

Assessing Surge Capacity for a Mass Casualty Incident in Hospitals in the United States Perspectives

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RESEARCH

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ABSTRACT

In the current world crisis of the SARS-CoV-2 pandemic, hospitals in the United States and across the globe have had to adapt to circumstances that have been unprecedented in many people's lifetime. Hospitals across the United States have resorted to utilizing their resources at full capacity and even beyond, innovating hospital units in warehouses and tents. Many hospitals in the United States are also trauma centers, which are expected to respond to incidents like a single gunshot wound in a patient, to a mass casualty train wreck. These trauma centers have mass casualty incident preparedness plans, as well as resource capacity or surge plans. However, plans for mass casualty incidents (MCI's) occurring while at resource capacity is not something commonly planned for, but is important to consider given the current situation. In this paper, we will conduct an extensive literature review of

hospitals' MCI and surge capacity plans. A case study of a trauma hospital in Miami, Florida, and a children's hospital in Little Rock, Arkansas was also conducted by way of a questionnaire. The information gathered led to the conclusion that this facility had a standard MCI plan as well as a surge plan but did not coalesce the two ideas into a single plan, though, as we have seen, an MCI can occur during this pandemic, putting additional stress on hospital facilities and personnel.

Key Words: Mass casualty incident, surge capacity, hospital preparedness

INTRODUCTION

Preparedness is key to set the stage for mitigation of a disaster or emergency situation, and also facilitates response and recovery when the situation does occur. This holds true for disaster and emergency management in any field, including healthcare. Since the beginning of 2020, we have experienced a novel situation that has impacted essentially every corner of the world. From changing everyday life routine, to overwhelming the healthcare system of even the most developed countries in the world, the SARS-CoV-2 pandemic has created an unprecedented stage for us to review and understand lessons to be learned and improve preparedness and emergency response. Analyzing it from an inpatient hospital perspective, the entire infrastructure and focus of a hospital had to be shifted. From triage, to radiology, to surgery and even environmental service staff, all had to adapt to new protocols and safety measures in order to rise above the circumstances [1]. This meant that a lot of other "nonessential" areas of healthcare would be neglected,



including cancelling elective surgeries and non-emergent healthcare services.

Mass casualty incidents have been a pressing issue in the United States for a long time, and in the current climate have become more common. The ability of hospitals to implement an effective mass casualty surge plan, immediately and expertly, has become even more important [2]. MCI response requires a certain type of resource base in order to meet the needs of the victims such as a readily available operating room, with adequate staff to do the job, readily available radiologic services, and ample intensive care unit beds and ventilators. These resources are also utilized by the hospital patients who may be critically ill, including those that have contracted COVID-19 [3].

One important step in responding to an MCI is the ability for emergency medical services to triage the patients in the setting of the incident, while understanding the capacity of each facility or hospital that will intake the victim(s). Because the development and spread of the novel coronavirus was a gradual process, it is not classified as an MCI event. Mistakenly, hospital administration may have shifted its attention from disaster and emergency preparedness for MCI's during the current healthcare climate, and simply focused on the pandemic situation at hand. Even exercises that may have been routinely scheduled previously for practice of an MCI, were impacted by new regulations of safe distancing and isolation guidelines due to the pandemic.

Normally, when a hospital who is supposed to receive patients involved in an MCI, they are first contacted via a dispatch from the county or municipality and their resource capacity is established. When capacity is lacking at the nearest trauma center, other nearby hospitals are called to intake some of the patients to alleviate the surge at the closest trauma hospital. What is novel about what we are currently experiencing is that all hospitals are being overwhelmed, so if the large county hospital with the greatest number of beds is overwhelmed and at or near capacity, then smaller hospitals may be in this similar predicament and unable to intake additional patients.

Despite the SARS-CoV-2 pandemic becoming the main focus of hospitals worldwide, the threat of an MCI is still an imminent threat for hospitals. As a result, there is a need for hospitals to understand the importance of planning and preparation for a possible surge of patients coming into the emergency department even when the facilities and personnel are busy, or possibly even overwhelmed, with COVID-19 patients.

