over the year following the event. Another interviewee expressed concern over the psychological impact of another MCI on staff after the psychological toll of the experienced event. They detailed their concerns further:

We've lost a lot of experience in healthcare that I think could be leveraged if we could get out of this thinking, it has to be a 12-hour shift at the bedside. If you [give] highly experienced nurses a six-hour shift as a resource nurse to help the new nurse learn things without having a patient care assignment, you don't lose that experience or those informal teachers. That's where I think our biggest problem is. It's not the sheer number, it's the experience. If you've got a whole bunch of [new] nurses, they don't have the life experience or the clinical experience to respond to something this big.

Some individuals expressed concern over the current state of healthcare and the impacts of COVID-19 on staff turnover.

We had so many people leave healthcare during COVID. A lot of the people that were there when the shooting happened took the early out or transitioned to other positions.

Similar to turnover experienced in the immediate aftermath of the mass shooting event, interviewees described an immense loss of the healthcare workforce due to the COVID-19 pandemic, with one interviewee describing a 25% decrease of the clinical workforce.

Staffing is really tough. We were using a lot of agency [nurses] at one point, which is unusual. I think that's a real risk across the nation; when you don't have folks that are invested in a hospital or system, they just won't know the nuances and policies. Especially in trauma, time to intervention is the difference...between life and death. Having people well-trained becomes very important. So that I think is a national risk. Agency is a very attractive payday and I get that. People go where the money is, but it's probably not good for patient care, certainly not in a disaster.

Another interviewee described the attrition of administrative staff with knowledge of policies, and the change in executive leadership following the mass shooting incident. A disinvestment in emergency management followed shortly thereafter. The interviewee stated, “they heard the stories but they didn’t live the story.”

One interviewee expressed that while the whole workforce is a concern, they worry more about space than anything else because of the ways in which staff and the community rise up to meet needs during a crisis. Another expressed the distinction between handling a small and large MCI:

All of our facilities have been under constraints for the past two years. They’re used to working under low supplies, low staff, like I almost feel like they would do just as well. But if it was a larger event, I worry about where we’re going to discharge patients to, who will care of patients upstairs if we have to house them and not transport them out? If we had a larger one, I don’t know of any hospital that would be super well-prepared right now.

2) “Lucky” the Event Happened the Way It Did

The perception of being “lucky” for the incident to have played out the way it did was a recurring theme in every interview. Whether the ED was uncharacteristically empty, or the event happened before COVID-19, or the right people happened to be in the hospital at the time of the event, all interviewees expressed some sense of irony or luck at the way the scenario unfolded.

We talked about it the following Monday, saying, can you imagine if this happened today? The moon and earth aligned and things worked out for us, which we don’t take lightly at all.

In five of the events, interviewees expressed that they had a unique and uncommonly large number of beds available, one in which they had an additional 30–40 beds available that day in their ED and inpatient area compared to the following week.

We were very lucky that it was a very slow night with bed availability at that time. Now with most hospitals across the country being overloaded, it would be a lot more difficult to expand.

Another individual expressed that they felt lucky about the particular injuries their hospital had to treat, in that they were mostly extremity injuries and not life-threatening.

We were very lucky because we had a children's hospital right next to us that was staffed by people who were trained in adult medicine. Had we had a more formal notification system, I'm not sure that that would've helped us in that amount of time. I think we just got really lucky.

3) Investing in Emergency Management

Some interviewees discussed that one of the more surprising lessons learned for them was that, even after a major emergency, their leadership did not allocate resources for emergency management.

One individual mentioned the culture of healthcare as a contributing factor and the culture of staff having multiple jobs and handling most things themselves. They expressed the need for hospital leaders to “realize they're not experts in this, they need guidance in really managing an incident.” One interviewee disclosed that leadership turnover caused a disinvestment in emergency management. Two years after handling the mass shooting event, their administration decided to eliminate the position of emergency manager due to resource constraints.

I didn't expect the head in the sand. I really thought there would be more investment. The next fire comes up and it gets further back. Pretty soon, you've got new staff, you've got new leaders, you've got people that don't have that historical knowledge, don't remember the details of the day, and it becomes less important than the thing that's facing you now. We do a lot of fighting fires, there's always another crisis. So training and education gets pushed back a lot.

While this experience was particular to this hospital, interviewees expressed concern about emergency management not being prioritized until the next emergency. Many interviewees spoke of how their job was only partially dedicated to preparing the hospital or health system for an emergency. Others spoke of how, even with robust resources, they were still responsible for several hospitals. One interviewee expressed concern that hospitals never consider themselves responsible to deal with emergencies, which are instead considered a function of local fire or police.

I just want healthcare in general to catch up to where we need to be. Because it's always been, "Fire [department], please take care of it." It's never been that the hospital needs to take care of it. My biggest thing is the investment in preparedness and employee safety. I know there are profit margins that need to be made and investors that need to be satisfied, but it's like wearing a seatbelt. You only need it that one time.

Moreover, interviewees expressed the long-term costs and benefits of a robust emergency preparedness program.

Healthcare in general needs to take preparedness seriously and invest in the training and the supplies and the education that goes with it. It is not cheap. It will not be used very often. It's a hard cost, but as I've advocated on multiple occasions, it's a lot less expensive to train your staff than to defend yourself in a court of law because you weren't trained.

Ultimately, a consistent refrain from community hospitals was that their responses may not be based on the most systematic plans, but they remain effective. Much of their success hinges on deep knowledge of the institution and longstanding relationships within an interwoven healthcare community. However, there was the resounding concern of turnover and loss of institutional knowledge.

There is enough collaboration and cross-training because people may work on the ambulance but they also work as a tech in one of the hospitals. We have a lot of interwoven things here. We would respond, we would be challenged, but we'd make it work. Would we be better prepared? That's hard to say, we've been facing a lot of crap since that happened. We're better prepared in a lot of ways, but we also are shorter staffed and shorter supplied in a lot of ways. I have confidence in our ability to take care of the situation. I don't have confidence it would be pretty or that anybody would want make a template out of it. But I know we would do it.

