



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**RECOMMENDATION FOR A NATIONAL STANDARD
FOR TACTICAL EMERGENCY CASUALTY CARE AND
ISRAELI HOSPITAL TRAUMA PROTOCOLS IN THE
UNITED STATES**

by

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June 2015

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 2015		3. REPORT TYPE AND DATES COVERED Master's Thesis
4. TITLE AND SUBTITLE RECOMMENDATION FOR A NATIONAL STANDARD FOR TACTICAL EMERGENCY CASUALTY CARE AND ISRAELI HOSPITAL TRAUMA PROTOCOLS IN THE UNITED STATES			5. FUNDING NUMBERS	
6. AUTHOR(S) Robert L. Kierstead				
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. IRB protocol number ____N/A____.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			12b. DISTRIBUTION CODE A	
13. ABSTRACT (maximum 200 words) This research asks the following question: Why are tactical emergency casualty care (TECC) rescue task force (RTF) and Israeli hospital trauma programs the best approaches to addressing the current gaps and weaknesses in trauma management in the United States in the context of terrorist attacks and/or active shooter incidents? The purpose of this thesis is to ascertain why existing tactical emergency medical service protocols in most public safety jurisdictions are deficient and to analyze which types of resources jurisdictions need in order to ensure that they have optimal programs in place for mass casualty incident response. Active shooter and terrorist attacks have been on the rise since the 1990s. This thesis found that most public safety organizations in the United States are unprepared to provide emergency medical services during these incidents. Provision of tactical emergency medical services in hostile environments require that emergency medical services personnel train and deploy using TECC RTF guidelines and the Israeli hospital paradigm. This thesis recommends the implementation of a national standard to ensure that these programs are instituted in jurisdictions across the United States.				
14. SUBJECT TERMS tactical emergency casualty care (TECC); tactical combat casualty care (TCCC); Israeli hospital; Israeli trauma protocols; rescue task force (RTF) tactical medic			15. NUMBER OF PAGES 171	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

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EMERGENCY CASUALTY CARE AND ISRAELI HOSPITAL TRAUMA
PROTOCOLS IN THE UNITED STATES**

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Submitted in partial fulfillment of the
requirements for the degree of

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

from the

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ABSTRACT

This research asks the following question: Why are tactical emergency casualty care (TECC) rescue task force (RTF) and Israeli hospital trauma programs the best approaches to addressing the current gaps and weaknesses in trauma management in the United States in the context of terrorist attacks and/or active shooter incidents?

The purpose of this thesis is to ascertain why existing tactical emergency medical service protocols in most public safety jurisdictions are deficient and to analyze which types of resources jurisdictions need in order to ensure that they have optimal programs in place for mass casualty incident response.

Active shooter and terrorist attacks have been on the rise since the 1990s. This thesis found that most public safety organizations in the United States are unprepared to provide emergency medical services during these incidents. Provision of tactical emergency medical services in hostile environments require that emergency medical services personnel train and deploy using TECC RTF guidelines and the Israeli hospital paradigm. This thesis recommends the implementation of a national standard to ensure that these programs are instituted in jurisdictions across the United States.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACFD	Arlington County Fire Department
ACS	American College of Surgeons
AFD	Aurora Fire Department
AFG	Assistance to Firefighters Grant
ALS	advanced life support
APD	Aurora Police Department
ATLS	advanced trauma life support
BLI	blast lung injury
C.A.T.	combat application tourniquet
CBP	Customs and Border Protection
CFR	case fatality rate
CHS	Columbine High School
CoTCCC	Committee Tactical Combat Casualty Care
CQC	close quarters combat
DHS	Department of Homeland Security
DMH	Denver Medical Health
ED	emergency department
EMS	emergency medical service
EMT	emergency medical technician
FEMA	Federal Emergency Management Agency
FBI	Federal Bureau of Investigation
GSW	gunshot wound
HHS	Health and Human Services
HHSTU	Hebrew-Hadassah Hospital Shock Trauma Unit
HPP	Hospital Preparedness Program
HREP	high risk extraction protocol
HSGP	Homeland Security Grant Program
ICP	incident command post
IAFF	International Association of Firefighters
IED	improvised explosive device

ITR	Israel National Trauma Registry
JTTR	Joint Theater Trauma Registry
LAFD	Los Angeles Fire Department
LAPD	Los Angeles Police Department
LAX	Los Angeles International Airport
LAWAPD	Los Angeles World Airport
LESMA	Local Emergency Medical Services Agency
MACTAC	Multi-Assault Counter-Terrorism Action Capabilities
MBHSR	Metro Boston Homeland Security Region
MDA	Magen David Adom
MGH	Massachusetts General Hospital
MIEMSS	Maryland Institute for Emergency Medical Services Systems
MTF	medical treatment facility
NCR	Colorado North Central Region
NCTC	National Counterterrorism Center
NIMS	National Incident Management System
NTDB	National Trauma Data Bank
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OHA	Office of Health Affairs
OMG	Operation Mountain Guardian
PHTR	Prehospital Trauma Registry
PHTLS	Prehospital Trauma Life Support
RTF	rescue task force
SHSP	State Homeland Security Program
SIC	surgeon in charge
SMC	Swedish Medical Center
SOP	standard operating procedure
SWAT	special weapons and tactics
TCCC	tactical combat casualty care
TECC	tactical emergency casualty care
TEMS	tactical emergency medical support