METHODS

Initially, a literature review was done to assess the baseline of preparedness in hospitals across the United States. There is limited published literature about MCI's in the setting of the SARS-CoV-2 pandemic. However, there was a thorough amount of research demonstrating the importance of assessing surge capacity in a facility and understanding what the proper steps are to mitigate further losses or damage. The literature review was conducted by way of PubMed searches with keywords including "MCI plans and resource capacity" and "MCI plans during a pandemic". Furthermore, we wanted to obtain first-hand information from different level 1 and 2 trauma centers which were equipped to receive patients resulting from an MCI. An Internal Review Board (IRB) protocol was submitted and approved which allowed us reach out to various institutions from different areas of the United States. A level 1 trauma center in Miami, FL, and a level 1 pediatric trauma hospital in Little Rock, AR responded and answered the interview questions about their surge and preparedness plans. The security director/emergency manager of the facility in Miami agreed to sit down and review their hospital plans in order to contribute to the aim of this paper. The questionnaire was developed to address the main question "Did hospitals have an MCI plan in place in the setting of resource capacity?" There were some challenges faced with communication back and forth between the researchers and the institution, but a meeting was finally set, and the questionnaire was provided. We were also able to conduct a phone interview utilizing the questionnaire with the environmental health and safety

director/emergency manager of a level 1 trauma pediatric hospital in Little Rock, AR.

Data and analysis

A case study was conducted whereby a 23-item questionnaire was provided to the department chair of security and emergency management of a Level one trauma hospital in Miami, FL and the environmental health and safety director/emergency manager of a Level 1 pediatric hospital in Little Rock, AR. With this questionnaire, we were able to gauge the level of preparedness these hospitals had for their MCI plans, and analyze in greater depth if there had been consideration that an MCI could occur where the hospital is at resource capacity.

Level 1 hospital in Miami, FL

The questionnaire was given to the security director in person. The items in the questionnaire were also asked verbally, in the form of an interview. During the sessions we discussed details relating to their emergency management protocols as well as exercise design, planning, and frequency of exercises and plan review. One of the questions focused on understanding the level of emergency management involvement in the facility and the security director responded with "The department was abandoned back in 2017 when the old emergency manager left. They didn't bring anyone until I came later in 2018. At that point there were a lot of missing pieces so there was no adequate structure at all. So, I really have two hats on and not a lot of staff under me in terms of disaster planning." From 2018, to present, for various reasons, tabletop exercises were done, rather than full-scale exercises which are much more challenging to conduct due to a large number of individuals needing to be available and present, all while maintaining full function of the facility.

The questionnaire then shifted the focus from preparedness in general to understanding to what extent the facility could grasp their capacity and ability to respond to an MCI. When asked about rehearsal of the plans or if their plan had to be implemented in the past, he responded

stating that they had recently done a surge plan tabletop exercise with the Miami-Dade County health care professional coalition which included all hospitals in the county. In this exercise, the facility was a receiving hospital, meaning they were first to receive patients from the scene of an incident, as well as a hospital which could provide resources to nearby institutions that needed them. In order to assess whether the hospital has the capacity to lend those resources or accommodate the intake of the number of patients being received, there is a system where every hospital in the county has access to the bed availability and bed type within each hospital. For example, "If hospitals needed three in intensive care unit beds, they would simply just log onto that system, and see if we would be able to lend it to them. It's a lot of communication back-and-forth really." Despite not having a full-scale exercise done in the past year due to the pandemic and other logistical obstacles, the security director states that their plan is "pretty solid". When asked about the lessons learned so far, he stated:

"The one thing I have noticed a lot about our capabilities between departments is the communication is good when we do a table top exercise because we just turn to the apartment and talk to them about what we would do. However, in a full-scale exercise, it is completely different to communicate, so we needed to establish a safe reliable method of communication, so we decided to start purchasing radios little by little. Back when I came in 2018, the storage area for security and emergency management had been totally cannibalized. Antennas, batteries had been taken from the radios, and so we had to build the department and its supplies back little by little. It's hard to tell the administration in the hospital that we need funding for something when we don't know when we'll use it. Regardless, we were able to buy the radios little by little and then one night we had 'downtime' which meant all phone lines went down, computers went down, and we were able to communicate through these radios so Private Branch eXchange (PBX), which is our communications department that normally let's everyone in the hospital know when different codes are occurring, was able to reach out to each

department or team as needed through the radio channel as if it were an overhead announcement.”

Although operating at resource capacity during an MCI is not something that has occurred in the past, their tabletop exercises are conducted at random each quarter and utilize the current status of the hospital that very day, “so if the hospital is working at 60% capacity that morning and our exercise is a school bus accident, then we develop strategies on how to triage these patients, see which ones come here and which ones get sent to other sister hospitals, and so forth.” Their plans do not explicitly take into account hospital capacity, but their table-top exercises did attempt to function as real-time as possible.