X. Discussion

The findings of this study, while consistent with published literature, highlight experiences of individuals working in community hospitals that cared for the victims of mass shooting incidents, providing perspectives that have not been previously explored. The detailed interviews provided important context and rich descriptions of the interviewees' experiences, as well as a deeper understanding of the relevance of existing MCI guidance and the importance of preparedness. This

section presents several overarching themes that emerged from the study as well as present recommendations, which are organized around the emergency management framework. The section also explores potential study limitations and concludes with next steps for this area of research.

A. Critical Needs

Five major priorities emerged in the study, each of which is imperative to address for hospitals to effectively plan for, respond to, and recover from mass shootings.

1. Engaged leaders who advance preparedness.

Hospitals require renewed efforts by their leaders to prioritize, and allocate resources to, MCI preparedness in both their institution and their community. Many interviewees tried to lead further MCI planning efforts in their hospitals prior to the actual event but found it difficult to convince other hospital staff to invest time and energy on this work. They had trouble communicating risk or translating the importance of additional preparedness to other hospital staff amidst conflicting priorities, particularly clinical staff who were already under immense pressure in the wake of COVID-19.

The importance of regional full-scale exercises, inclusive of all local hospitals, that simulate the actual likely magnitude and complexity of real events cannot be overstated; these exercises are also an important conduit for developing trust and relationships across the public sector and hospitals. True readiness requires an investment in emergency preparedness that is supported by hospital and local leaders and requires reinforcing a culture around preparedness, despite constraints on healthcare systems.

2. Evidence-based planning assumptions.

Being ready to respond to a mass shooting incident requires preparedness initiatives based on realistic assumptions that reflect the actual possible magnitude of MCIs and keep pace with the

current state of the healthcare system. An MCI involves the entire hospital. There is a time and order in which specific actions must occur, and these actions must be coordinated across the hospital for effective response.

Before interviewees responded to mass shooting events, they felt their hospitals were prepared for the event because they had plans that met regulatory requirements and they engaged in regional exercises. However, they did not expect a major mass shooting to happen in their communities. While they had written plans and participated in exercises, these plans were based on inaccurate assumptions—they did not anticipate how rapid, chaotic, complex, and emotionally taxing the real event would be on their hospitals.

To practice these coordinated responses, hospitals must base their planning assumptions on the current environment. This should include plans for creating physical space and pre-identification of alternate spaces to use during an MCI, as well as staff management plans with methods to recall staff, maintaining pediatric-specific trauma supplies even if the hospital does not normally have pediatric services, considering long-term staffing needs and ongoing operations, and leveraging skilled individuals from other departments or institutions.

3. Timely and consistent communication to combat misinformation.

Timely, transparent, and actionable communication that aggressively combats misinformation is crucial across the span of a hospital's response and recovery to an MCI. It is necessary to have clear, concise, and repeated communications about the event through multiple channels. During the event onset, swift and actionable situational awareness before patients arrive is essential. It is incumbent upon prehospital personnel at the scene to communicate incident details for hospitals to activate MCI protocols and garner resources to provide rapid patient care. Misinformation is common at the beginning of these events and can cause concern among

patients and staff. Not only is it difficult to obtain situational awareness in a rapidly evolving event, but unsubstantiated information also spreads rapidly through social media from a variety of sources, often the shooter themselves. Hospital leadership must provide quick, transparent, and regular communications to patients, staff, and the community throughout the response. When communicating with media outlets, regional coordination is necessary for unified messaging from all responding hospitals and local first responders.

4. Rapid and coordinated regional communication, response, and recovery.

There were several areas where hospitals assumed that local, state, and federal authorities would take responsibility of response actions, including providing ongoing situational awareness, providing secondary transport for critical patients, informing hospitals of media updates and coordinating messaging, and rapidly deploying family assistance resources. A consistent theme in interviews was that regional response was not adequately nimble or coordinated with the hospitals. As a result, the responsibility fell upon hospital leadership, which was not only outside of their authority and expertise but took resources away from ensuring patient care.

One particular area of focus was the importance of family assistance centers. Local government is the responsible authority for coordinated and rapid implementation of family assistance and reunification services, which include special consideration for the needs of vulnerable populations that may have been targeted during the mass shooting event. Some hospitals described significant delays from the region in implementing these services, causing immense strain on hospitals that had to undertake these roles, including significant unreimbursed costs, lack of physical space, security concerns, and an increased emotional toll on hospital staff.

5. Robust long-term support and mental health services for patients and staff.

Long-term mental health needs for first responders were noted as the number one concern amongst interviewees. Comprehensive proactive mental health services that are tailored for all responding staff as well as patients must be rapidly and consistently available after the response occurs. Suggested resources included disaster mental health teams, therapy dogs, and leveraging regional resources. Collective debriefing of the event, along with capturing lessons learned, were important for staff to adequately process what occurred.

B. Recommendations

From these overarching findings, a detailed set of recommendations is outlined in Appendix G. These recommendations are based on problems that were described during the interviews and focus on three phases of the emergency management cycle: preparation, response, and recovery. This is not intended to be an exhaustive list but rather to address major issues and possible solutions identified by interviewees based on their actual experiences, which were often different from those described in key sources of guidance. Preparedness recommendations (see *Appendix G: Table G1*) focus on the planning process and methods to effectively engage stakeholders. Response recommendations (see *Appendix G: Table G2*) provide considerations of the realities and difficulties in response that hospitals, departments, and whole communities should include in their plans. Finally, recovery recommendations (see *Appendix G: Table G3*) examine the long-term impacts of mass shooting incidents, describing ways for hospitals to support staff after the event and move toward a new normal.

Within each table, recommendations range from the individual level, to the hospital departmental level, to the entire region or community level. Individual recommendations are targeted to hospital senior leaders, emergency managers, and any other individuals responsible for MCI planning for the entire hospital. Hospital-wide departmental recommendations are intended to advise frontline

staff and departmental leadership, who are responsible for developing MCI plans for their respective departments. Finally, regional recommendations are intended for healthcare coalitions and local authorities, such as departments of health as well as health and medical emergency support function coordinators. Interviewees reported that lessons learned from these events were used to improve regional response for future events. It is incumbent upon hospital leadership to continuously advocate with local government and hospital associations for community-wide MCI planning. Coalitions and local governance must be accountable to lead regional preparedness work and conduct sophisticated health and medical support planning.

