NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

TWO TEAMS, ONE MISSION: A STUDY USING EMS UNITS IN HOSPITAL TRIAGE DURING ACTIVE-SHOOTER AND OTHER MASS-CASUALTY EVENTS

by

Thomas B. Simons

December 2019

Co-Advisors: Anke Richter
Lauren Wollman (contractor)

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** December 2019	**3. REPORT TYPE AND DATES COVERED** Master's thesis

4. TITLE AND SUBTITLE
TWO TEAMS, ONE MISSION: A STUDY USING EMS UNITS IN HOSPITAL TRIAGE DURING ACTIVE-SHOOTER AND OTHER MASS-CASUALTY EVENTS

5. FUNDING NUMBERS

6. AUTHOR(S) Thomas B. Simons

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release. Distribution is unlimited.

12b. DISTRIBUTION CODE
A

13. ABSTRACT (maximum 200 words)

The Las Vegas Route 91 shooting, as well as other recent mass-casualty events, have exposed gaps in the response of Emergency Medical Services (EMS) and hospitals to these types of incidents. This research sought to examine whether the use of EMS field resources in hospital triage could enhance the overall response to active-shooter and other mass-casualty events. Case studies of the Boston Marathon bombing and the Route 91 shooting were conducted. Additionally, an exercise by St. Marks Hospital testing the concept of EMS triage at hospitals was analyzed. The Las Vegas case study revealed significant gaps in hospital and EMS response and the Boston Marathon case study showed just how efficient hybrid teams of hospital and EMS personnel could be. A review of the St. Marks exercise showed that EMS crews at the hospital significantly enhanced the efficiency and efficacy of the triage operation. Finally, current EMS operations were reviewed and recommendations made to allow EMS crews to be assigned to the nearest hospitals without harming the on-scene response to these incidents.

14. SUBJECT TERMS
active shooter, mass-casualty, triage, EMS, TECC, START, hospital surge

15. NUMBER OF PAGES
69

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

TWO TEAMS, ONE MISSION: A STUDY USING EMS UNITS IN HOSPITAL TRIAGE DURING ACTIVE-SHOOTER AND OTHER MASS-CASUALTY EVENTS

Thomas B. Simons
Firefighter/Paramedic, Salt Lake City Fire Department
BS, Utah Valley State College, 2012

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(HOMELAND SECURITY AND DEFENSE)**

from the

**NAVAL POSTGRADUATE SCHOOL
December 2019**

Approved by: Anke Richter
Co-Advisor

Lauren Wollman
Co-Advisor

Erik J. Dahl
Associate Professor, Department of National Security Affairs

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The Las Vegas Route 91 shooting, as well as other recent mass-casualty events, have exposed gaps in the response of Emergency Medical Services (EMS) and hospitals to these types of incidents. This research sought to examine whether the use of EMS field resources in hospital triage could enhance the overall response to active-shooter and other mass-casualty events. Case studies of the Boston Marathon bombing and the Route 91 shooting were conducted. Additionally, an exercise by St. Marks Hospital testing the concept of EMS triage at hospitals was analyzed. The Las Vegas case study revealed significant gaps in hospital and EMS response and the Boston Marathon case study showed just how efficient hybrid teams of hospital and EMS personnel could be. A review of the St. Marks exercise showed that EMS crews at the hospital significantly enhanced the efficiency and efficacy of the triage operation. Finally, current EMS operations were reviewed and recommendations made to allow EMS crews to be assigned to the nearest hospitals without harming the on-scene response to these incidents.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I. INTRODUCTION....1
A. PROBLEM STATEMENT....1
B. RESEARCH QUESTION....3
C. LITERATURE REVIEW....3
1. Mass-Casualty Case Studies....3
2. Triage Guidance....5
3. Hospital Surge Guidelines....8
D. RESEARCH DESIGN....9

II. CURRENT MASS-CASUALTY RESPONSE....11
A. GENERAL MASS-CASUALTY RESPONSE....11
B. ACTIVE-SHOOTER RESPONSES....12
C. HOSPITAL OPERATIONS....14
D. ANALYSIS....14

III. CASE STUDY: BOSTON MARATHON BOMBING, APRIL 15, 2013....15
A. INCIDENT OVERVIEW....15
B. PRE-HOSPITAL RESPONSE....16
C. HOSPITAL RESPONSE....18
D. ANALYSIS....18

IV. CASE STUDY: ROUTE 91 FESTIVAL SHOOTING, LAS VEGAS....21
A. INCIDENT OVERVIEW....21
B. EMS RESPONSE....22
C. HOSPITAL RESPONSE....25
D. ANALYSIS....27

V. ST. MARKS HOSPITAL DRILL REVIEW AND ANALYSIS....29
A. DESIGN....29
B. QUANTITATIVE DATA....31
C. QUALITATIVE DATA AND PERSONAL OBSERVATIONS....31
D. ANALYSIS....33

VI. EMS FIELD RESPONSE MODIFICATION....37
A. MODIFICATIONS TO ALLOW FOR EMS IN TRIAGE AT CLOSEST HOSPITALS....37
1. Scene Operations....37

2. Hospital Operations 39
B. CONCLUSIONS 39

VII. LIMITATIONS, FURTHER STUDY, AND CONCLUSIONS 41
A. LIMITATIONS 41
B. FURTHER STUDY 42
C. CONCLUSIONS 43

LIST OF REFERENCES 45

INITIAL DISTRIBUTION LIST 49

LIST OF FIGURES

Figure 1. Current Process for Active Shooter 13

Figure 2. Proposed Scene Response Flow for All Mass-Casualty Events 39

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

CCFD	Clark County Fire Department
EMS	emergency medical services
ER	emergency room
FEMA	Federal Emergency Management Agency
HHS	Health and Human Services
ICU	intensive care unit
MACC	Multi-Agency Coordination Center
RTF	response task force
START	simple triage and rapid treatment
TCCC	tactical combat casualty care
TECC	tactical emergency casualty care

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

Hospital planners generally assume that the majority of patients from a mass-casualty event will have received some sort of field triage, that transport from the scene to the hospital will have been coordinated through on-scene incident command, and that hospitals will have received some sort of notification of incoming patients. Recent events, however, have invalidated such assumptions. In the 2017 Las Vegas active-shooter event, only 20 percent of the estimated 850 patients were transported by ambulance to local hospitals.[1] While on a much smaller scale, the Orlando Regional Medical Center saw similar results in the wake of the Pulse Nightclub shooting, with initial transport from the scene being initiated by police and civilians using police units and privately owned vehicles.[2]

These two events, taken together, would seem to indicate a shift in the way patients arrive at hospitals after active-shooter events. Why this shift is occurring is not entirely clear. Whatever the reason, this pattern of civilian and police transport of victims has been seen in virtually all the recent mass-casualty events reviewed for this research.

In all the cases reviewed, hospital emergency room (ER) staff initiated their mass-casualty response protocols. However, with the majority of patients not arriving by ambulance, ER nurses and physicians were forced to perform initial triage on large numbers of incoming patients and direct them to appropriate care areas.[3] This lack of initial triage caused hospitals in both of the previously mentioned incidents to become overwhelmed rapidly. While non-emergency medical services (EMS) transport has generally been acknowledged to have improved victim survivability, case studies of mass-

---

[1] Mary Radebach, "Healthcare Response to a No-Notice Incident: Lessons Learned from Las Vegas Festival Shooting," *ASPR* (blog), April 24, 2018, https://www.phe.gov/ASPRBlog/Lists/Posts/Post.aspx?ID=308.

[2] Michael Cheatham et al., "Orlando Regional Medical Center Responds to Pulse Nightclub Shooting," *Bulletin of the American College of Surgeons*, November 1, 2016, http://bulletin.facs.org/2016/11/orlando-regional-medical-center-responds-to-pulse-nightclub-shooting/.

[3] Christopher Lake, *A Day Like No Other: A Case Study of the Las Vegas Mass Shooting* (Reno: Nevada Hospital Association, 2018), 57, https://drive.google.com/file/d/1CxbLHiWJwL9ZRbWddbaPv15NN6YiNFEc/view?usp=embed_facebook.

casualty incidents actually showed that the process could be improved with some kind of assistance in triage at the hospital. The question that this research seeks to answer is whether EMS can provide this assistance.

While the logistics of the response to the Boston Marathon were well outside the scope of what might usually be expected in a mass-casualty incident, the case was still reviewed due to the hybrid team of hospital and EMS personnel who responded to the event. What this review and analysis showed was that this hybrid team could provide initial triage and treatment in an expedient and efficient manner. While unlikely to be seen in future mass-casualty events, this incident certainly showed what was possible when EMS crews assist hospital personnel with triage.

As the largest mass-casualty incident to date, the Las Vegas shooting exposed the gaps in current response plans on an exponential scale.[4] Of the approximately 850 victims of the shooting, only about 250 of them were triaged and transported by EMS resources on scene.[5] This massive influx of patients, especially non-EMS triaged patients, quickly began to overwhelm local hospitals. One hospital even reported a quarter-mile long line of vehicles waiting to get in the parking lot at one point during the incident.[6]

Reviewing the situation faced at the closest hospitals to the Route 91 shooting, St. Marks Hospital, as a part of its regularly scheduled disaster drill program, conducted an exercise to simulate the experience of Sunrise Metro Hospital.[7] During the course of this drill, EMS was assigned to take over triage operations and nurses were relieved to return to the ER. Data collected during this drill showed that EMS crews were faster and more

---

[4] Eric Levenson, "The Cold, Calculating Timeline of the Las Vegas Gunman," CNN, October 10, 2017, https://www.cnn.com/2017/10/05/us/las-vegas-shooting-timeline/index.html.

[5] Janet Smith, Glen Simpson, and A. J. Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas," *Journal of Emergency Medical Services* 43, no. 4 (April 1, 2018), https://www.jems.com/articles/print/volume-43/issue-4/features/ems-response-to-the-mass-shooting-at-the-route-91-harvest-festival-in-las-vegas.html.

[6] Lake, *A Day Like No Other*, 10.

[7] John Jones, *St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018: After Action Report* (Salt Lake City, UT: St. Marks Hospital, 2018), 1, unpublished.

accurate at performing initial triage and treatment of patients arriving at the hospital, whether by EMS or non-EMS means.[8]

With gaps exposed in the Las Vegas shooting and an exercise showing that EMS is potentially faster and more accurate than ER nurses are, the question remaining is whether EMS crews may possibly be spared from the field incident response to assist at the closest hospitals. In exploring current EMS responses to active-shooter incidents, several redundant areas of patient care appear to be performed at the same time. Triage and treatment is performed "under fire" using the tactical emergency casualty care (TECC) principals; a researched backed civilian variation of basic sorting and life-saving treatments utilized by military medics in combat situations. Casualties are then removed from the danger area and pass through another triage and treatment section where simple triage and rapid treatment (START) triage is applied. Finally, victims are moved to the transport area where they are sent to area hospitals, based on their level of severity.

TECC protocols and the tactical combat casualty care (TCCC) protocols on which they are based have a mounting body of evidence supporting their efficacy while START triage lacks any real evidentiary support in field operations. Thus, the need for these redundant processes to occur on scene seems to be invalidated. Victims instead could be moved directly to the transport area when being removed from where they were initially encountered by medical personnel. The EMS crews that would have otherwise been assigned to the triage and treatment operation could then be freed to be sent to assist with triage and treatment at hospitals, where they could capture both EMS and non-EMS transported patients.