Level 1 pediatric hospital in Little Rock, AR

A phone interview was conducted with the environmental health and safety director/emergency manager, who oversees the emergency management and operations of the children’s hospital. We first discussed the types of plans and exercises done to prepare for MCI’s, which he responded by explaining, “We perform two exercises a year, which is what is required to be certified by the Joint Commission, and we try to make one of them a full-scale exercise. When we do the full-scale, we include the local EMS (emergency medical services), fire department, and police, nursing staff and others in the hospital that would be involved. When we do the table top exercises, we’ll usually have the chief medical officer, administrative presidents and vice presidents of the hospital, nursing managers of different floors present.” Following up on that thread, we inquired how often MCI plans are revised and edited, “well the plans themselves are reviewed once a month we get together in the command center with the emergency management committee and it is deeply looked at. It’s similar to a table top but we do not have an organized scenario that we can exercise. We normally do a deeper analysis and edition of the plan once a year or when we do a full-scale and determine there may be some holes in the plan. For example, we recently did an exercise with riots because it was a common occurrence in our own backyard. We triaged patients with potential

pepper spray and also taking into account the respiratory precautions from COVID-19.”

On the topic of COVID-19, we asked what some of the challenges were that they faced as an institution, and if the MCI plan was ever put in place while at resource capacity to which he responded by saying:

“Being a pediatric hospital, we did not become overwhelmed like other institutions, thankfully the virus did not affect the pediatric population as much, and we actually had to create a separate wing in the hospital and occupy it with hospital beds because other hospitals nearby were actually getting overwhelmed. We were actually one of the few hospitals in the area who were not at capacity and had the ability to do what we did. Another thing that we did was increase the age of patient admission from 21 to 26. Setting up that area of the hospital was a little bit challenging because we had to create the network of partnerships with not only the vendor companies that could sell the necessary hospital equipment or PPE (personal protective equipment), but also the staff required like available nurses and doctors. As part of the emergency operations plan, we have references additional volunteer capacity and activating staff to come in for the time needed. In terms of activating an MCI plan during this time, we did not have to do it, but if we would have, we have in place the arrangements with other facilities, ambulance services that are in the plan to service the hospital if we are overflowing.”

We then followed up with asking about lessons learned in the past year or in this implementation in order to act as a receiving hospital and help off-load nearby centers, he stated that some of the challenges that needed to be addressed were in security. “One of the things that had not been considered were issues with the adult population entering a pediatric hospital. Were these adult patients a threat? We started getting concerns for weapons and firearms, sexual molestation and started to wonder if the safety of our pediatric population would be compromised if there is an adult roommate next to them. Thankfully, this never happened, but it was a concern that we got once we started to review what we were actually doing.”

DISCUSSION

It goes without saying that planning and preparedness for an MCI is an ongoing process of review and revision of hospital preparedness plans based on experiences and lessons learned. A preparedness plan is a living document which should be periodically reviewed. It may be unfair to expect hospitals to develop MCI plans specific to resource capacity, as it is challenging enough to accurately prepare for an incident of such proportions. Plans should be reviewed and updated at least yearly to address the gaps and areas of weakness discovered from actual incidents or from table top or full-scale exercises which should be conducted regularly. These exercises should include hospital personnel from various departments, as well as other hospitals in the area, community stakeholders, and should address different aspects of the hospital's preparedness plan such as communications, patient intake, or reunification. One of the issues that arose during the COVID-19 pandemic is that the hospitals were already stretched thin and personnel were overworked. So if the hospital was not already prepared for an MCI and a surge of emergency or trauma patients, there was little to no time to review and work on that, update plans, or address gaps during the pandemic. This point emphasizes the need to prepare for such gray sky events before they occur, as well as the importance of exercising, working with community partners, and the need for different departments to collaborate and understand the needs and gaps of the others.

An interesting perspective was obtained from a study published by the World Journal of Emergency Surgery, where they equate the SARS-CoV-2 pandemic to a world live MCI event, and highlighting the widespread under-preparedness and urgent need to establish global government cooperation in preparedness for MCI's, specifically the pandemic as an MCI of global proportions [4]. Particularly, the idea of an MCI almost implies a hyper acute or acute event that overwhelms an establishment in a short period of time that does not resonate with the way a pandemic unfolds. However, certain peaks of the pandemic

have proven to overwhelm the hospitals very quickly, perhaps resembling the effects that an MCI would have.