Ultimately, to apply the lessons learned from these real events, hospitals must invest time and resources to reset planning assumptions and reassess existing plans on a granular level, across all departments in their institution. It is notable that all hospitals felt they were prepared for the event because they met regulatory requirements and passed accreditation. In light of this, as well as the absence of MCI planning-specific requirements for hospitals, the Centers for Medicare and Medicaid Services should require additional specificity on MCI planning in regulatory requirements across all hospitals to better prepare the nation to adequately respond to MCIs.

Investing monetary resources as well as staff time and attention on preparedness pays dividends during an event as well as in normal operations. Ensuring that staff know what to do and have the backing of strong systems and leaders during the most difficult circumstances reassures first responders that they are supported by the institutions they work for. One emergency manager described the multitude of MCI planning efforts that she had instituted at her hospital for several years, as well as a particularly effective full-scale exercise that she conducted a few months prior to the actual event that occurred. Upon notification of an actual MCI, the individual ran down to the ED and described what she saw.

They just looked at me and said they were putting on their vests and taking out their job action sheets. They said, "See? We don't need you." It was the highest compliment. So, I mean, I can retire.

C. Study Limitations

Despite its strengths, this study had several limitations. First, the number of interviewees (N = 9) was small. Interviews about past events also can introduce recall bias. All but one interviewee was still employed with the hospital in which they responded to the mass shooting event. This may have made them hesitant to speak openly about institutional failures or lack of preparedness. I attempted to address this by deidentifying interviewees and encouraging candid feedback to advance knowledge about MCI preparedness. I also attempted to develop rapport with each interviewee and sequenced my questions to explore other topics before introducing themes around areas for improvement.

Because mass shootings are relatively rare events, the group of professionals eligible to participate in the study was small, which made recruiting participants especially difficult, particularly recruiting leaders from community hospitals. While I did post recruitment materials on a variety of social media platforms, the target audience for these posts was emergency managers due to my own professional role and network. I was also referred to several practitioners through mentors, advisors, and professional networks, and those individuals referred me to leaders in other mass shooting incident responses. While this snowball sampling methodology was effective, the small sample may have introduced sampling bias, likely individuals who are most engaged in emergency response or known leaders within their communities.

Further, while I was connected to diverse practitioners who responded to major events across the US, their experiences and opinions are not representative of all hospitals or first responders responding to the same incident. In addition, while achieving thematic saturation with my interviewees,

the small sample, both in terms of number of mass shootings and interviews, means that the study lacks some perspectives and issues that arose in other types of mass shooting incidents.

C1. Reflexivity Statement

I am a hospital emergency manager with a background in humanitarian assistance and emergency management in city government. My main point of reference in hospital emergency response and planning is the primary institution that I serve, a well-resourced level-I trauma center and large academic medical center. My other experience in emergency planning and response is with New York City, a large urban area with multiple level-I trauma centers with extensive resources and relatively stringent gun laws. Furthermore, in these interviews I represented the Harvard T.H. Chan School of Public Health, and I was mentored by a renowned expert in the field of healthcare preparedness. While these connections supported participant recruitment, they likely impacted the perceptions of interviewees when entering conversation with me about preparedness.

In addition, I cannot fully relate to the difficulties of leading a community hospital through a crisis or serving in a critical access hospital in a rural area. I also cannot fully understand the lived experience or fear associated with a mass shooting incident in my community. Furthermore, some of these regions have responded to many mass shooting incidents over the course of the past decade. The fear, mental strain, and stress from these major events have a major toll on interviewees that I cannot fully understand. I emphasized my limited experience with mass shootings and desire to learn from their experience and expertise in interviews to display transparency, humility, and build trust with participants.

D. Contributions to Host Organization

This study was developed with input from emergency management leadership at Mass General Brigham. I joined this team during the onset of the third wave of COVID-19 and supported Brigham leadership in responding to the hospital capacity crisis. Immediately following this response, my team led an HVA at both Brigham and Women's Hospital and Faulkner Hospital. Through several facilitated discussions, both trauma-related MCIs and general patient surge events ranked in the top ten hazards of concern. The team conducted an impact and needs assessment of the top hazards and prioritized MCI planning because of the impacts of a sudden influx of patients to the ED, operating room, ICU, and inpatient care spaces and the already limited availability in these departments due to ongoing patient surge.

MCI planning is recognized as a major priority across all hospitals within the Mass General Brigham system. The goal across Mass General Brigham emergency preparedness is for all hospitals to update their plans during 2023 and conduct full-scale exercises by 2024. At Mass General Brigham, our team is taking deliberate and detailed measures to update our MCI plans so that they incorporate updates to our renovated ED space while also considering healthcare constraints. We have worked with individual departments to plan MCI response using large maps, whiteboards, and magnets, using the guidance and considerations outlined in this study. While we have worked extensively on planning for the immediate response during the first 30 minutes of an MCI, we are still developing our plans that extend across the hospital. Findings and recommendations from this study will enhance coordinated planning efforts across the hospital as well as provide preliminary recommendations for system and regional MCI planning.

E. Next Steps

As hospitals continue to struggle without sufficient surge capacity, and mass shootings continue to increase, it is essential to understand how hospitals can better prepare to mitigate the direct and indirect impacts of these events, particularly in terms of caring for the most vulnerable populations. MCI plans for hospitals continue to be based on outdated planning assumptions and do not consider the unique perspectives of community hospitals, which are most often the closest hospitals to mass shooting events. This study explores the real perspectives of first responders during recent mass shooting incidents and provides key themes, learnings, and recommendations from these real events.

In doing so, this study provides evidence of the importance of public–private partnerships and building regional resources to support hospitals during mass shooting incidents. While a great deal of literature exists on mental health during a crisis, further studies specific to first responders in mass shootings are important, particularly within non-level-I trauma centers. Further development of healthcare regulatory requirements to encompass MCI planning at all hospitals is also an important area of future focus.

In addition, this study characterized the general experiences of mass shooting incidents. As many of these events target specific populations, further studies should specifically explore planning, response, and recovery considerations for vulnerable populations during these events. With the increase in school shootings, a key focus should be on effectively treating pediatric patients in hospitals that do not traditionally handle the pediatric population. In addition, further guidance in regional planning for family reunification and assistance centers is a key area, particularly best practices to effectively support non-English-speaking or migrant communities.