It seems clear, given the gaps in response identified in this research, that the utilization of EMS in triage operations at the closest hospitals has the potential to enhance the response to mass-casualty events significantly. While further study is required to validate these results and much work remains to identify how best to implement this system, the results observed in this study indicate that these changes should be made in the very near future.

---

[8] Jones, 7.

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

I would like to extend my deepest gratitude to my thesis committee. Without the guidance, encouragement, and support of Dr. Lauren Wollman, and the expertise of Dr. Anke Richter, this valuable research would never have been able to reach a successful conclusion.

I would like to thank Keith Squires and Martha Ellis for their support and recommendations. I would also like to extend my thanks to the Center for Homeland Defense and Security and all its staff and alumni for their assistance on my path through the program.

To all the past and current members of cohort 1803/1804, I send my sincere and heartfelt thanks for accepting me as a part of our little family. The life-long bonds I have forged with you, as we faced the gauntlet of this program together, not only enhanced my experience in this program, but my life in general. I will look back on my time with you all with the greatest fondness as I also look forward to a future where we work together to advance the Homeland Security enterprise.

John Jones, my friend and mentor: thank you for planting the seed of this research with your tremendous exercise. Not only were the findings of that drill critical to my success, but also have significant potential to save lives. You were the one who started me on this path and I cannot wait to continue to walk and learn with you.

To my family and friends: I would not be where I am without you nor would I ever have been able to complete this rigorous program without your unwavering love and support. While the list of those who have supported me is far too long to mention, a few bear mention.

Leland and Shan Doller, my mother and father-in-law: your support with the day-to-day operations of my family and childcare were invaluable to me.

Blaine and Diane Simons, my parents: words cannot express just how grateful I am and how much your love and support have meant to me. Thank you for always encouraging

me to push my boundaries and for your endless encouragement throughout my graduate school experience.

Jan Buttrey, my aunt: you have continued to inspire me as I look for ways to make my mark in public safety. You started me on this journey some 23 years ago and you continue to show me new paths and ideas.

Stacie Simons, my sister: I am so proud of what you have become. Thank you for bringing your newfound passion for emergency management into my life at a time when I needed encouragement to push forward.

Camden and Scarlet Simons, my children: you have showed maturity and wisdom well beyond your years as you have sacrificed your time with me in the pursuit of my dreams. I truly hope to one day provide you with the same kind of love and support as you pursue your hopes and dreams.

Finally, to my wife, Leesha Simons: I would not be who I am or where I am without you by my side. I know this journey has taxed and tested you to your limits as you have been left to run a household for weeks on end as I journeyed across the country. I will never be able to tell you just how much your love and support has meant to me. This research and wherever it takes me is all because of you. I love you with all my heart.

I. INTRODUCTION

A. PROBLEM STATEMENT

Hospital planners generally assume that the majority of patients from a mass-casualty event will have received some sort of field triage, that transport from the scene to the hospital will have been coordinated through on-scene incident command, and that hospitals will have received some sort of notification of incoming patients. Recent events, however, have invalidated such assumptions. In the 2017 Las Vegas active-shooter event, only 20 percent of the estimated 850 patients were transported by ambulance to local hospitals.[1] While on a much smaller scale, Orlando Regional Medical Center saw similar results in the wake of the Pulse Nightclub shooting, with initial transport from the scene being initiated by police and civilians using police units and privately owned vehicles.[2]

These two events, taken together, would seem to indicate a shift in the way patients arrive at hospitals after active-shooter events. Why this shift is occurring ‘is not entirely clear. Orlando Regional Medical Center was within three blocks of the Pulse Nightclub. Knowing this location, police officers not engaged in the initial firefight with the suspect initiated transport with police vehicles and pickup trucks while EMS waited a few blocks away for police to secure the scene.[3] In the Las Vegas shooting, bystanders used the mapping and GPS capabilities of their phones to find the closest hospitals and initiate transport before EMS arrived on scene. Whatever the reason, this pattern of civilian and police transport of victims has been seen in virtually all the recent mass-casualty events reviewed for this research.

In all the cases reviewed, hospital emergency room (ER) staff initiated their mass-casualty response protocols. However, with the majority of patients not arriving by

---

[1] Mary Radebach, “Healthcare Response to a No-Notice Incident: Lessons Learned from Las Vegas Festival Shooting,” *ASPR* (blog), April 24, 2018, https://www.phe.gov/ASPRBlog/Lists/Posts/Post.aspx?ID=308.

[2] Michael Cheatham et al., “Orlando Regional Medical Center Responds to Pulse Nightclub Shooting,” *Bulletin of the American College of Surgeons*, November 1, 2016, http://bulletin.facs.org/2016/11/orlando-regional-medical-center-responds-to-pulse-nightclub-shooting/.

[3] Cheatham et al.

ambulance, ER nurses and physicians were forced to perform initial triage on large numbers of incoming patients and direct them to appropriate care areas.[4] In their case study of the Las Vegas shooting, Dr. Christopher Lake and the Nevada Hospital Association found that ER physicians and nurses were more valuable to the overall response when they were working in their department rather than performing intake and triage of arriving patients. Their suggested solution involves ER nurses initiating triage but rapidly returning to the ER as cross-trained nurses from other, less-critical care areas replace them.[5] Current guidance, however, dictates skilled and experienced providers should perform that triage to achieve the most efficient results.[6] Hospital staff from other care areas may have had some triage training but have little to no experience in triage.

While no question remains that hospitals have to rely on their own internal resources in the opening stages of any incident, capacity limitations and a need for more efficient triage seem to require outside assistance. Local emergency medical service (EMS) providers could provide this qualified assistance. They have received extensive training in triage and mass-casualty incidents, which they use daily in the course of their core professional duties.[7]

The major concern with EMS reporting to hospitals to provide triage assistance is the need for these resources on scene. The previously mentioned recent events, however, suggest that perhaps the greater need for triage is in fact at the hospitals because it may be the first point of contact with medical providers for the majority of victims.

---

[4] Christopher Lake, *A Day Like No Other: A Case Study of the Las Vegas Mass Shooting* (Reno: Nevada Hospital Association, 2018), 57, https://drive.google.com/file/d/1CxbLHiWJwL9ZRbWddbaPv15NN6YiNFEc/view?usp=embed_facebook.

[5] Lake, 39.

[6] Michael S. Baker, "Creating Order from Chaos: Part I: Triage, Initial Care, and Tactical Considerations in Mass Casualty and Disaster Response," *Military Medicine* 172, no. 3 (March 1, 2007): 232, https://doi.org/10.7205/MILMED.172.3.232.

[7] S. M. Sasser et al., "Guidelines for Field Triage of Injured Patients. Recommendations of the National Expert Panel on Field Triage," National Expert Panel on Field Triage, Centers for Disease Control and Prevention, *MMWR Recomm Rep.* 58, no. RR-1 (January 23, 2009): 8, https://www.ncbi.nlm.nih.gov/pubmed/19165138.

Thus, it becomes clear that EMS may have a role to play in hospital triage after active-shooter events and other similar mass-casualty incidents. Questions about response models, interagency planning, and logistical challenges remain, but it seems worth exploring whether EMS can improve the overall efficiency of the response to these events by assisting with triage and intake at the hospitals closest to the scene.

B. RESEARCH QUESTION

Would the use of EMS field resources in hospital triage enhance the overall response to active-shooter and other mass-casualty events?

C. LITERATURE REVIEW

A review of the literature surrounding active-shooter and mass-casualty events reveals an emerging trend of large numbers of patients being transported to hospitals by means other than EMS. Some debate has arisen as to the most efficient and effective method of pre-hospital triage in these events. Various after-action reports and case studies of major active-shooter and mass-casualty events are readily available; however, any definitive study on the efficacy of any particular triage method and of the use of EMS within the hospital setting is not available. While several sources recommend that EMS assist hospitals with intake and triage in the wake of a mass-casualty event, any evidence to back this guidance does not appear to exist, nor do recommendations for its execution.

1. Mass-Casualty Case Studies

Case studies have been conducted of recent high-profile active-shooter and mass-casualty events. Specifically relevant to this study are the after-action reports and other sources on the Las Vegas shooting, the Pulse Nightclub shooting, and the Boston Marathon bombing.[8] The Las Vegas and Pulse Nightclub events reveal the emerging trend of patients being transported to hospitals by methods other than EMS. The Boston Marathon bombing

[8] Lake, *A Day Like No Other*; Frank Straub et al., *Rescue, Response, and Resilience: A Critical Incident Review of the Orlando Public Safety Response to the Attack on the Pulse Nightclub* (Washington, DC: Office of Community Oriented Policing Services, 2017), 198; Jonathan D. Gates et al., "The Initial Response to the Boston Marathon Bombing," Annals of Surgery 260, no. 6 (December 2014): 960–66, https://doi.org/10.1097/SLA.0000000000000914.

shows what is possible when EMS and hospital personnel work together within the triage and transport piece of a mass-casualty event.

In 2018, Dr. Christopher Lake and the Nevada Hospital Association released their final report on the performance of local hospitals in the wake of the 2017 Las Vegas mass shooting.[9] This report summarizes the situations faced at local hospitals and proposed recommendations for future events. Lake's report found that a majority of patients were transported to local hospitals in private vehicles instead of ambulances.[10] Federal Emergency Management Agency's (FEMA's) after-action report later showed that this type of transportation used was not due to a lack of ambulance resources, as more than 130 ambulances were dispatched to the scene.[11] Based on this influx of patients in private vehicles who had received no field triage or treatment, Lake makes several recommendations, including focusing more on patient throughput than surge capacity and utilizing personnel other than emergency department staff in triage.[12]

The Pulse Nightclub shooting in Orlando, Florida, on June 12, 2016, was the deadliest mass shooting in the United States until it was surpassed by the Las Vegas shooting. In the former event, 49 individuals were killed and another 58 were injured.[13] Cheathem et al. found that, as in the Las Vegas shooting, though on a much smaller scale, many patients arrived on foot or in private vehicles rather than in ambulances, especially in the opening stages of the event.[14] In their after-action report, Straub et al. found that the transport of patients in police vehicles in the initial stages of the event was beneficial to the overall outcome, while acknowledging that it quickly overwhelmed hospital staff.[15] They identified the need for further relationship-building between first-response agencies and

---

[9] Lake, *A Day Like No Other*.

[10] Lake, 57.

[11] Federal Emergency Management Agency, *1 October After-Action Report* (Washington, DC: Department of Homeland Security, 2018), 10.

[12] Lake, *A Day Like No Other*, 21.

[13] Cheatham et al., "Orlando Regional Medical Center Responds."

[14] Cheatham et al.

[15] Straub et al., "Rescue, Response, and Resilience," 78.

hospitals to increase the overall efficiency of future events.[16] Neither source finds fault or issue with private nor police transport of injured individuals, per se. What both of these sources find, however, is that this type of transport quickly overwhelms the intake and triage capacity of the receiving hospitals.

Due to the unique combination of hospital and EMS personnel on scene, the literature on the Boston Marathon bombing of April 13, 2013 is relevant and valuable. Biddinger et al. concluded that the overall medical response to this event was successful.[17] A study by Gates et al. explored the response of EMS and hospital medical staff in Alpha medical tent, which was in immediate proximity to the explosions.[18] It documented the rapid triage by EMS personnel, basic lifesaving treatment by hospital personnel on site, followed by rapid transport to receiving hospitals as keys to the lack of mortality among those transported.[19] This particular incident was a unique combination of EMS and hospital personnel working together on a mass-casualty incident. While this particular triage event occurred in the field, it gives a glimpse of what may be possible when these entities work together in a hospital setting.