Creating surge capacity in a hospital requires the distribution of casualties to hospitals that are not designated as trauma centers. Shartar et al, attempted to develop a surge capacity protocol where they extrapolated MCI response research into operational objectives for MCI distribution plan development and formulated a patient distribution model based on research, hospital capacities, resource availability, and design and disseminate a casualty distribution tool for use by EMS personnel to distribute patients to the appropriate level of care [5].

CONCLUSION AND FURTHER DIRECTIONS

One of the greatest challenges that a hospital may come across when trying to prepare for MCI's in different circumstances is trying to reproduce an accurate result by examining previous incidents, using lessons learned from those incidents, and further strengthening their action plan. This process can be meticulous, time consuming, and demand a number of resources that may not be readily available when a hospital is operating even at baseline, or minimal capacity, let alone during a pandemic. A study conducted in University Hospitals across Italy done to test a software simulator of mass casualty incidents, was able to demonstrate the responsiveness of each institution while varying certain factors within the hospital such as capacity and their ability to respond to the simulated MCI's. The results of the study concluded that this tool was effective in understanding and self-reporting from an internal perspective of what a hospital would be ready to withstand, given certain circumstances such as resource capacity [6]. There is currently a lack of such resources for use in the United States, but this type of tool can be used by hospitals that are meant to intake victims of MCI's, such as trauma centers, and thus provide some data as to the resilience of the hospital given the theoretical circumstances created by the simulation tool. This can better prepare the hospital to reinforce the areas of weakness and help that hospital respond to a real-life event. A tool like this can also be used to stimulate or guide the discussion in table top exercises,



where representatives from different departments of the hospital can provide input on the weak points or gaps of the simulation and can be used to further update their mass casualty incident plans at different capacity levels. For now, hospitals must rely on plan review and exercising different part of their plan to find the gaps so they can be addressed.

The perspective obtained from a pediatric hospital in the setting of the pandemic, and their role in the community to aid when other hospitals are functioning at resource capacity, is one that warrants further exploration. There is little to no literature about this type of situation, although a study conducted by Cambridge University Press Disaster Medicine and Public Health Preparedness studied the response of two hospitals on the west coast who very early on activated their Incident Command System (ICS) and Emergency Operations Center (EOC) and plans in preparation for a surge of patients, but soon realized they had to change the role to regional support for the adult hospitals nearby [7]. The potential to create a county or local infrastructure for hospitals and healthcare facilities to coordinate with pediatric hospitals is an important step.

In healthcare, medically necessary, essential, and issues of imminent importance are given greater priority than tools and resources designed to be preventative in nature. Because of this, disaster preparedness and emergency management may suffer budget shortcomings, especially in times of a pandemic where the main focus is not the typical acute emergency like an MCI. This is especially noticeable in hospitals that are private for-profit and non-university affiliated due to lack of state and federal funding. In a study published by the Scandinavian Journal of Trauma Resuscitation Emergency Medicine, it was found that preparedness for MCI's in Swedish hospitals were dependent on the county budget, and surgical surge capacity for an MCI was being neglected [8].

A hospital's capacity to respond to an MCI is an indicator of how prepared other nearby hospitals should also be. It becomes challenging to assess capacity in an objective manner when certain hospitals in the community can provide resources and services at a particular time where other hospitals in the community are not able to

offer. Hospital surge capacity in multiple casualty events (MCE) is the core of hospital medical response, and an integral part of the total medical capacity of the community affected. One challenge is that there has not been a consensus on how to gather or quantify this surge capacity or development of a tool that helps EMS triage the patients from the scene of an MCI and transport them to the proper facility in order to minimize loss of life and improve overall outcome [9]. Since hospital capacity during real events is not static, largely depending on occupation of the available resources, it is important that the regional command center and the hospitals receiving casualties constantly communicate on specific agreed upon critical resources, in order for the regional command center to timely evaluate the overall regional capacity and guarantee the appropriate distribution of the patients [10]. This approach, of course, relies on pre-established regional cooperation of area hospitals, as the environmental health and safety/emergency manager for the pediatric trauma hospital in Little Rock, AR mentioned during his interview. Having for-profit, not-for-profit, university hospitals, and hospitals belonging to different hospital groups, this is another challenge to overcome.

Granted the COVID-19 pandemic causing facilities to be overwhelmed is, thankfully, not a regular occurrence. However, with an influenza pandemic in 2009-2010, the potential for Ebola Virus Disease to reach the United States in large numbers, and the current pandemic, this has shown to be not just a once in a lifetime occurrence.

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