Finally, while emergency medicine is the focus of the majority of MCI response literature and guidance, there are inextricable links between the ED, the rest of the hospital, and the entire

community. Building stronger connections among all three must be a priority for responding effectively to mass shooting incidents and other MCIs. While this study attempted to illuminate the complexity of these relationships, additional studies of complex systems are needed. In particular, developing dynamic frameworks and quantitative tools, such as systems dynamics modeling of a hospital's actual bed capacity, staffing, and available supplies during sudden patient influx, may enable realistic assumptions for hospital preparedness.

F. Conclusion

Current standards for hospital preparedness are inadequate to address the needs of mass shooting incidents, particularly with current bed capacity, workforce, and other constraints on hospitals and healthcare systems.

Adequate and realistic planning at organizational and regional levels is key to optimize and coordinate responses to mass shootings and other unexpected MCIs. An MCI plan ensures that responsibility, accountability, and roles are clarified in advance and facilitates efficient communication, resource utilization, and safety of staff and patients. Although hospitals are required to maintain emergency preparedness plans, Eds and hospitals have become busier and more crowded, and emergencies have become increasingly frequent, complicated, and devastating. Mass shooting incidents can easily overwhelm most hospital resources, staff, and space (Ahmad, 2018). Furthermore, it has become increasingly difficult to maintain knowledge of emergency policies, particularly in rare but high-impact events such as mass shootings.

The findings of this study suggest three major imperatives to improve preparedness, response, and recovery to mass shootings:

1. No hospital is an island.

Leaders must foster close relationships with other hospitals, first response agencies, and regional healthcare coalitions. In turn, jurisdictions in which hospitals reside must be prepared, nimble, and accountable to support hospitals with critical resources and regional coordination before, during, and after a mass shooting. Communities must develop a common operating landscape among EMS, government, and hospitals about responsibilities and expectations for MCI response.

2. Expect it to happen on the worst day.

Developing a culture of preparedness across an institution goes beyond creating policies to meet regulatory requirements. It requires acknowledging that a mass shooting event can happen in any community, under any circumstances. Leaders must invest time, money, and strategy to build a culture of readiness, maintain constant vigilance, assess risk to their hospital, search for operational gaps, and adapt to current constraints.

3. The time to prepare for the next emergency is now.

While staff will rise to the occasion, they will need to adapt to the needs of the event. It is the job of hospital leadership to be accountable for the institution's overall response to the tragedy amidst public scrutiny. Leadership must prioritize developing the systems that support and coordinate this work, develop a sense of urgency in addressing known gaps, and ensure staff know these systems despite current healthcare constraints.

Effective leadership prioritizes preparedness when there is not an emergency and the ability to adapt to dynamic circumstances when an event happens, understanding risks to minimize the impact of a crisis. In the wise words of one interviewee:

Grab a hold of these factual incidents that occurred to us, Vegas, and others, and don't [assume] you're in some area this isn't going to happen. That's not acceptable anymore. It's not a matter of if or where, it's a matter of when. It will happen. With that, you need to have proper plans, you need to have training and testing to back that up. If you're not doing that, you're only hurting yourself and your team. We learned a lot from this event and we're still learning from it.

In the US, the threat of a mass shooting is a daily reality. Collectively, it is evident that many hospitals will need to respond to a mass shooting incident at some point. However, the individual or local perception of this risk is that it is unlikely to happen or that a level-I trauma center will receive all patients, which is reflected in community hospitals' varying levels of preparedness. When mass shootings occurred in each community, healthcare professionals rose to the occasion but shouldered the responsibility of an immense undertaking that was beyond what they were trained or equipped to do. Ultimately, healthcare professionals in community hospitals not only had a front-row seat to the gruesome reality of a mass shooting incident, but they also bore the brunt of ongoing clinical care and family support. While we cannot predict where or when a mass shooting will occur, for the country to be ready all hospitals must handle these tragic events with a coordinated, consistent nationwide effort in preparedness.

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XII. Appendices

Appendix A: Overview of Mass Shooting and Mass Casualty Guidance for Healthcare					
Title and Year	Author/Organization	Audience	Objective	Methods	Key Concepts/Areas of Focus
15 'til 50 (2016)	Henry Mayo Newhall Memorial Hospital and Providence Little Company of Mary Medical Center Torrance, sponsored by Los Angeles County EMS agency	Health care personnel (clinicians, staff, leaders, policymakers)	<p>Designed to enable hospital staff to receive a surge of 50 or more patients within 15 minutes of notification of an MCI</p> <p>Distinct in that it covers hospital activity 15 minutes before the first patient arrives and through the first two hours of response, including pre-positioning and rapid deployment of staff, supplies, and equipment to successfully operate MCI triage and treatment areas</p> <p>The framework falls under the “Dual Wave Phenomenon” in which the larger group of less severely injured walking wounded typically arrive within 15–30 minutes of an incident, followed within an hour or two by a second wave of more severely injured patients.</p>	A renowned response program conceptualized by a multidisciplinary team within the ED at Providence Little Company of Mary Medical Center Torrance, California, developed, tested, and modified over 10 years.	<ul style="list-style-type: none"> • Creating buy-in • Planning process • Coordinate and pre-position supplies • Blueprints <ul style="list-style-type: none"> ○ Pre-incident ○ Activation ○ Operations ○ Transition
In a moment's notice (2010)	Richard Hunt, developed by CDC Injury Center	Health care personnel (clinicians, staff, leaders, policymakers)	Develop surge capacity for terrorist bombings to organize and support response to an influx of 300 patients injured from an explosion for a 72-hour period	Expert panels in 2005, 2006, and 2009	<ul style="list-style-type: none"> • Surge capacity challenges and solutions • EMS response • ED response • Surgical department response • ICU response • Radiology response • Blood bank response • Hospitalist response • Admin response • Drugs and pharmaceutical supplies • Nursing care