While the Las Vegas and Orlando after-action reports and case studies document problems with hospital triage, little consensus exists as to a path forward. These documents present suggestions and recommendations, but they offer neither a common thread nor innovative solutions. As far as EMS use in hospital intake and triage, published studies or research are extremely lacking. Taken together, it has been demonstrated that a problem has been identified but no single solution has yet emerged.

2. Triage Guidance

Since the 1980s, START (simple triage and rapid treatment) triage has been the dominant system among U.S. first response agencies. While this system establishes a

---

16 Straub et al., 79.

17 Paul D. Biddinger et al., "Be Prepared—The Boston Marathon and Mass-Casualty Events," *New England Journal of Medicine* 368, no. 21 (May 23, 2013): 1958, https://doi.org/10.1056/NEJMp1305480.

18 Gates et al., "The Initial Response to the Boston Marathon Bombing."

19 Gates et al.

uniform approach to triage, it is regularly criticized as having no evidence from which to draw upon for its use in the field.

Recent research that has attempted to validate START triage has also led to a renewed search for a better method. START and TECC (tactical emergency casualty care) methods of triage and casualty care are examined since they are relevant to the examined case studies, as well as current and proposed methods of operation.

Hoag Hospital and Newport Beach Fire Department developed START triage in the 1980s.[20] This system involves sorting patients into four categories within the first 60 seconds of patient contact by patient care providers.[21] A review of the literature on START triage produces some conflicting thoughts about its efficacy. The primary issue regularly identified as a limiting factor is the lack of research surrounding the accuracy and efficiency of START in disaster situations.[22] This finding is not particularly surprising, as the situations in which this system is used are chaotic, overwhelming, and occur without any notice. Thus, it becomes very difficult to collect any kind of useful data.

Kahn et al. endeavored to study START triage in the wake of a train crash in 2003. They hypothesized that START would be about 90% successful in correctly sorting patients into the appropriate category. Their research of the event found that this hypothesis was fairly accurate.[23] However, they also found that the system led to a substantial level of over triage and that pre-hospital triage levels were a poor predictor of patient outcomes in general.[24] Kahn et al. postulated that this tendency of the system to over-triage some lesser-injured patients might actually delay the care of more critical patients and lead to

---

[20] Hiroyuki Nakao, Isao Ukai, and Joji Kotani, "A Review of the History of the Origin of Triage from a Disaster Medicine Perspective," *Acute Medicine & Surgery* 4, no. 4 (July 14, 2017): 379–84, https://doi.org/10.1002/ams2.293.

[21] Will Cannon and A. J. Heightman, "A Scientific Look at START and Our Ability to Do It," *Journal of Emergency Medical Services,* May 4, 2015, https://www.jems.com/articles/print/volume-40/issue-5/features/a-scientific-look-at-start-and-our-ability-to-do-it.html.

[22] Cannon and Heightman.

[23] Christopher A. Kahn et al., "Does START Triage Work? An Outcomes Assessment after a Disaster," *Annals of Emergency Medicine* 54, no. 3 (September 2009): 429, https://doi.org/10.1016/j.annemergmed.2008.12.035.

[24] Kahn et al., 429.

increased mortality.[25] This finding also seems to support the idea that field EMS crews are quite adept at applying the principals of START triage, but that these categories are a poor predictor for which patients actually required more immediate transport.

The other method of relevance to this research is TECC. This system is specifically designed for pre-hospital medical professionals based on the military combat medicine system of TCCC (tactical combat casualty care).[26] While TCCC was originally attempted, as a whole, to be transplanted into pre-hospital care, its combat orientation made it less than suitable. However, as TCCC is credited with a nearly 50% reduction in battlefield fatalities, it was recognized that its implementation in some form would be beneficial to the management of trauma in civilian emergency medicine.[27]

The full body of TECC guidelines contains guidance from initial patient triage through delivery to definitive care. Callaway et al. lay out a comprehensive outline for the phases and principals of TECC and their application in civilian emergency medicine.[28] This approach focuses very narrowly on those conditions identified by TCCC as preventable causes of death: hemorrhage, airway compromise, and tension pneumothorax. The overall aim of this system is rapid extrication, minimal intervention, and rapid evacuation to definitive care at the closest trauma center.[29]

TECC principles are rapidly being integrated by local pre-hospital EMS and fire agencies into RTF (response task force) models of active-shooter response.[30] A search of the literature seems to show broad adoption of the TECC principals within the narrow

---

[25] Kahn et al., 425.

[26] David Wayne Callaway et al., "Tactical Emergency Casualty Care (TECC): Guidelines for the Provision of Prehospital Trauma Care in High Threat Environments," *Journal of Special Operations Medicine : A Peer Reviewed Journal for SOF Medical Professionals* 11, no. 3 (2011): 104–22.

[27] Callaway et al., 105.

[28] Callaway et al., 106–112.

[29] Callaway et al., 113.

[30] "FDIC 2019 Quick Take: Deploy the Fire/EMS RTF to Active Shooter/Hostile Events," FireRescue1, accessed July 11, 2019, https://www.firerescue1.com/mci-mass-casualty-incidents/articles/393870018-FDIC-2019-Quick-Take-Deploy-the-fire-EMS-RTF-to-active-shooter-hostile-events/.

confines of the "care under fire" phase of TECC.[31] While little published literature exists as yet, a review of Salt Lake City Fire Department's policy, a department recognized as a RTF innovator, shows a transition to more standard START triage guidance once the patient is removed from the "warm zone" of an active-shooter incident.

As the adoption of TECC is quite recent, very little data supports its relevance or efficacy. That being said, the dramatic reduction in combat fatalities seen with TCCC principles would seem to indicate that, given enough time, they could lead to a similar decrease in fatalities from active-shooter and other mass-casualty events.

3. Hospital Surge Guidelines

Current guidance from the Department of Health and Human Services (HHS) is that hospitals should maintain a 20% surge capacity of available staffed beds.[32] Most all relevant reference materials reviewed in a search of the literature corroborate this number and seem to support its near universal adoption. The same search, though, seems to recognize also a difficulty in maintaining this number as most hospitals are already operating at maximum capacities, and even must regularly divert ambulance patients during normal operating conditions.[33] Further, as previously referenced in Lake's after-action review of the Route 91 Festival shooting in Las Vegas, it was found that throughput, or the ability to progress patients rapidly through each phase of care, was more important than the actual surge capacity of available staffed beds.[34]

---

[31] Callaway et al., "Tactical Emergency Casualty Care (TECC)," 106.

[32] Hospital Preparedness Program, *Hospital Preparedness Program (HPP) Healthcare Preparedness Capability Review National Call Capability 10: Medical Surge and Immediate Bed Availability (IBA) Meeting Summary* (Washington, DC: Department of Health & Human Services, 2013), 12, https://www.phe.gov/Preparedness/planning/hpp/meetings/Documents/capability10.pdf.

[33] Catharine W. Burt and Linda F. McCaig, "Staffing, Capacity, and Ambulance Diversion in Emergency Departments: United States, 2003–04," *Centers for Disease Control and Prevention*, no. 376 (2006): 24.

[34] Lake, *A Day Like No Other*, 21.

Another common theme amongst guidance for hospital operations in mass-casualty situations is the need for EMS assistance in triage operations at overwhelmed hospitals.[35] While this recommendation is repeated in many resources, no literature exists providing further evidence or guidance for its implementation.

The literature reviewed for this project has very clearly identified an emerging trend towards more law enforcement and civilians transporting patients in the opening phases of mass-casualty events. While identified as beneficial in the Pulse nightclub incident, it is also shown to overwhelm the triage capacity of the closest hospitals.[36] With a need for assistance in triage at hospitals and an identified weakness in the use of START on scene, the literature seems to suggest that another solution is needed.

D. RESEARCH DESIGN

To understand how the current system may be changed, the first step is to examine current EMS operations in mass-casualty events. The overall structure is presented, as well as how TECC and START principles are applied. Field and hospital operations are reviewed in the format likely applied in the Las Vegas shooting, as well as most other mass-casualty events.

After reviewing current operations, three different case studies are conducted. The first is that of the Boston Marathon bombing. As mentioned previously, significant differences occurred between the circumstances of this event and typical mass-casualty operations. Even given these differences, valuable data still needs to be extracted. More specifically, the performance of the hybrid team of EMS and hospital personnel involved in the response must be examined. While their operations were conducted on scene, the speed and efficiency with which they operated provided a glimpse into the potential of similarly composed teams working at the hospital.

---

[35] ASPR TRACIE, *Mass Casualty Trauma Triage Paradigms and Pitfalls* (Washington, DC: Department of Health and Human Services, 2019), 59.

[36] Cheatham et al., "Orlando Regional Medical Center Responds."

The second case study is the Las Vegas Route 91 Festival shooting. The magnitude of the event, as well as the large volumes of patients transported by means other than EMS, exposed the weaknesses in the current response system that this research aims to address.

The last case study is that of a simulated mass-casualty exercise conducted by St. Marks Hospital in Salt Lake City, UT. Utilizing the results of the Las Vegas after-action reports, the hospital sought to test whether the use of EMS crews in triage would have enhanced the overall response. Data surrounding the efficiency and accuracy of EMS crews and nurses assigned to triage are analyzed. Given the results of this data analysis, some conclusions are presented.

The results of all these case studies are integrated and recommendations for modifications of current mass-casualty response presented. EMS's place in hospital triage, as well as where these resources may come from, are also reviewed. Changes in the timing and application of START and TECC protocols are also discussed.

II. CURRENT MASS-CASUALTY RESPONSE

Before examining case studies of mass-casualty events to identify gaps in the response, it seems prudent to examine how current operations are conducted. This chapter explores START triage, TECC response protocols, and how field and hospital responses are generally structured. After examining some case studies in the chapters that follow, some changes to this system are suggested for implementation.

A. GENERAL MASS-CASUALTY RESPONSE

When faced with any mass-casualty incident, EMS crews must assess and sort patients as they are encountered. The most prolific system currently in use is START triage.[37] START triage consists of a rapid assessment, no longer than 60 seconds per patient, of the severity of a patient's condition.[38] Patients are sorted into four categories; "red" or "immediate" patients include those in most urgent need of transportation and care, "yellow" or "delayed" can endure slight delays in transportation, "green" or "walking wounded" patients can tolerate significant delays, and "deceased or expectant" patients are either deceased or expected to die and are not moved or transported.[39] These categories are usually designated by tags or colored tape placed on victims by initial responders.

Once assessed, patients are moved by EMS crews, in order of triaged severity, to a "triage and treatment" area where their triage level is reassessed and some basic treatments provided. From this area, they are moved, again by severity, to the transportation section where they are loaded in ambulances and sent to receiving hospitals. The transportation section officer gathers information about available hospital beds, makes decisions about which facility to send each patient to, and tracks the destination and outcome of each patient.

---

[37] Cannon and Heightman, "A Scientific Look at START and Our Ability to Do It."

[38] Cannon and Heightman.

[39] Cannon and Heightman.

Within this system exists several overlapping periods of time used for patient assessment and treatment. Time that could, perhaps, be saved by streamlining the process. As mentioned previously, scant evidence actually supports the use of START triage on scene.