TMCA	The Medical Center of Aurora
TSA	Transportation Security Agency
UASI	Urban Areas Security Initiative
UCH	University of Colorado Hospital
USFA	U.S. Fire Administration
WDMET	wound data and munitions effectiveness team

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EXECUTIVE SUMMARY

Active shootings and terrorist attacks have increased at an alarming rate in recent years in the United States. According to research conducted by the Federal Bureau of Investigation (FBI) and Texas State University, between 2000 and 2013, 486 people were killed and another 557 were wounded in 160 separate active shooter incidents.¹ Data gathered by U.S. Department of Homeland Security's (DHS's) National Consortium for the Study of Terrorism and Responses to Terrorism indicates that 208 terrorist attacks took place in the between 2001 and 2011 in the U.S.² Active shooter and other mass casualty incidents require the deployment of extensive law enforcement and emergency medical resources. While the primary police mission at these incidents is to neutralize threats, firefighters and emergency medical services (EMS) personnel must administer on-scene medical aid to victims. The quintessential public safety response to active shooter events is one in which law enforcement and emergency medical responses are integrated. However, multi-disciplinary responses to contemporary mass shootings in this country, such as those that have taken place in Aurora, Colorado (Century Theater in 2012), Washington, D.C. (Washington Navy Yard in 2013), and the Los Angeles World Airport (LAX in 2013), have been disjointed rather than consolidated. In fact, most jurisdictions in the United States have insufficient resources and protocols in place to administer emergency medical services at mass casualty incidents.

The primary purpose of this research is to demonstrate the need for public safety jurisdictions in the U.S. to adopt dynamic tactical emergency programs to ensure the delivery of medical services at mass casualty incidents. This is because penetrating and blunt trauma injuries sustained by victims in active shooter and terrorist attacks, such as gunshot and shrapnel wounds, cause massive hemorrhaging and can be fatal in minutes

¹ J. Pete Blair, and Katherine W. Schweit, *A Study of Active Shooter Incidents, 2000–2013*, (Washington, DC: Texas State University, and Federal Bureau of Investigation, 2014), 6.

² Gary LaFree, Laura Dugan, and Erin Miller, *Integrated United States Security Database (IUSSD): Terrorism Data on the United States Homeland, 1970 to 2011* (College Park, MD: START Resilient Systems Division, U.S. Department of Homeland Security, Science and Technology Directorate, 2012), http://www.start.umd.edu/sites/default/files/files/publications/START_IUSSDDataTerroristAttacksUS_1970-2011.pdf, 8.

unless treated quickly. Furthermore, the administering of emergency medical services in mass casualty situations is frequently hampered by the lingering presence of perpetrators at the scene of the attack.

Over the course of the past two decades, the U.S. military has developed program that has revolutionized the way in which casualties are treated on the battlefield. The military's tactical combat casualty care (TCCC) has been proven to save lives because its protocols address the need to stop bleeding and hasten evacuation from sites of injury to hospitals. TCCC doctrine is adaptable to the civilian emergency medical community where it has applicability in the treatment of wounded people in high-threat environments. A civilian version of TCCC, known as tactical emergency casualty care (TECC) has gradually made its way into some public safety jurisdictions in the U.S. TECC makes provisions for the rendering of emergency medical services in austere environments, including active shooter events, wilderness settings, and urban environments. A TECC program known as the rescue task force (RTF) is ideal for the delivery of on-site emergency medical care at active shooter and terrorist incidents. In TECC RTFs, specially trained and equipped EMS personnel enter hostile scenes under the escort of police force protection units to treat trauma victims and evacuate them to hospitals.

TECC is different from TCCC in that it makes provisions for the treatment of children, the elderly, and the infirm in civilian domains. In addition, TECC doctrine also takes into consideration statutory limitations and civil liability concerns that TCCC does not. There are alternatives to the TECC RTF model. One involves specially trained police officers providing initial emergency medical services at the scenes of active shooter incidents and terrorist attacks. Another is for tactical medics assigned to SWAT police teams to render these services. This thesis will demonstrate why the TECC RTF is superior to the two alternatives.