Appendix A (Continued): Overview of Mass Shooting and Mass Casualty Guidance for Healthcare					
MCI Response Toolkit (2019)	Greater New York Hospital Association and Fire Department of New York Working Group	Emergency managers	<p>Guidance for hospitals to prepare and train for MCIs, using expertise across New York City health system and state and local government</p> <p>Includes foundations of preparedness and regulatory standards</p> <p>Focuses specifically on New York City hospitals</p>	Developed by the Hospital Bed Availability Workgroup, with the goal of improving communication and coordination between EMS and 911-receiving hospitals in New York City	<ul style="list-style-type: none"> • Response planning: key concepts • Monitoring, notification, and activation protocols • Patient triage • Clinical management • Safety and security • Supporting family and friends in the aftermath • Managing the community response • Legal and regulatory considerations • Recovery • Preparing hospital staff training
Mass Shooting Incidents (2022)	Goolsby et al., Uniformed Services University's National Center for Disaster Medicine and Public Health	Emergency medicine clinicians, surgeons	Eight recommendations address readiness training, public education, triage, communication, patient tracking, medical records, reunification, and mental health for responders specifically for mass shootings in the US	Consensus conference of EMS clinicians, EM physicians, and surgeons who provided medical response to six large recent mass shootings in level-I trauma centers	<ul style="list-style-type: none"> • Readiness training • Public education • Triage • Communication • Patient tracking • Medical records • Family reunification • Mental health services for responders

Appendix A (Continued): Overview of Mass Shooting and Mass Casualty Guidance for Healthcare

<p>Mass Casualty Preparedness and Response in Emergency Units (2020)</p>	<p>World Health Organization Academy</p>	<p>European Union-centered, developed for frontline healthcare staff</p>	<p>Provides a universally applicable MCI management framework for a wide range of geopolitical and resource settings</p> <p>Includes 25 components from preparedness to considerations around confidentiality and incident command</p> <p>Framework only includes preparedness and response intended to be incorporated into clinical training programs</p>	<p>Three-round Delphi process with international experts</p>	<ul style="list-style-type: none"> • Development, operational phases, routine preparedness • Training • Identification of thresholds • Rapid activation of plan • Legal protection and ethical considerations for staff • Crowd control • Communications • Staff and patient safety • Safe movement of patients • Supplies • Infection control • Patient documentation and tracking • Patient dignity, privacy, and confidentiality • Triage • Clinical zones • Incident Command team • Roles and staff visibility • Staff surge support • Management of the dead • Managing of media • Caring for family members • Operational debriefings • Psychological impact on staff
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Appendix B: IRB Human Subjects Research Exemption



HARVARD

Human Research Protection Program

Harvard T.H. Chan School of Public Health
Office of Regulatory Affairs and Research Compliance
90 Smith Street, 3rd Floor
Boston, MA 02120
Federalwide Assurance FWA00002642

Notification of Initial Study Exemption Determination

December 15, 2022

Sarah Tsay
sarahtsay@hsph.harvard.edu

Protocol Title: Hospital Emergency Preparedness: A systems framework for mass casualty incident planning and response
Principal Investigator: Sarah Tsay
Protocol #: IRB22-1138
Funding Source: None
IRB Review Date: 9/2/2022
IRB Effective Date: 9/2/2022
IRB Review Action: Exempt

This Initial Study submission meets the criteria for exemption per the regulations found at 45 CFR 46.104(d) (2)(2). As such, additional IRB review is not required.

The Principal Investigator is responsible for ensuring compliance with any applicable local government or institutional laws, legislation, regulations, and/or policies, whether conducting research internationally or nationally. Additionally, if local IRB/ethics review is required, it must be obtained before any human subjects research activities are conducted in the field. If assistance with applicable local requirements is needed, please contact the Harvard T.H. Chan School of Public Health IRB office.

The documents that were finalized for this submission may be accessed through the IRB electronic submission management system at the following link: [IRB22-1138](#)

This approval includes review of all study documents and initial IRB application materials. The IRB-approved documents can be viewed on the Documents Tab of the ESTR Workspace (linked above). For instructions on how to navigate the ESTR Smartform and ESTR Workspace, visit the ESTR Support Site – Accessing a Submission (<https://estrsupport.fss.harvard.edu/accessing-submission>).

Appendix C: Informed Consent Form

*Hospital Emergency Preparedness:
A systems framework for mass casualty incident planning and response*

Permission to take part in a human research study:

You are being asked to take part in a research study. This research is being conducted to learn about healthcare preparedness related to mass casualty incidents (MCIs). Specifically, we are interested in learning about *your experiences with preparing for and responding to mass casualty incidents, as well as your perceptions of preparedness for mass casualty incidents*. You are being asked to participate in this research because *of your subject matter expertise and/or real-life experience planning for and responding to mass casualty incidents at your place of employment*.



Your participation in this study is voluntary and you may withdraw your participation at any time for any reason. If you take part in this study, you will be asked to *participate in a one hour interview on a virtual platform (e.g., Zoom, Teams) or in person if preferred. This interview will be both audio and video recorded for the purposes of the study*. Specifically, you will be asked a number of questions about *priorities with planning for mass casualty incidents, perceptions on preparedness, and barriers to implementing best practices*.

The possible risks of participating in this study include *psychological risks from answering uncomfortable questions about an upsetting topic such as Mass Casualty Incidents. Furthermore, disclosing institutional gaps in emergency preparedness at your place of employment may pose a risk given a breach of confidentiality, though steps will be taken in an effort to maintain confidentiality and deidentify data*.

The benefits of participating in this study are: *There are no direct benefits to you from your taking part in this research. We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include importance of knowledge to be gained in emergency preparedness or society at large*. You can decline to participate in any part of this study for any reason and can end your participation at any time.

If you have any questions about this study, you can contact Sarah Tsay at sarahtsay@hsph.harvard.edu or 929-343-7237.

Thank you again for your time and participation. *Your signature documents below documents that you have freely given your consent to participate in this study.*

	
Signature of Subject	
Printed Name of Subject	Date
	Date
Printed name of person obtaining consent	

Appendix D: Interview Guide – Key Informant Experience with Mass Casualty Incidents

Thank you for taking the time to speak with me today about your experience with responding to a mass casualty incident. This study aims to explore practitioner experiences in mass shooting response and to understand facilitators and barriers to preparedness for these events, given current constraints on hospitals.