B. ACTIVE-SHOOTER RESPONSES

After-action studies from incidents, such as the Columbine High School and the Pulse Nightclub shootings, which determined that several patients might have survived, had EMS crews been able to access them more quickly, led to the development of the RTF concept.[40] An RTF response consists of an integrated team of law enforcement and EMS personnel. These teams are able to gain access to the "warm zone" of an active shooter event and provide rapid triage, treatment, and extrication of injured patients.[41] While this team is critical to the field response, the details of the system are outside the scope of this research. What is of note, however, is the use of the TECC protocols during these types of operations.

TECC protocols are a system of triage and treatment designed for civilian emergency responders, but based in military combat field medicine.[42] The system allows for the rapid sorting of patients and application of only the most basic and critical life-saving interventions while in the hazard zone. The combination of RTF and TECC allows for rapid access to patients while minimizing the exposure of EMS personnel to a dangerous environment.

When RTF teams encounter a patient, they make a rapid assessment of the survivability of the patient. Tourniquets and clotting gauze are applied if any major

---

[40] E. Reed Smith, Geoff Shapiro, and Babak Sarani, "Fatal Wounding Pattern and Causes of Potentially Preventable Death Following the Pulse Night Club Shooting Event," *Prehospital Emergency Care: Official Journal of the National Association of EMS Physicians and the National Association of State EMS Directors* 22, no. 6 (December 2018): 662–68, https://doi.org/10.1080/10903127.2018.1459980.

[41] National Fire Protection Administration, *NFPA 3000™ (PS): Standard for an Active Shooter/ Hostile Event Response (ASHER) Program* (Quincy, MA: National Fire Protection Administration, 2018), 15, https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=3000.

[42] Callaway et al., "Tactical Emergency Casualty Care (TECC)," 106.

bleeding is present and then patients are rapidly extricated from the area by a second RTF team while the primary team continues to sort and treat patients as they encounter them.[43] This process continues until all viable patients have been removed from the scene. As patients are removed from the scene, they are moved to the triage and treatment area, outside the hazardous area, where the previously described method of START triage is begun. Figure 1 shows the current active shooter response.

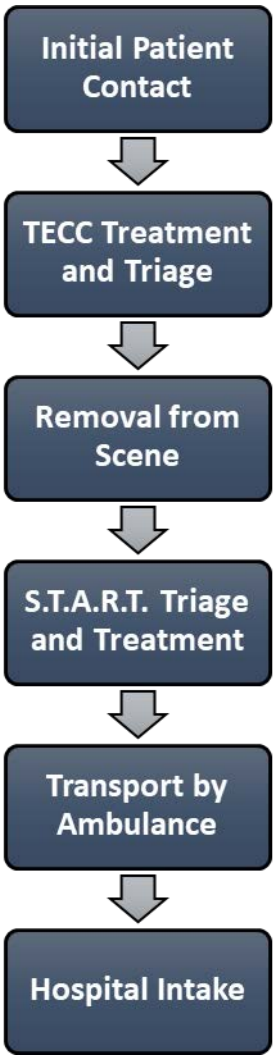

Figure 1. Current Process for Active Shooter

[43] Callaway et al., 107.

C. HOSPITAL OPERATIONS

Once transport from the scene of a mass-casualty incident has begun, hospital plans assume that EMS crews will notify them of the incident and incoming patients. Hospitals will then activate whatever internal disaster response protocol they may have in response.

With the ER situated as the primary intake location for the hospital, these departments are often the first to encounter the incoming patient load. Nurses and doctors from the ER are tasked with reassessing EMS triage and directing the flow of patients to the appropriate care area based on their triaged level of acuity. One or two of these physicians supervise the area while the nurses unload vehicles, triage patients, and move them to their destination. As the event progresses, non-clinical workers are assigned to the ER for patient transport and movement so that nurses can focus on triage. This system will continue to operate until all patients are triaged.

D. ANALYSIS

The previously described triage process, used in the response to the Las Vegas shooting, as well as most other recent mass-casualty events, is explored in more detail in the following sections.[44] While the TECC protocols have some basis in research-driven practices, START triage is something of a legacy system that, as mentioned previously, has no evidence from which to draw upon for its use in the field. Removing this link from the chain and solidifying TECC as a guiding principle on all mass-casualty is worth exploring.

The hospital process appears to be very straightforward and uncomplicated. The following chapters show, however, that hospital operations endured several challenges when put into practice in the Las Vegas shooting, as well as in other mass-casualty incidents.[45] With the majority of patients not arriving by EMS, as anticipated, the system found itself being quickly overwhelmed. This research seeks to close that gap and provide support for hospitals during the triage process.

---

[44] Lake, *A Day Like No Other*, 15.

[45] Lake, 15.

III. CASE STUDY: BOSTON MARATHON BOMBING, APRIL 15, 2013

The Boston Marathon bombing represents a unique case study for this research. It shows a multi-hazard, multi-discipline team of EMS and hospital personnel already assembled less than a hundred yards away from an actual mass-casualty incident. Much of the logistics of the response to this event are well outside the parameters of this research. Vast amounts of resources were pre-staged at the event and significant numbers of patients were already expected with marathon-related medical issues, an unlikely scenario in mass-casualty events. What it does offer is a look at the potential efficacy and efficiency that can be achieved in the triage and treatment of mass-casualty patients when hospital and EMS personnel work together in a coordinated effort.

A. INCIDENT OVERVIEW

April 15, 2013 was the 117th running of the Boston Marathon.[46] A significant amount of planning had gone into preparations for the medical coverage of this event. A Multi-Agency Coordination Center (MACC) had been established to oversee public health and safety, as well as EMS operations. The MACC, fully activated by 9:00 that morning, consisted of 80 representatives from agencies such as police, fire, EMS, race organizers, hospitals, and local emergency management.[47] Thanks to an unprecedented number of medical issues during the 2012 marathon, capacities and capabilities for the event had been increased substantially.[48] Due to the high numbers of medical issues and patients treated during the course of the marathon each year, Boston treats each running as a "planned mass-casualty event" and uses it to exercise and test their response capabilities to large numbers of casualties.[49]

---

[46] "History," Boston Athletic Association, accessed July 14, 2019, https://www.baa.org/races/boston-marathon/results/history.

[47] Jenn Ball et al., *After Action Report for the Response to the 2013 Boston Marathon Bombings* (Framingham, MA: Massachusetts Emergency Management Agency, 2014), 19.

[48] Arthur Hsiah, "5 Triage Lessons Learned from the Boston Marathon Bombing," EMS1, January 16, 2014, https://www.ems1.com/ems-products/Bleeding-Control/articles/1649473-5-triage-lessons-learned-from-the-Boston-Marathon-Bombing/.

[49] Biddinger et al., "Be Prepared," 1958.

The race started at 09:00 in the morning. By 11:00, all the race's 27,000 participants were on the course.[50] While the winners of the race had all been declared by 12:36, large numbers of spectators remained at the finish line.[51] The crowd at the finish line had been further expanded by thousands of fans who were leaving the Boston Red Sox game, which ended at 2:08. These spectators and a number of race participants were still in the area when the first bomb exploded at 2:49 and the second just 13 seconds later.[52]

B. PRE-HOSPITAL RESPONSE

Alpha medical tent was located just beyond the finish line in Copley Square.[53] Volunteer medical personnel including EMTs, nurses, and physicians staffed this large tent.[54] The purpose of this tent was to provide advanced medical care to runners and spectators on site rather than sending them to local hospitals.[55] Additionally, 16 ambulances were staged in Copley Square near the area designated for medical transports at the medical tent.[56] At 2:55, just after the bombings, another 73 would be requested by Boston EMS.[57] Even before the bombs exploded, Alpha medical tent was fully functional and caring for a large volume of patients.[58]

The first bomb exploded just before the finish line and within close proximity to Alpha medical tent. While announcements were made inside the tent for physicians to remain with their patients, EMTs and nurses stationed in the tent, as well as medical teams outside the tent, responded to the blast site without delay.[59] While these teams rushed in, however,

---

[50] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 35.

[51] Ball et al., 15.

[52] Ball et al., 18.

[53] Ball et al., 38.

[54] Ball et al., 39.

[55] Biddinger et al., "Be Prepared," 1958.

[56] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 39.

[57] Ball et al., 39.

[58] Sushrut Jangi, "Under the Medical Tent at the Boston Marathon," *New England Journal of Medicine* 368, no. 21 (May 23, 2013): 1953–55, https://doi.org/10.1056/NEJMp1305299.

[59] Jangi, 1954.

ambulances and medical crews in staging maintained admirable discipline and remained at their posts until directed to a specific location by command.[60]

While possessing advanced medical care capabilities, the medical team quickly recognized that the medical tent was not the ideal point to provide care and quickly converted it into a casualty collection point for the blast at site one. Simple stabilization care, such as bleeding control, tourniquets, and basic airway protection, were the only interventions performed on scene.[61] Once collected at the medical tent, critically injured patients were given top priority and placed in ambulances for transport. Patients who required slightly less urgent transportation were staged near the ambulance loading area for transport after the most critical patients were evacuated.[62] Due to the rapid response to this incident by on-scene medical personnel, only a very few non-critically injured patients were transported by private vehicles.[63]

The second bombing site was located another 180 yards up the course from the finish line.[64] With Alpha medical tent being further away, Boston EMS mostly managed this site. A second casualty collection point was established and ambulance resources directed to this location for the transport of patients.[65] This site was run very similarly to the first with basic life-saving measures applied, patient priority established, and patients transported to local hospitals. The care, triage, and transportation conducted by EMS and hospital personnel on scene at both locations, though not formally identified as such, very much resembled TECC principles.

Final reports show that 118 patients were transported to local hospitals from the two bombing sites.[66] A unique outcome of this incident was that not a single patient found alive

---

[60] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 39.

[61] Biddinger et al., "Be Prepared," 1958.

[62] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 40.

[63] Ball et al., 40.

[64] Ball et al., 41.

[65] Ball et al., 41.

[66] Ball et al., 40.

when encountered by medical personnel on scene died.[67] Patients received nearly immediate life-saving medical care, triage and transportation was well planned and coordinated by hospital and EMS personnel on scene, and coordination between scene operations and local hospitals ensured that no one hospital was overwhelmed.

C. HOSPITAL RESPONSE

Thanks to early notification of the mass-casualty event (just four minutes after the explosions), pre-planned coordination with hospital personnel already on scene, and well-distributed patients, the hospital response was relatively problem free. Brigham and Women's Hospital would see the largest share of patients at 23, but no single facility was overwhelmed by patients in this event.[68] The majority of the chaos that usually accompanies mass-casualty events was avoided by the initial triage and transportation operation conducted by hospital staff and EMS on scene of the event from Alpha medical tent.

Another noted success in the hospital operation of this incident was the coordination and communication between scene operations and the hospital.[69] The only problem was the unanswered question of whether patients had been contaminated by the explosion and needed decontamination. The quality of communication throughout the incident, however, led hospitals to conclude, and correctly so, that no notification meant no contamination.[70] This type of response, once again, was made possible by the cooperation and coordination of hospital staff and EMS working together at the incident scene and through pre-designated channels.

D. ANALYSIS

It is important to note again, before beginning any kind of analysis, that the kind of pre-planning and pre-staging of resources present in this event is very unlikely to be possible for most mass-casualty events. To have a "pre-planned mass-casualty" become an actual

---

[67] Biddinger et al., "Be Prepared," 1958.

[68] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 40.

[69] Hsiah, "5 Triage Lessons Learned from the Boston Marathon Bombing."

[70] Ball et al., "After Action Report for the Response to the 2013 Boston Marathon Bombings," 41.

mass-casualty event is not likely to occur again in the near future. Nevertheless, lessons can be learned from the coordinated response between EMS and hospital personnel working together in triage and treatment at Alpha medical tent.

One of the most notable aspects of this response was the speed and efficiency with which it took place. The first device exploded at 2:49 and the first patient left the scene by ambulance just nine minutes later at 2:58.[71] The last critical patient left the scene by ambulance just 39 minutes later, at 3:37.[72] Broken down further, 118 patients received life-saving treatment, were triaged, and placed in ambulances within 48 minutes of the initial blast. Put another way, this coordinated team of EMS and hospital personnel processed just short of two and a half patients every minute.

The location of Alpha medical tent is one issue for this case's relevance. While this research is focused on the coordination of hospital and EMS personnel at the hospital, Alpha medical tent was located on scene. In reviewing the case, however, the triage and treatment activities at Alpha medical tent are very similar to the actions that this research proposed to be performed by similarly integrated teams at the hospital. The amount of triage and treatment to be provided to patients before they are transported from the triage area at the hospital is very similar to that of the patients being transported from the medical tent in the Boston event. What this case shows, then, is the potential efficiency of these integrated teams, regardless of their location. Had the 199 patients seen at Sunrise Metro Hospital in Las Vegas been triaged at the rate of two and a half per minute, the entire patient load could have been processed in less than 80 minutes.[73] While the differences are substantial, this level of efficiency and its potential for improving patient care cannot be overlooked.

---

[71] Ball et al., 21.

[72] Ball et al., 22.

[73] Janet Smith, Glen Simpson, and A. J. Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas," *Journal of Emergency Medical Services* 43, no. 4 (April 1, 2018), https://www.jems.com/articles/print/volume-43/issue-4/features/ems-response-to-the-mass-shooting-at-the-route-91-harvest-festival-in-las-vegas.html.

THIS PAGE INTENTIONALLY LEFT BLANK

IV. CASE STUDY: ROUTE 91 FESTIVAL SHOOTING, LAS VEGAS

This chapter examines the mass shooting at the Route 91 Music Festival in Las Vegas, Nevada on October 1, 2017. This event is, to date, the deadliest mass shooting in history.[74] The event precipitated a huge EMS response, as well as an unprecedented flood of patients to surrounding hospitals. This case study highlights several of the gaps in mass-casualty response that the remainder of this research seeks to address.

A. INCIDENT OVERVIEW

The Route 91 Music Festival was a three-day music festival held September 29–October 1, 2017.[75] On the final day of the event, October 1, more than 22,000 people were in attendance.[76] In a city that sees festivals and conventions that can exceed 400,000 attendees, this event was not considered a particularly large event.[77] This smaller number becomes significant to the response, as no dispatcher was dedicated to the event, as was customary for larger events, and the Clark County Fire Department (CCFD) had not been notified it was occurring.[78]

The final performer of the festival, Jason Aldean, took the stage at 9:40 p.m.[79] Twenty-five minutes later, at 10:05, Stephen Paddock opened fire on the crowd from his 32nd floor corner suite at the MGM Grand Hotel.[80] The shooter fired more than 1,100 rounds into the crowd of spectators over the span of about 10 minutes. He was well armed

---

[74] Las Vegas Metropolitan Police Department, *1 October After-Action Review* (Las Vegas: Las Vegas Metropolitan Police Department, 2019), 1, https://www.lvmpd.com/en-us/Documents/1_October_AAR_Final_06062019.pdf.

[75] Eric Levenson, "The Cold, Calculating Timeline of the Las Vegas Gunman," CNN, October 10, 2017, https://www.cnn.com/2017/10/05/us/las-vegas-shooting-timeline/index.html.

[76] Las Vegas Metropolitan Police Department, *1 October After-Action Review*, 4.

[77] Lake, *A Day Like No Other*, 6.

[78] Federal Emergency Management Agency, *1 October After-Action Report*, 11.

[79] Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

[80] Federal Emergency Management Agency, *1 October After-Action Report*, 9.

with some 23 weapons including rifles, bump stocks, and handguns, which he had gradually moved into his room during the week preceding the shooting.[81]

The sheer magnitude and volume of gunfire led to mass confusion amongst concertgoers, police, and EMS officials on the ground. Victims began dispersing from the site through exits and by overcoming all types of fencing, including razor wire. Concertgoers and victims ended up spread across multiple hotel properties, airport hangers, and other locations surrounding the scene. This scattering of victims led to further response complications as panicked 911 calls reported active shooting events in multiple locations around the actual scene.

The shooter fired his last round 10 minutes later, at 10:15, and ended his own life with a self-inflicted gunshot between 10:16–10:18. Police did not secure the room and shooter until nearly an hour later at 11:20.[82] Nevertheless, EMS units already in place for the festival, and soon after EMS and fire units that responded to the shooting, began the process of triage, treatment, and transportation of victims from the scene nearly immediately, even in the face of active gunfire. Las Vegas Metro Police's official after-action report shows that 58 individuals were killed in the attack and over 850 were injured.

B. EMS RESPONSE

Community Ambulance, a local 911 EMS response agency, was providing first-aid and emergency medical services for the event. Sixteen of the company's staff members were onsite; most of them experienced providers. Active shooter scenarios had been discussed by organizers prior to the event. As a result, the medical tent was erected in a position that allowed for immediate access for responding ambulances.[83] Three ambulances dedicated to the event were staged in parking lots immediately adjacent to the medical tent and EMS personnel were staged in the tent and at other strategic locations

[81] Levenson, "The Cold, Calculating Timeline of the Las Vegas Gunman."

[82] Federal Emergency Management Agency, *1 October After-Action Report*, 9.

[83] Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

throughout the event area.[84] These units, along with Las Vegas Metropolitan Police, were the first authorities to be alerted that an active-shooter incident was occurring. With the sound of the gunfire echoing off surrounding buildings, crews on the ground speculated that there were multiple shooters.[85] Casualties quickly overwhelmed the first aid tent, even while gunfire continued. Within the first 10 minutes, deceased victims were already being moved out of the medical tent to make room for critically injured patients with survivable injuries.[86]

While CCFD was not aware of the festival, Engine 11 was driving near the festival at 10:05 when they heard gunshots and reported them to dispatch, but were advised that no active incidents were occurring in the area.[87] Three minutes later, Engine 11 was assigned to the incident. They requested a full medical alarm and declared a mass-casualty event, which triggered the dispatch of seven additional fire department EMS units.[88] While EMS units on scene were performing lifesaving measures within minutes of the onset of the event, triage and treatment areas were not formally set up until Ladder Truck 11 did so at 10:18 and were assigned to the south division.[89] Over the next 11 minutes, a unified command was established, and the north and west divisions were assigned as well.[90]

While units on scene continue to work on the triage, treatment, and transport of patients, many fire and EMS units were having difficulty accessing the area due to concerns of multiple shooters and responder safety.[91] After a delay of nearly an hour, RTF units from CCFD were able to access the actual incident scene at 11:01, long after bystanders

---

[84] Smith, Simpson, and Heightman.

[85] Smith, Simpson, and Heightman.

[86] Smith, Simpson, and Heightman.

[87] Federal Emergency Management Agency, *1 October After-Action Report*, B–2.

[88] Federal Emergency Management Agency, B–2.

[89] Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas"; Federal Emergency Management Agency, Federal Emergency Management Agency, *1 October After-Action Report*, B–3.

[90] Federal Emergency Management Agency, *1 October After-Action Report*, 9.

[91] Lake, *A Day Like No Other*, 9.

and law enforcement had removed the last patients from the scene.[92] EMS units from Community Ambulance observed an overwhelming willingness by bystanders to assist EMS with the care of the sick and injured. Patients were sent to hospitals by any means necessary, including "Uber vehicles, police cruisers, pick-up trucks, and passenger vehicles."[93] Additionally, CCFD units on scene reported that they had run out of ambulances and were placing patients in privately owned vehicles for transport to area hospitals.[94]

Compounding the already thin resources on scene, fire and EMS units were called to some 20 different locations. They found anywhere from three to 40 injured patients at each of these sites as the wounded scattered in search of refuge from the gunfire.[95] During the course of this response, patients were found in other hotels, parking lots, and airport hangers, just to name a few. This dispersal further complicated EMS response efforts, as many of these gunshot victims calls for help triggered false reports of additional active shooter events.[96] The final report was that 16 distraction calls, consisting of reports of fires, hostage situations, and additional shootings, delayed the overall response to this incident.

Less than an hour after the shooting started, all critical patients had been transported from the scene by various means.[97] It is noted that, at this time, a large volume of EMS units and ambulances were still unassigned in the area and available to assist with the incident.[98] It was much later, however, before all pending medical calls were cleared by CCFD (3:30 a.m.) and command was terminated (7:32 a.m.).[99] Final numbers show that

---

92 Federal Emergency Management Agency, *1 October After-Action Report*, 9.

93 Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

94 Federal Emergency Management Agency, *1 October After-Action Report*, B–3.

95 Lake, *A Day Like No Other*, 9.

96 Lake, 10.

97 Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

98 Smith, Simpson, and Heightman.

99 Federal Emergency Management Agency, *1 October After-Action Report*, B–5.

only about 250 of the estimated 850 victims of this incident were transported to the hospital by ambulance.[100]

C. HOSPITAL RESPONSE

The situation at the hospitals surrounding the Route 91 festival was quite normal in the hours leading up to the shooting. Many had sent staff home due to decreased patient counts and nearly all had dwindling medical supplies as they approached the end of the weekend and anticipated delivery of fresh supplies on Monday.[101] Three hospitals were within close proximity of the incident: Deseret Springs Hospital, a community hospital, 4.4 miles away; Sunrise Metro Hospital, a Level II trauma center, 4.8 miles away; and University Medical Center, a Level I trauma center, six miles away.[102] Sunrise Metro and University Medical Center handled the vast majority of patents from this incident, 199 and 104, respectively.[103]

The closest hospitals received no notice or notification of a mass-casualty event before cars full of victims began to arrive at their doors.[104] Thus began a near constant flow of patients arriving by private vehicle, police cruiser, and later, ambulances that would not ebb for several hours. One hospital reported a quarter mile-long line of vehicles waiting to get in the parking lot at one point during the incident.[105]

This massive influx of patients quickly began to overwhelm local hospitals, especially Sunrise and University. Hospitals moved to discharge non-critical patients

---

100 Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

101 Lake, *A Day Like No Other*, 10.

102 Association of State and Territorial Health Officials, *Public Health and Medical Preparedness and Response Activities at the 2017 Route 91 Harvest Music Festival: A Peer Assessment Report* (Arlington, VA: Association of State and Territorial Health Officials, 2018), 5, http://www.astho.org/ASTHOReports/Public-Health-Medical-Preparedness-Response-Activities-at-2017-Route91-Harvest-Music-Festival/12-21-18/.