- *(Read consent script. If accepted, document and proceed.) Do you have any questions about this study before we proceed?*
 - *Are you okay with recording this conversation?*

Background information (5 minutes)

- Please describe your role in your organization.
 - What was your role in the organization at the time of the mass shooting event?
 - Can you describe your hospital/system?
 - Location of shooting
 - Specific level of trauma center
 - How many ED, inpatient, operating room, ICU beds?

Preparedness (10 minutes)

- Prior to this incident, what was your experience and role in planning for a mass casualty incident?
 - What did your planning process look like? What stakeholders were engaged in this process?
 - (Optional) How often were these plans reviewed?
- In general, what resources do you use when developing or updating emergency plans?
 - [e.g., MCI epidemiology, known practices, shared best practices, literature (source?), real world events, information series/speaker series, after-action reports]
 - How do you seek these out?
 - What resources are provided to you?

Experience with MCI response (20–30 minutes)

- Please describe an overall timeline of the response to the mass shooting event.
 - How and when were you notified of the event?
 - During the time period between notification and arrival of patients (or between waves of patients), what actions were taken?
 - How did you manage security at your healthcare facilities?
 - How did you notify staff and/or patients?
 - In hindsight, what should you have done?
 - Describe the role of incident command and the structure you had in place.

- What was your role?
 - How were you prepared for your role in this event? How were you less prepared?
- Please describe your recollection of how patients presented to your hospital.
 - What was the timeline of patients presenting to the hospital?
 - How did they present (e.g., walking, self-transport, ambulance)?
 - What types of patients presented and what were their clinical needs?
 - How did you triage patients?
 - How many staff were immediately available?
 - How did you manage incoming staff?
 - What additional clinical or support services were leveraged to handle patients in the ED?
 - Tell me more about them.
- Describe your hospital's experience with crisis communications during this incident.
- What had your hospital done prior to the event that you felt enabled an effective response?
 - Probes: planning (internally, regionally)
 - Training, exercises
 - Obtaining supplies or equipment
 - What was not done that should have been done?

Recovery and post-event experiences (5 minutes)

- What were lessons that you learned from the event?
- What were issues that your hospital experienced after the response concluded?

Mitigation (5 minutes)

- How have your hospital's MCI mitigation and preparedness efforts changed since the event?
 - How has your hospital's overall preparedness efforts changed since the event?
- Given current constraints on your hospital (e.g., staff, bed capacity, supply shortages), how do you feel about its ability to respond if the same event happened today?

Regional considerations (5–10 minutes)

- Describe the coordination of hospital-level and regional resources in MCI planning and response?
 - What systems and resources were in place that made your region more prepared to respond?
 - *(Clearly define what region is—ASPR region, city, state, healthcare coalition?)*
- What do you wish your region/county/city had done to handle the event?
 - What systems and resources were in place that made your region less prepared to respond?
- What were lessons learned?

- How have your region's MCI preparedness efforts changed since the event?
 - How have your region's overall preparedness efforts changed since the event?
- Given current constraints on your region (e.g., EMS, staff turnover, supply shortages), how do you feel about its ability to respond if the same event happened today?
- Can you speak a bit more about community-led response and factors in recovery?

Concluding thoughts (5 minutes)

- What surprised you the most about your institution's (or region's) response to this event (or what did you not expect)?
- Do you have any other comments regarding this topic?
- Do you have any feedback for this interview? What do you wish we had talked about more?

Appendix E: Overview of Interview Results

Preparedness

- Respondents used regulatory requirements as their standards in preparedness. While they felt prepared for MCIs prior to the incident and planning was valuable, their planning assumptions made plans untenable during the actual response. In particular, they did not expect the size and severity of the incident, particularly with the use of semi-automatic weapons.
- There was also difficulty garnering investment from both leadership and staff in pushing beyond required standards to make MCI planning a priority and more valuable in real emergencies.
- Difficulty in planning was particularly pronounced in the state of healthcare post-COVID-19. Developing relationships before emergencies is the crux of effective emergency management, and interviewees mentioned how difficult this was in a new working environment in which many people work remotely. Furthermore, many training and exercise priorities were cancelled or not maintained due to ongoing COVID-19 response. Interviewees mentioned how difficult it was to plan for an MCI when hospitals are already pushed to the brink with ongoing capacity issues.
- Regional partnerships and healthcare coalitions are a vital resource in maintaining institutional preparedness, particularly for smaller hospitals. Most hospitals referenced a regional or state MCI exercise as a critical resource that saved lives during the actual event.

Event and Context

- Hospitals interviewed were very close to the mass shooting incident (average: 2.27 miles; range: 3 blocks–4 miles). In three of the seven events, patients arrived by ambulance only, and hospitals received prior notice of the event 5–10 minutes before patient arrival. One hospital did not disclose this information. In four of the events, patients arrived by multiple modalities, and hospitals received patients before getting any formal notification of the mass shooting event.
- The response and needs of an event are significantly determined by the context in which the mass shooting occurred, including the time, location, population affected, and proximity to other hospitals. Late events in particular made note of the specific circumstances around the time of the event, including low staffing levels, limited supplies, and concerns around safety.
- Because trauma centers are the expected destinations of the most complex victims in a mass shooting event, they also get the most resources in training and preparedness. Many interviewees felt that because they were not a level-I trauma center, they were less equipped to respond to the event, less informed of the event's progression, and less accustomed to caring for trauma cases, ultimately putting an immense strain on staff.

Response

- Hospitals expressed difficulty in obtaining actionable situational awareness of what was occurring. Simply knowing there was an MCI was not enough to prepare hospitals to accept patients. Interviewees expressed the need to know the number of potential victims arriving to their hospital, the location of the shooting and whether it was an enclosed space, the age group affected, and the type of weapon used.