103 Smith, Simpson, and Heightman, "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas."

104 Lake, *A Day Like No Other*, 10.

105 Lake, 10.

quickly to make room for the surge. One hospital managed to discharge 160 patients within an hour to make room for victims of the attack.[106] Hospitals were caught unprepared as much of their previous mass-casualty training led them to assume that the majority of patients would arrive already generally sorted by acuity, having had some level of initial triage completed in the field.[107] What they actually experienced, however, was patients of all levels of acuity arriving in the same vehicle having self-triaged based only on GPS instructions to the closest hospital.[108] Various strategies were used at different hospitals to handle the heavy influx of patients. Some hospitals paired nurses with physicians and began using START triage to sort the patients.[109] Many of these hospitals recognized quickly that this type of triage was pulling valuable ER staff away from patients requiring treatment, so nurses were pulled from the intensive care unit (ICU). Having not had any recent training in triage, though, these nurses struggled to perform appropriately. Mistakes were made, including one in particular with the use of triage tags, meant to designate the acuity of each patient, which could easily have led to poor patient outcomes had it not been quickly discovered by better trained staff.[110] It was also reported that some paramedics were being used for these interventions at the hospitals, though which agency they worked for and where this occurred, is a bit unclear.[111]

One affected hospital, though it is not clear which, used protocols similar to those of TECC to handle the incoming casualties. Patients were quickly sorted and minimal interventions performed before moving directly past the ER and to surgery or other care destinations as appropriate.[112] This system was assessed by Lake in the Nevada Hospital

---

106 Association of State and Territorial Health Officials, *Public Health and Medical Preparedness and Response Activities at the 2017 Route 91 Harvest Music Festival*, 5.

107 Lake, *A Day Like No Other*, 10.

108 Association of State and Territorial Health Officials, *Public Health and Medical Preparedness and Response Activities at the 2017 Route 91 Harvest Music Festival*, 15.

109 Lake, *A Day Like No Other*, 15.

110 Lake, 15.

111 Association of State and Territorial Health Officials, *Public Health and Medical Preparedness and Response Activities at the 2017 Route 91 Harvest Music Festival*, 5.

112 Lake, *A Day Like No Other*, 15.

Association's after-action report to have worked efficiently and effectively.[113] This assessment appears to be the first evidence that the use of EMS in triage can be quite effective as TECC principles are trained on and used regularly for RTF operations by EMS agencies across the country.

D. ANALYSIS

The scope of this event was well beyond what anyone had prepared for or even imagined. Nonetheless, the rapid and decisive actions of EMS and bystanders on scene saved lives. With scene safety concerns and widely scattered patients preventing the major EMS scene presence that might be expected, people on scene improvised and adapted to provide some kind of a response.

Current medical studies show that any kind of delay in a patient's arrival to definitive care has disastrous consequences for their survival.[114] By this measure, the use of law enforcement vehicles, Uber vehicles, and privately owned vehicles to transport patients to the closest hospitals, by definition, decreased the chances that patients would die. What is also clear from this review, however, is that large numbers of patients arriving at these hospitals, regardless of their method of arrival, quickly overwhelmed hospital staff and their ability to triage these patients.

In his review, Lake notes that hospitals quickly recognized that ER staff was more valuable treating patients inside the emergency room rather than in triage. Other staff, scavenged from other hospital departments, were woefully unprepared to handle the kinds of triage needs demanded by this incident, and as mentioned previously, even made some potentially catastrophic mistakes involving the use of triage tags.[115] Beyond their struggles in performing the job, losing staff from any hospital department would seem to impair the hospital's ability to respond to this type of event. What is clear, then, is that some kind of

---

[113] Lake, 15.

[114] Mamta Swaroop et al., "Pre-Hospital Transport Times and Survival for Hypotensive Patients with Penetrating Thoracic Trauma," *Journal of Emergencies, Trauma, and Shock* 6, no. 1 (2013): 16–20, https://doi.org/10.4103/0974-2700.106320.

[115] Lake, *A Day Like No Other*, 15.

assistance is needed in the intake and triage section of the hospital's response to a mass-casualty incident and that it likely cannot be found internally. This case study presents a potential solution.

While EMS resources were stretched thin in the opening stages of this response, it becomes clear that large numbers of assets begin arriving on scene in relatively short order. Approximately 250 patients were transported by ambulance in this incident and roughly, 130 ambulances were deployed in support of the response.[116] Additionally, some 250 fire department personnel were dispatched to the scene on 50 different response vehicles, all of whom were capable of applying the basic triage and treatment protocols suggested by TECC.[117] With this mass of resources, Lake identifies that many of the EMS resources dispatched remained in staging throughout the event and were never utilized.[118]

While little question remains that an incident of this scale requires a substantial response, it is also clear that units may be spared to assist the hospitals without affecting scene response activities. EMS providers are skilled in triage since they use it daily in the performance of their job duties.[119] As more units arrived and were unable to access unsafe scenes or as initial transport units arrived at the closest hospitals, they could easily have been rotated in to support the triage operation without causing a detriment to operations on scene. The ER staff would thus have been able to move back to the ER, while other hospital staff remained in their departments, and enhanced coordination and communication between hospitals and EMS response agencies.

---

116 Federal Emergency Management Agency, *1 October After-Action Report*, 22.

117 Federal Emergency Management Agency, 10.

118 Lake, *A Day Like No Other*, 57.

119 Sasser et al., "Guidelines for Field Triage of Injured Patients," 2.

V. ST. MARKS HOSPITAL DRILL REVIEW AND ANALYSIS

Hospitals are required to conduct regular mass-casualty exercises as a part of their regulatory compliance. To meet this requirement, John Jones, St. Marks Hospital's Safety Officer and Emergency Manager, and the author, acting in his role as Disaster Response Team Lead, began planning an exercise. After reviewing the after-action report from the Las Vegas shooting, they developed this simulated mass-casualty event to test the efficacy of assigning field EMS units to triage during a large influx of patients during a mass casualty event. While this exercise, as well as others that St. Marks regularly conducts, was primarily designed to assess and enhance the skills of its employees to handle a wide variety of events, the concept of this drill was also to test whether the use of EMS in triage could fill some of the gaps identified by the after-action reports generated from the Las Vegas incident. This drill was executed on October 4, 2018.

A. DESIGN

To test the idea that EMS in triage could have been beneficial in the Las Vegas shooting, this event was designed to, as closely as possible, mimic the situation faced by Sunrise Metro hospital. Patients in this exercise were volunteers recruited from the local community. Simulated wounds were placed on the volunteers and they wore cards with relevant medical assessment findings around their necks. One hundred of these simulated patients were sent to the ED in ambulances, police vehicles, and private vehicles from a staging area near the hospital, staggered to resemble what was seen in the actual event. The majority of the patients arrived by private vehicle, as was the case in Las Vegas.

This drill was filmed by several cameras.[120] Several relevant findings discovered in the video clips are discussed later in this chapter. Evaluators and drill controllers were stationed throughout the exercise area to monitor progress, ensure participant safety, and collect data.

[120] The recording of this exercise was done by the hospital's marketing division to be distributed to local media and to create a promotional video for the hospital's new trauma program. A collection of shorter video clips was created instead rather than one continuous video feed, which complicated data collection, as it obscured the time line of events.

The drill started when three patients arrived in a private vehicle at the main entrance to the ED.[121] These patients were attended to by the on-duty triage nurse who was informed that they had come from a costume party where someone had "just shot a whole bunch of people." Just as the first arriving patients were the first indication Sunrise Metro received that a shooting had occurred, it was simulated to be the first notification that the hospital received of the event. The nurse who encountered the first patients notified the ED charge nurse and a "code yellow" or mass-casualty response was initiated.[122]

Initially, one ED physician and three ED nurses assumed the role of triage at the front doors of the hospital. Per their response protocols, patients were triaged in front of the main doors or in the entrance lobby and moved to different areas based on their triaged level of severity. Red (Critical) patients were moved directly to the ED, yellow (emergent but delayed) were moved to an outpatient surgical center, and green (non-urgent) were moved to a physician's office waiting room. Simulated care was provided to all patients until they arrived at the operating room, at which point their involvement in the drill was considered complete.

After two ambulances and a paramedic fire engine handed off their patients to ED staff for triage, the physician in charge of triage was coached by drill planners to assign EMS crews to take over triage operations and send the ED staff inside to handle patients who had already been triaged. This transition to EMS triage happened once approximately one third of the patients had already arrived and been triaged. EMS crews then continued to operate the triage area until all patients had arrived and been triaged.

Once the exercise was completed, evaluators and drill participants participated in a "hot wash" where all aspects of the drill were reviewed. Additionally, some reviewers composed and submitted observational data in the days following the drill. The reviewers' comments and minutes from the hot wash were compiled into an after-action report. The following recap and analysis are based entirely on the after-action report, the footage captured by the cameras, and the author's own observations from the triage area during the exercise.

---

[121] John Jones, *St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018: After Action Report* (Salt Lake City, UT: St. Marks Hospital, 2018), 4, unpublished.

[122] Jones, 4.

B. QUANTITATIVE DATA

Data gathered by evaluators and reviewed after the drill seems to show an improvement in the triage performance when taken over by EMS crews. Metrics gathered included triage and treatment time per patient and overall accuracy of triage based on the four-tiered START system. Evaluators recorded the amount of time spent triaging the patient, as well as applying any basic life-saving interventions, such as bleeding control or opening of patient's' airways. During the time that nurses were responsible for care, times ranged between two and three minutes for each patient.[123] This time decreased slightly to one and a half to two minutes per patient when EMS took over operations in the triage area.[124] While triage and treatment time per patient was collected, what was not gathered or clear was the overall rate and capacity of the triage operation. This data could have been used to compare this operation to the two and a half patients per minute benchmark recorded during the Boston Marathon response.

After passing through the triage area, the triage level assigned to the patient was recorded and then compared to the triage category that should have been assigned according to START guidance. Accuracy at the "red" or "immediate" category was consistent throughout the exercise, with 95% triaged appropriately by nurses and 96% by EMS. EMS remained consistent with 95% accuracy for "yellow," 90% accuracy for "green," and 98% accuracy for "expectant." Nurses, however, recorded accuracies of 80% for "yellow," 75% for "green," and only 20% for "expectant."[125]

C. QUALITATIVE DATA AND PERSONAL OBSERVATIONS

Video of the nurses conducting triage operations shows a chaotic scene; nurses can be seen running, yelling, and struggling with triage tags.[126] Footage recorded inside the entrance lobby shows bottlenecks and delays throughout the time nursing staff is solely responsible for

---

123 Jones, 7.

124 Jones, 7.

125 Jones, 7.

126 "St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018," 2018, unpublished, HCA Marketing Division, video.

triage. At no time during the videos taken during nursing triage was the lobby observed to be clear of patients. In one particular instance, a nurse is observed taking approximately 20 seconds to prepare the tag for use on a patient before triage is even begun, while the patient stands in the middle of the lobby.[127] Two other patients are observed sitting on a chair in the triage area, unattended, for at least 40 seconds, though the cameras do not capture their ultimate disposition.[128]

The author's own observations echoed those of the reviewers and the video evidence. The scene within the triage area was very chaotic. Staff was observed running and yelling for assistance. Ambulances, loaded with three to five patients each, struggled to collaborate with ED staff to move patients out of their vehicles to appropriate triage areas and lost valuable time standing at their ambulances waiting for staff. In the case of the second ambulance to arrive at the hospital, nearly 75 seconds elapse during the operation to remove the four patients being transported in this vehicle.[129] Given the breaks in footage, the time taken to unload this vehicle was likely even longer than the elapsed video time.

Multiple comments gathered from the hot wash, evaluator feedback sheets, and the after-action report all make mention of the success of the EMS assignment to triage. Evaluators and participants commented that the overall organization and flow of the triage area improved once this transition happened.[130] Video recordings from this area seem to corroborate this assessment, as no yelling is observed, EMS providers seem confident and comfortable with triage tags, and patients appear to be flowing smoothly from the drop off area to the appropriate care area.[131] The bottlenecks and delays observed under nursing triage seem to resolve entirely. Video footage from the triage area during EMS triage does not show any patients stopping or even pausing as they pass through the lobby. In one instance, an EMS provider is seen to be calling out patient severity, without the aid of a triage tag, and sending

---

[127] HCA Marketing Division.

[128] HCA Marketing Division.

[129] HCA Marketing Division.

[130] Jones, *St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018: After Action Report*, 1–7.

[131] HCA Marketing Division, "St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018."

patients to appropriate areas where tags are applied as they walk.[132] All these observations would likely have directly contributed to the more efficient triage times discussed earlier.

The author's own experience in this area was very similar to that of the evaluators and observations from the video. The overall atmosphere of the triage area changed dramatically when EMS took over the task of triage. A sense of calm prevailed in the area as patients were triaged and moved very rapidly as soon as they arrived. In one video segment, EMS is observed unloading and triaging a pickup truck carrying five patients, including a baby in a stroller. Patients are triaged and removed simultaneously in a coordinated manner and the vehicle is emptied in less than 45 seconds.[133] This whole operation is conducted smoothly and efficiently with none of the chaos and yelling observed in the earlier nursing videos.

Not only did the quantitative data show that EMS holds the advantage in triage over hospital staff, it also becomes clear from reviewing the after-action report and video footage, as well as through the author's own observations during the drill, that EMS also brought a qualitative improvement to the triage area when it took over operations. Not only did the objective data gathered showed improvement during EMS operations, but multiple comments about an improvement in the overall feel and flow of the triage area were seen on video and expressed by evaluators.

D. ANALYSIS

This drill took many of the action items from the Las Vegas after-action report and explored whether EMS being assigned to triage could improve future responses to these types of mass-casualty incidents.[134] With specific attention given to capturing the volume of patients transported by means other than EMS, it appears to have created a similar scenario to what might have occurred at Sunrise Metro hospital, though on a slightly smaller scale.

The performance of the nurses in the opening minutes of this drill seems to mirror those found by Lake in his Las Vegas incident review. Nurses and staff were quickly

---

[132] HCA Marketing Division.

[133] HCA Marketing Division.

[134] Lake, *A Day Like No Other*, 57–59.

overwhelmed by the volume of incoming patients, as evidenced by the previously mentioned wait and triage times of patients from both EMS and non-EMS transports. The chaos and yelling observed in the videos would seem to show that nurses were pushed to the limits of their skills and abilities.[135] All indications are that EMS units would arrive to find this type of situation as they were assigned to take over triage.

The assignment of EMS resources to the triage area appears to have a rapid and dramatic effect. This change seems to be most evident with the contrast between the second ambulance to arrive and the pickup truck that arrives later in the scenario, as explored under the aforementioned qualitative data findings. Also noticeable, however, is the much more rapid movement through the lobby and virtual elimination of patient delays or bottlenecks. With daily experience in patient movement from vehicles and scene triage, the EMS providers seem quite adept at performing the required tasks in this area, and their performance seems to reflect that.

Data collected shows that EMS crews, when assigned to triage, function more efficiently and more effectively than nurses in the same role did. While both ER nurses and EMS crews receive training in START triage as part of their required education, it would seem the increased amount of utilization and experience of the EMS crews in their day-to-day work results in substantially improved performance. With Lake having identified that many EMS and fire crews remained unassigned throughout the Las Vegas incident, it would seem to be a much more efficient use of at least some of these resources.[136]

It is worth noting that Lake identified triage training for non-ER nurses as a potential solution to the patient intake issue.[137] Training these nurses and providing experience through further exercise could, of course, provide some support for triage. While the ER will be the initial receiving point of patients at the hospital, all patient care areas will be affected as patients move through the treatment process. Nursing staff will thus become a critical and limited resource throughout the hospital. With the ability of EMS to bring trained and

---

135 HCA Marketing Division, "St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018."

136 Lake, *A Day Like No Other*, 57.

137 Lake, 39.

experienced assistance to triage, the use of non-ER nurses in triage would be a waste of an already limited resource that could harm the overall response to the incident.

With EMS able to handle triage, ED nurses were freed up to return to their assigned areas. While their performance in these areas was not a part of this research, a few video clips were observed that showed several nurses being available to tend to patients as they were transported in.[138] Additionally, one report is recorded of an unnamed drill participant recounting that, not only was the additional nursing staff in the ED helpful, but that the more accurate triage from EMS made for a more efficient treatment process in the care areas. While not directly observed or recorded as part of this study, these findings would seem to show a potential to improve patient flow, identified as a critical performance measure by Lake.[139]

Quantitative and qualitative data gathered from this exercise seems to indicate that the usage of EMS in hospital triage will increase efficiency and accuracy. ER nurses are then freed to return to work in the ER without the significant decrease in functionality seen in Las Vegas when ICU nurses are assigned.[140] Based on this exercise, from a hospital perspective, EMS is the logical choice to receive this assignment. How these resources fit into the overall field response is explored in the next chapter.

---

138 HCA Marketing Division, "St. Mark's Hospital MCI Drill Operation Twilight October 4th, 2018."

139 Lake, *A Day Like No Other*, 39.

140 Lake, 15.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. EMS FIELD RESPONSE MODIFICATION

The preceding chapters and case studies have provided evidence that, during a mass-casualty incident, the utilization of EMS in triage could have a significant positive impact on the hospital response. Despite the appearance of available EMS resources in the Las Vegas event, the question remains as to where these resources should come from and whether their use will be detrimental to the field response of the same incident. This chapter explores one potential model for assigning field EMS resources to hospitals surrounding a mass-casualty event.

A. MODIFICATIONS TO ALLOW FOR EMS IN TRIAGE AT CLOSEST HOSPITALS

Chapter II of this research explored field operations currently configured in some major jurisdictions in the United States. These systems were put to use, with some success, in the Las Vegas shooting explored in the earlier case study. The after-action report seems to indicate that room for improvement still exists, however. The preceding chapter indicated that EMS involvement could improve triage performance at the closest hospitals to an incident. This section explores how modifications to the current system can possibly be made to provide for these resources and make the overall field response more efficient.

1. Scene Operations

Studies of combat operations and preventable fatalities from earlier active shooter events indicate that RTF and TECC protocols have significant potential to improve the survivability of future events.[141] The use of these systems should continue to be encouraged. Even when RTF operations are not indicated by the situation on scene, the use of TECC protocols seems to be the more efficient and effective way to handle initial scene triage and treatment. The lack of evidentiary support for START triage in

[141] Smith, Shapiro, and Sarani, "Fatal Wounding Pattern and Causes of Potentially Preventable Death Following the Pulse Night Club Shooting Event."

the field points to a potential change that would free up EMS resources to move to the closest hospitals and improve the overall efficiency of field operations.

These changes would come when patients were no longer within the hazardous area of response or after they had been assessed using TECC protocols, be it an active shooter or some other threat. Rather than transitioning to START triage at a “triage and treatment” area, patients would move directly to the transport area, as they should have already received basic triage and treatment from the triage team or RTF operating under TECC protocols. Though transportation officers could exercise some discretion, patients would mostly be sent to hospitals as they arrived in the transportation area. Resources that would have been assigned to the “triage and treatment” area would then be freed to be assigned to the hospitals closest to the incident. Priority should be given to those facilities judged by incident command to have the highest potential to receive large numbers of patients from the event by EMS and non-EMS means. See Figure 2 for a proposed patient care flow chart.

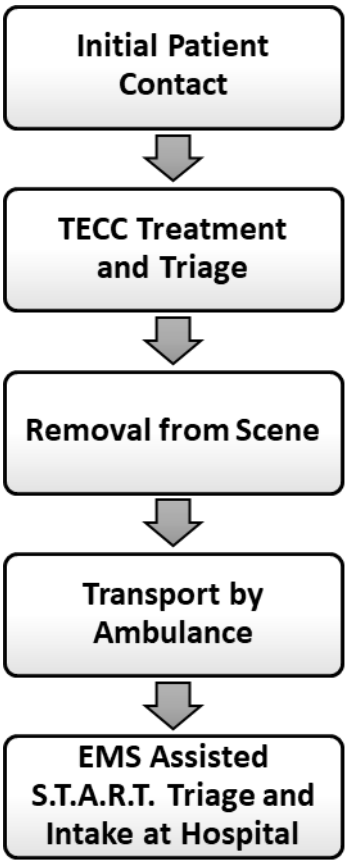

Figure 2. Proposed Scene Response Flow for All Mass-Casualty Events

2. Hospital Operations

With the triage and treatment area relocated to the closest hospitals, EMS crews would be assigned to work under the physician in charge of triage, ideally a senior trauma surgeon or ER physician. EMS crews, who use triage and patient movement skills in their daily practice, would be well suited for the tasks of removing patients from the vehicles they arrive in and sorting them in to the START triage categories. With EMS personnel handling triage, ER nurses are freed to return to their posts without sacrificing skilled RNs from other areas of the hospital.

B. CONCLUSIONS

In looking at the system proposed in this thesis, the changes involved seem fairly minor. Rather than assigning a “triage and treatment” area on scene, these resources will

be assigned to the closest hospitals, at the discretion of the incident commander. While the Las Vegas event seems to identify that resources may be available for this assignment without any changes, these changes may possibly streamline the overall field response and hasten the movement of patients to the hospital where they will be met by a more efficient and accurate triage process, staffed by EMS resources assigned to the hospital.

VII. LIMITATIONS, FURTHER STUDY, AND CONCLUSIONS

The research conducted for this project has shown that recent mass-casualty events have exposed some gaps in current EMS and hospital response protocols. Through reviewing the case studies of Boston, Las Vegas, and the St. Marks exercise, some procedural changes have emerged that have the potential to fill these gaps. While this study has concluded that EMS can be beneficial in hospital triage and that these resources can be made available to be assigned, many questions must be answered before moving towards implementation. This section explores the limitations of the research conducted, identifies future research needed to advance these procedures, and presents some concluding thoughts about this research.

A. LIMITATIONS

The primary limitation for this project is the lack of research and data surrounding the subject. While after-action reports and gap analysis are generated and usually readily available for these types of incidents, little to no academic study seems to exist to remedy them. Often, as in the case of the St. Marks drill, individual entities attempt to find and test unique solutions, but these solutions are rarely made available to the EMS and hospital communities as a whole.

Along with the lack of study comes the difficulty in actually testing these ideas. The St. Marks exercise was a monumental undertaking requiring many months and countless hours to plan, organize, execute, and review. To validate the findings of this exercise with any real academic rigor, these results will need to be tested several more times to prove that they are reliable and repeatable. Even with some repetition of this type of exercise, variances in each facility and EMS jurisdiction could cause fluctuations in the results. To validate these findings, however, several more of these exercises must be conducted.