- Upon actionable information, the immediate first steps for most hospitals were to create space to receive patients within the ED, notify the operating room to stop all new cases, and garner as many supplies as possible from across the entire hospital.
- Interviewees discussed the importance of relationships and staff expertise and knowledge to quickly act, adapt, and respond to the needs of the event during the first critical moments before patients arrived.
- Sudden and rapid arrival of multiple patients was a common theme throughout all interviews. Hospitals that handled a large volume of patients also mentioned difficulty in handling multiple waves of patients, depending on the type of transportation victims used to arrive at the hospital.
- Despite being trained in a specific triage method as a best practice, interviewees reported not using these methods during the chaotic and rapidly evolving events. What was cited as a critical operation was creating a triage area and assigning an experienced clinician in the role of triage at entry, and then watching patients carefully and continuing to triage as their conditions changed.
- Because of the time-sensitive need of highly specialized trauma surgeons in these events, healthcare systems used trauma teams to service multiple hospitals and allocate patients based on hospital resources.
- Individuals expressed needing to quickly adapt their physical space to handle a sudden influx of patients. It was important to have a large open space that was properly resourced to allow senior clinicians to provide guidance. In addition, coordination and communication as they used these spaces was critical. Mass shooting incidents that had a large number of patients were forced to constantly adapt the space needed to the shifting numbers and types of patients that presented in several waves.
- Individuals described creating teams that were assigned to each room and signing in and accounting for all staff. Patients were moved through this system based on need, with staff staying in place.
- Interviewees described the large number of staff that showed up to assist, whether or not they were formally requested. All hospitals felt comfortable with the staff they had to handle the event, but many discussed creating better methods to manage staff, particularly accounting for operational periods in a prolonged event.
- Interviewees described running out of many supplies, including surgical supplies, chest tubes, IV tubing, dressings, saline, monitor cables, and triage tags. Many hospitals had agreements or relationships in place with nearby hospitals and sent runners to garner more supplies.
- The location in which trauma supplies were stored as well as the availability of pediatric-specific equipment were particular concerns.
- Interviewees described the importance of having department-specific MCI plans across the institution. In particular, clear and robust blood bank and emergency radiology protocols were critical in effective response.
- It was critical to maintain operations and stay open to provide ongoing patient care while responding to the event. While many resources were suddenly diverted to the mass shooting, this did not mean that individuals stopped coming into the ED for care or that the needs of existing patients were diminished, particularly for hospitals in rural areas. This emphasized the need for leadership to fully understand and plan for the long-term effects of MCIs on an entire

hospital. While many are focused on immediate clinical needs and clinical providers are supporting care of victims, there is the concern of using too many staff at the onset of an incident and not being able to provide quality care to patients after the first operational period of the event.

- A rapid response of increasing security staff, securing the perimeter, and communicating with staff and patients about the emergency and what actions have been taken to ensure their safety is critical during mass shooting incidents.
- While hospitals had developed plans to manage media and conduct press briefings, interviewees described being surprised by both the number of reporters who arrived to the hospital and how quickly they arrived. Interviewees mentioned it was difficult to coordinate and maintain consistent messaging between hospitals and the region, alongside how rapidly they were urged to communicate with the press.
- Providing necessary support for victims' families was consistently one of the most difficult aspects of a mass shooting response. Creating and maintaining adequate reunification operations was cited as a major area of improvement across interviews. While considerations will vary based on the event, a space, resources, and a phone bank need to be offered for family and friends searching for loved ones at hospitals to provide support as well as to maintain security and crowd control and not impact clinical care.
- While hospitals should have plans to transition from a local family reunification center to a regional family assistance center as soon as it is established, early development of a regional center should not be a planning assumption. Many interviewees described the enormous toll of managing the needs of family and loved ones with little support from their region. Several hospitals described their frustrations with the lack of coordinated response to family reunification from their governments during these events, with a few hospitals incurring significant costs that were never reimbursed.

Recovery

- Several interviewees spoke about the extended timeframes to bring their operating rooms back to normal, as well as the need for continued care of patients after mass shooting incidents.
- Ongoing media coverage and investigation of the shooting caused prolonged trauma and the inability to move on from the event. Four interviewees described needing to coordinate and manage security, logistics, media, and internal communications, among other things, around unplanned visits from elected officials, celebrities, or CEOs to their respective hospitals.
- Mental health was emphasized by every interviewee and frequently cited as an overlooked topic in MCI guidance. Participants spoke of the emotional and shocking impact of these mass shooting incidents, and how staff in their hospitals were forced to respond with little preparation and assistance. Describing the scene and needs as "overwhelming," "chaotic," and "too much to handle," many individuals described staff being unable to continue working at their place of employment after the event. Some individuals spoke of their surprise at how much the mass shooting incident personally affected them.
- Interviewees described the ways in which their hospitals tried to support staff during and after the event, including bringing in staff to replace those who responded immediately to the event as soon as possible, as well as outreach to ED staff within 1–2 hours of the event. Hospitals used their employee assistance programs, social workers and staff who were part of their clinical and

psychology programs, spiritual care and chaplains, and therapy dogs to support staff, particularly in long-term recovery.

- Ultimately, while many of these resources were helpful, the hospital or health system alone could not provide all the necessary resources to staff who needed care. All individuals expressed their reliance on other organizations, government resources, or health systems to support this work.

Mitigation

- Individuals expressed concern about current healthcare constraints, including staff turnover, loss of institutional knowledge, and the availability of bed space in the event of a large MCI.
- The perception of hospitals being “lucky” in terms of the context in which they responded to the mass shooting incident was a recurring theme in every interview. Whether the ED was uncharacteristically empty, the event happened before COVID-19, or the right people happened to be in the hospital at the time of the event, all interviewees expressed some sense of luck at the way the scenario unfolded.
- Some interviewees discussed that one of the surprising lessons was that, even after a major emergency, their leadership did not allocate resources for emergency management. One individual mentioned the culture of healthcare as an attributing factor, with the norm of individuals doing multiple jobs and emergencies being an afterthought. They expressed the need for hospital leaders to invest in preparedness before an event happens.

Appendix F: Results, Continued – Other Critical Considerations

One particularly important and time-sensitive need was to activate plans to notify the blood bank and obtain a predetermined supply of blood product very rapidly for care. To do this, hospitals must have thorough knowledge of blood on hand, notify blood suppliers about the event, monitor the needs of the event, and care for other patients. One individual explained:

Blood is a hot commodity and you probably heard a lot about blood and how big of a deal it is for shortages. In this event, we used 550 units of blood on patients. Our average daily use is 35 units. We typically keep 300 units of blood products on hand, and we had one patient alone that used 200 units of blood. That's astronomical.

Immediately registering patients and limiting the time needed for medical documentation to provide rapid patient care were also major points of discussion. Preparedness was essential for this aspect of patient care; creating manual processes or ways to quickly enroll patients in the medical system was crucial to provide continuity of care.

The hospital had this very crazy system for enrolling patients in a mass casualty. It was very bad, the nomenclature that they were using to identify. When multiple patients arrive, you don't know who they are and they may or may not have IDs. We always think these patients should be pre-enrolled as soon as they're coming so that you have everything set up, but hospital administrators don't really get that. I had been struggling for several years to implement a better system of enrollment and we actually started that [a few months before the event].

Our resuscitation flow sheets are on paper. That was one of the things I did as the person who was not committed to any one patient. At some point, the resuscitations in the emergency room weren't quite so fast and furious and patients were in the operating room. I started entering orders into the computer system so that when the patients got to the ICU, they were ready.

Several interviewees also mentioned the rapid and necessary coordination of radiology with emergency care. Not only did this require rapid escalation of imaging needs, but it also required accurate and immediate patient registration and documentation. One individual described the need to rapidly communicate through the process of completing imaging, lab tests, and assessments for each patient in under five minutes. “We were doing a lot of very visual communication, as well as communicating through the electronic health record system and staging.” Another interviewee described:

At that time, if patients had any sort of penetrating chest trauma, they were intubated and chest tubes were placed because X-ray was overwhelmed. We only had two portable X-rays. It made more sense to just treat if they had penetrating abdominal trauma and if their vitals were unstable, they went straight to the operating room.

Appendix G: Summary of Planning Recommendations

Appendix Table G1: Preparedness Recommendations	
Leadership	<ul style="list-style-type: none"> • Invest time, money, and strategic prioritization into emergency management, particularly participation in and planning of full-scale MCI exercises. • Use annual HVA results to identify institutional priorities and work with senior leaders to ensure adequate resources can be devoted to robust planning, training, and exercising. • Refer to diverse resources to develop plans, including literature, best practices, and experiences or after-action reports from real events. While scenarios of more than 15 critical patients at community hospitals were previously considered unlikely, increased use of high-caliber weapons in these events requires leadership to reimagine past planning assumptions.
Hospital (Departments)	<ul style="list-style-type: none"> • Engage all relevant staff in comprehensive and role-based training of MCI plans, as well as other topics such as basic hemorrhage control. • Conduct exercises at the department level during different shifts to ensure all staff are trained. • In consultation with internal medicine, create an inpatient medical branch in the hospital incident command system structure to coordinate augmented clinical support in MCIs, particularly decompressing emergency rooms through admitting, rapidly discharging, and prioritizing patient transfers. • Enroll all staff in mass notification systems and have a method to contact each other and other identified departments in emergencies. • Pre-identify secondary and tertiary spaces for operations (receiving patients and triage, patient surge, patient care areas, secure entrances, command center, family reunification center). • Leverage existing staff not in emergency room/trauma areas to support the incident (e.g., anesthesiologists, ambulatory staff)
Region	<ul style="list-style-type: none"> • Healthcare coalitions and regional authorities must hold the responsibility of developing regional full-scale exercises involving all hospitals in a region, with a particular focus on community hospitals. • Encourage hospitals to develop memoranda of understanding and agreements to share supplies or staff in an emergency.

Appendix Table G2: Response Recommendations	
Leadership	<ul style="list-style-type: none"> • When alerted of an MCI, assign a staff member to continuously monitor verified information sources. Consider investing in capabilities for 24/7 monitoring of government and information-sharing resources. • Provide clear and timely communication to staff and patients. • Create strategies to communicate with law enforcement, elected government officials, and the media. • Enable staff to lead in their roles and provide support where needed.
Hospital (Departments)	<ul style="list-style-type: none"> • Pre-identify clear response triggers for an MCI and train staff in the emergency room on this. Also develop protocols with clear initial steps that must be taken within the first 10–15 minutes of an activation. Consider the context of the event when developing these triggers and protocols (e.g., time of day, population). • Assume waves of patients, with less critical ambulatory patients arriving at a hospital first. Use trauma resources deliberately across a hospital or system. • Leverage relationships as needs arise, including specialists from nearby hospitals and vendors that are critical in emergencies. • Even if a hospital does not usually care for pediatric patients, it may need to in a mass shooting incident. Stock supplies that are needed for pediatric trauma patients and be able to adapt if necessary. • Clinical staff will be doing what they know but in a different environment and must be adaptable. • Devote significant resources, including patient and family relations, social work, spiritual care, and security, to support family reunification. The onus for family support will fall on the hospital until a regional family assistance center is established. • Plans should include ways to meet the unique needs of vulnerable groups, such as those with special needs, non-English-speakers, or children.
Region	<ul style="list-style-type: none"> • Identify ways to expedite situational awareness during an event, including notification systems or radios for all hospitals. • Leverage specialty staff from other facilities or hospitals to pair with hospital clinicians or staff. • Develop robust plans for EMS around load-balancing across hospitals, including secondary transport. • Develop a joint information center to coordinate hospital public messaging and rapidly establish a press briefing area. • Rapidly create a family assistance center that can expand when needed and coordinate this process with local hospitals.

Appendix Table G3: Recovery Recommendations

Leadership	<ul style="list-style-type: none">• Begin long-term planning and demobilization as soon as possible.• Create long-term mental health resources for patients, family, and staff. Existing strategies include the Employee Assistance Program, therapy dogs, and mental health specialists within the hospital.• Plan for extended media coverage of the event, directing press to an area away from clinical areas.• Provide many opportunities to both debrief the event as well as thank and acknowledge staff who responded to the event.• Show continued commitment to preparedness after the event, with measurable improvements to MCI preparedness.
Hospital (Departments)	<ul style="list-style-type: none">• Create avenues for department- or operation-specific debriefs to capture best practices, opportunities for improvement, and process what happened.• Provide other opportunities to process the event and show appreciate to staff in each department, including focus groups, employee appreciation, or providing needed leave. Provide outreach to each staff member to tailor mental health services.• Leverage experienced staff and champions to implement continuous improvement or lessons learned.
Region	<ul style="list-style-type: none">• Use regional and community resources to support mental health needs at hospitals.• Use regional and community resources to support ongoing needs of family assistance, particularly addressing costs incurred by hospitals in family support.