Another component limiting the amount of data available is the relative infrequency of mass-casualty events. While exercises can attempt to recreate these incidents, it is impossible to account for all the variables during real-world events. Even when these

events do occur, data collection is often fairly scarce. The focus of involved entities, as it should be, is on the care and transportation of the victims. Data collection is a secondary concern and often very difficult given the scale of the event and the chaos created. After-action reports often capture some data, but rarely with enough specificity to draw any strong conclusions.

While scarce, the data gathered for this project supports the conclusions that have been drawn. With some further study to address these gaps in the research, the case for these procedural changes will only strengthen.

B. FURTHER STUDY

Two categories of further study become apparent at the conclusion of this project: validation and execution. With the St. Marks exercise having provided something of a proof of concept, further study could build upon these findings by adding depth and breadth to the study of these proposed procedures. As many stakeholders as possible should be involved in the planning of any future study to identify performance metrics and data relevant to all agencies rather than just the sponsoring agency. With these metrics identified, data collection could be conducted in a much more efficient and effective manner. More consistent video coverage and further training of evaluators could dramatically expand the ability to collect data. With this expanded data collection conducted in multiple studies, it could show the ability to duplicate the results observed in the St. Marks exercise and further validate its findings.

The second category of further study required is that of execution. While this study has endeavored to explore whether these systems will work, it did not explore what is required to make it work. Many administrative components, such as workers' compensation coverage, memoranda of understanding between hospitals and EMS agencies, EMS scope of practice limitations, and medical control issues must be addressed before this plan is implemented. While this research has shown a potential benefit to patients and victims, this further study will be required to mitigate the risks to EMS and hospital personnel, as well as their agencies.

C. CONCLUSIONS

While observed in several events prior, the scope and scale of the Las Vegas shooting exposed a growing trend in mass-casualty incidents away from EMS transportation of patients. This shift, especially in events as large as Las Vegas, is causing hospitals nearest the event to be rapidly overwhelmed as their staff is tasked with triage efforts with which they are not familiar.

EMS crews, far more familiar and experienced with performing triage, are sitting in staging areas waiting for scene clearance while civilians and police are moving the victims quickly towards the hospital. While many of these resources should still be devoted to their traditional scene response roles, it is clear that some can be spared to assist the hospitals.

These skilled and experienced personnel have been shown in this research to have a tremendous impact on the overall efficiency and accuracy of triage operations at the hospital. This significant benefit can be achieved through some minor changes to EMS field operations that would not be detrimental and might actually increase the efficacy of the response. With this increased cooperation and coordination between hospitals and EMS, the survivability of mass-casualty events can be dramatically increased.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Association of State and Territorial Health Officials. *Public Health and Medical Preparedness and Response Activities at the 2017 Route 91 Harvest Music Festival: A Peer Assessment Report*. Arlington, VA: Association of State and Territorial Health Officials, 2018. http://www.astho.org/ASTHOReports/Public-Health-Medical-Preparedness-Response-Activities-at-2017-Route91-Harvest-Music-Festival/12-21-18/.

ASPR TRACIE. *Mass Casualty Trauma Triage Paradigms and Pitfalls*. Washington, DC: Department of Health and Human Services, 2019.

Baker, Michael S. "Creating Order from Chaos: Part I: Triage, Initial Care, and Tactical Considerations in Mass Casualty and Disaster Response." *Military Medicine* 172, no. 3 (March 1, 2007): 232–236. https://doi.org/10.7205/MILMED.172.3.232.

Ball, Jenn, Christine Packard, Rene Fielding, Ron Bashista, Stephen Ahern, Cindy Duggan, and Christina Giacobbe et al. *After Action Report for the Response to the 2013 Boston Marathon Bombings*. Framingham, MA: Massachusetts Emergency Management Agency, 2014.

Biddinger, Paul D., Aaron Baggish, Lori Harrington, M.P.H., Pierre d'Hemecourt, James Hooley, Jerrilyn Jones, Ricky Kue, Chris Troyanos, and K. Sophia Dyer. "Be Prepared—The Boston Marathon and Mass-Casualty Events." *New England Journal of Medicine* 368, no. 21 (May 23, 2013): 1958–1960. https://doi.org/10.1056/NEJMp1305480.

Boston Athletic Association. "History." Accessed July 14, 2019. https://www.baa.org/races/boston-marathon/results/history.

Burt, Catharine W., and Linda F. McCaig. "Staffing, Capacity, and Ambulance Diversion in Emergency Departments: United States, 2003–04." *Centers for Disease Control and Prevention*, no. 376 (2006): 1–24.

Callaway, David W., Elizabeth R. Smith, Judith Cain, Geoffrey Shapiro, Wallace T Burnett, Sean D. McKay, and Robert L. Mabry. "Tactical Emergency Casualty Care (TECC): Guidelines for the Provision of Prehospital Trauma Care in High Threat Environments." *Journal of Special Operations Medicine : A Peer Reviewed Journal for SOF Medical Professionals* 11, no. 3 (2011): 104–22.

Cannon, Will, and A. J. Heightman. "A Scientific Look at START and Our Ability to Do It." *Journal of Emergency Medical Services*, May 4, 2015. https://www.jems.com/articles/print/volume-40/issue-5/features/a-scientific-look-at-start-and-our-ability-to-do-it.html.

Cheatham, Michael L., Chadwick P. Smith, Joseph A. Ibrahim, William S. Havron, Matthew W. Lube, Marc S. Levy, and Susan K. Ono. “Orlando Regional Medical Center Responds to Pulse Nightclub Shooting.” *Bulletin of the American College of Surgeons*, November 1, 2016. http://bulletin.facs.org/2016/11/orlando-regional-medical-center-responds-to-pulse-nightclub-shooting/.

Federal Emergency Management Agency. *1 October After-Action Report*. Washington, DC: Department of Homeland Security, 2018.

FireRescue1. “FDIC 2019 Quick Take: Deploy the Fire/EMS RTF to Active Shooter/Hostile Events.” Accessed July 11, 2019. https://www.firerescue1.com/mci-mass-casualty-incidents/articles/393870018-FDIC-2019-Quick-Take-Deploy-the-fire-EMS-RTF-to-active-shooter-hostile-events/.

Gates, Jonathan D., Sandra Arabian, Paul Biddinger, Joe Blansfield, Peter Burke, Sarita Chung, and Jonathan Fischer et al. “The Initial Response to the Boston Marathon Bombing.” Annals of Surgery 260, no. 6 (December 2014): 960–66. https://doi.org/10.1097/SLA.0000000000000914.

HCA Marketing Division. “St. Mark’s Hospital MCI Drill Operation Twilight October 4th, 2018.” 2018, unpublished. Video.

Hospital Preparedness Program. *Hospital Preparedness Program (HPP) Healthcare Preparedness Capability Review National Call Capability 10: Medical Surge and Immediate Bed Availability (IBA) Meeting Summary*. Washington, DC: Department of Health & Human Services, 2013. https://www.phe.gov/Preparedness/planning/hpp/meetings/Documents/capability10.pdf.

Hsiah, Arthur. “5 Triage Lessons Learned from the Boston Marathon Bombing.” EMS1, January 16, 2014. https://www.ems1.com/ems-products/Bleeding-Control/articles/1649473-5-triage-lessons-learned-from-the-Boston-Marathon-Bombing/.

Jangi, Sushrut. “Under the Medical Tent at the Boston Marathon.” *New England Journal of Medicine* 368, no. 21 (May 23, 2013): 1953–55. https://doi.org/10.1056/NEJMp1305299.

Jones, John. *St. Mark’s Hospital MCI Drill Operation Twilight October 4th, 2018: After Action Report*. Salt Lake City, UT: St. Marks Hospital, 2018, unpublished.

Kahn, Christopher A., Carl H. Schultz, Ken T. Miller, and Craig L. Anderson. “Does START Triage Work? An Outcomes Assessment after a Disaster.” *Annals of Emergency Medicine* 54, no. 3 (September 2009): 424–430.e1. https://doi.org/10.1016/j.annemergmed.2008.12.035.

Lake, Christopher. *A Day Like No Other: A Case Study of the Las Vegas Mass Shooting*. Reno: Nevada Hospital Association, 2018. https://drive.google.com/file/d/1CxbLHiWJwL9ZRbWddbaPv15NN6YiNFEc/view?usp=embed_facebook.

Las Vegas Metropolitan Police Department. *1 October After-Action Review*. Las Vegas: Las Vegas Metropolitan Police Department, 2019. https://www.lvmpd.com/en-us/Documents/1_October_AAR_Final_06062019.pdf.

Levenson, Eric. "The Cold, Calculating Timeline of the Las Vegas Gunman." CNN. October 10, 2017. https://www.cnn.com/2017/10/05/us/las-vegas-shooting-timeline/index.html.

Nakao, Hiroyuki, Isao Ukai, and Joji Kotani. "A Review of the History of the Origin of Triage from a Disaster Medicine Perspective." *Acute Medicine & Surgery* 4, no. 4 (July 14, 2017): 379–84. https://doi.org/10.1002/ams2.293.

National Fire Protection Administration. *NFPA 3000™ (PS): Standard for an Active Shooter/Hostile Event Response (ASHER) Program*. Quincy, MA: National Fire Protection Administration, 2018. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=3000.

Radebach, Mary. "Healthcare Response to a No-Notice Incident: Lessons Learned from Las Vegas Festival Shooting." *ASPR* (blog), April 24, 2018. https://www.phe.gov/ASPRBlog/Lists/Posts/Post.aspx?ID=308.

Sasser, S. M., R. C. Hunt, E. E. Sullivent, M. M. Wald, J. Mitchko, G. J. Jurkovich, M. C. Henry et al. "Guidelines for Field Triage of Injured Patients. Recommendations of the National Expert Panel on Field Triage." National Expert Panel on Field Triage, Centers for Disease Control and Prevention. *MMWR Recomm Rep.* 58, no. RR-1 (January 23, 2009): 1–35. https://www.ncbi.nlm.nih.gov/pubmed/19165138.

Smith, E. Reed, Geoff Shapiro, and Babak Sarani. "Fatal Wounding Pattern and Causes of Potentially Preventable Death Following the Pulse Night Club Shooting Event." *Prehospital Emergency Care: Official Journal of the National Association of EMS Physicians and the National Association of State EMS Directors* 22, no. 6 (December 2018): 662–68. https://doi.org/10.1080/10903127.2018.1459980.

Smith, Janet, Glen Simpson, and A. J. Heightman. "EMS Response to the Mass Shooting at the Route 91 Harvest Festival in Las Vegas." *Journal of Emergency Medical Services* 43, no. 4 (April 1, 2018). https://www.jems.com/articles/print/volume-43/issue-4/features/ems-response-to-the-mass-shooting-at-the-route-91-harvest-festival-in-las-vegas.html.

Straub, Frank, Jack Cambria, Jane Castor, Ben Gorban, Brett Meade, David Waltemeyer, and Jennifer Zeunik. *Rescue, Response, and Resilience: A Critical Incident Review of the Orlando Public Safety Response to the Attack on the Pulse Nightclub*. Washington, DC: Office of Community Oriented Policing Services, 2017.

Swaroop, Mamta, David C. Straus, Ogo Agubuzu, Thomas J. Esposito, Carol R. Schermer, Marie L. Crandall. "Pre-Hospital Transport Times and Survival for Hypotensive Patients with Penetrating Thoracic Trauma." *Journal of Emergencies, Trauma, and Shock* 6, no. 1 (2013): 16–20. https://doi.org/10.4103/0974-2700.106320.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California