Response to mass casualty incidents also requires hospitals that are uniquely trained, equipped, and staffed. The nation of Israel has developed a methodology for the effective management of casualties that occur in mass terrorist attacks, such as suicide bombing attacks. In the Israeli model, logistics are as important as the medical

procedures that are performed on patients. Upon notification of terrorist attacks, Israeli hospitals activate surgical teams for each patient and senior trauma surgeons quickly diagnose patients as they arrive at emergency departments to determine which are most in need immediate life-saving interventions. The Israeli system is adaptable to the U.S. In the wake of the marathon bombings, hospitals in Boston were able to care for high volumes of casualties seamlessly because they had learned Israeli hospital concepts such as surge capacity, assigning multi-disciplinary surgical teams to each patient, and the importance of having experienced trauma physicians monitor each victim's progression throughout the emergency department.³

This thesis examines four case studies to evaluate the need for the implementation of TECC rescue task force programs and specialized hospital trauma care protocols in the United States.⁴ The case studies are the Israeli hospital trauma model, the Century Theater shooting (Aurora, Colorado), the Boston Marathon bombings, and the Los Angeles International Airport active shooter incident of 2013. Qualitative analysis of the research material was undertaken in an effort to determine the effectiveness and feasibility of military tactical emergency medical programs and their utility in the civilian domain. Analyses of these case studies illustrate the urgent need for standardized TECC rescue task forces and the Israeli trauma paradigm in the U.S.

The research conducted for this thesis indicates that most public safety jurisdictions in the United States are not ready for active shooter events or terrorist attacks resulting in mass casualties because they have not implemented TECC rescue task force programs and Israeli hospital trauma protocols or anything as effective. The research indicates that most public safety jurisdictions in the United States are not ready for active shooter events or terrorist attacks resulting in mass casualties. As a result of these systemic deficiencies, the nation is particularly vulnerable, and lives could be lost unnecessarily due to the inability to get medical care to the wounded during high threat situations. The TECC rescue task force model is the most optimal one to ensure that

³ The Boston Marathon bombing will be the subject of one of the case studies of this thesis.

⁴ The case studies are on Israeli hospital trauma model, the Century Theater shooting in Aurora, Colorado, the Boston Marathon bombings, and the Los Angeles International Airport active shooter incident in 2013.

emergency medical services are administered effectively at scenes of mass casualty events, and the Israeli hospital model is the exemplar for definitive care.

Obstacles to the implementation of TECC rescue task forces include the high cost of training and equipment, as well as the increased risks posed to EMS personnel. Establishment and sustainment of TECC rescue task forces requires funding, support from public safety officials, and joint tactical training for both police officers and EMS practitioners. Police officers assigned rescue task forces need to provide force protection to firefighters and EMS personnel as they enter active shooter scenes to administer first aid. Furthermore, fire and EMS departments will need to outfit their rescue task force personnel with basic TECC equipment such as combat application tourniquets and hemostatic bandages. Additionally, medics assigned to rescue task forces need ballistic protection equipment—specifically body armor and helmets—because they will be entering high threat areas, running the risk of being exposed to gunfire and explosive devices.

The U.S. Congress, the Department of Homeland Security’s Office of Health Affairs (OHA), and the Federal Emergency Management Agency (FEMA) should identify funding mechanisms that will meet the needs for TECC rescue task force training and equipment. Possible sources of funding include FEMA’s Assistance to Firefighters Grant (AFG) and homeland security grants such as the State Homeland Security Grant Program (SHSP). Priority should be given to public agencies that either have TECC programs or who are in the process of establishing them.

There is also a need for hospitals in the United States to emulate the Israeli hospital method for treating mass casualties. The Israeli all-hazards approach works well for any type of large-scale trauma event. In order for U.S. hospitals to provide comprehensive care during active shooter events, terrorist attacks, and other large-scale medical emergencies, they need to prepare to handle a high volume of seriously injured or sick people. Funding for improvements in hospital capabilities may be available through the U.S. Department of Health and Human Services’ Hospital Preparedness Program (HPP), which helps communities increase medical operational capacities during disasters.

ACKNOWLEDGMENTS

I would like to thank my wife, Elaine, and children Molly, Penny, John Paul, and Erica for putting up with my prolonged absences and encouraging me during my participation in the CHDS program over the course of the past two years. I would like to give special thanks to my father, Bob, who always taught me the value of higher education—mainly leading by example.

I would like to express the utmost gratitude to my thesis co-advisors, Dr. Kathleen Kiernan and Dr. Nadav Morag, who challenged me and helped guide me through the thesis process. I am also greatly appreciative to all of the NPS faculty and staff who create an environment par excellence for learning.

To my classmates in CA 1301 and 1302—it was a privilege to meet and participate in the CHDS master's program with each of you.

Finally, I would like to express my gratitude to the U.S. Secret Service for allowing me the opportunity to participate in this tremendous program.

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I. INTRODUCTION

Active shootings and terrorist attacks are on the rise in the United States.¹ According to the Federal Bureau of Investigation (FBI) and researchers from Texas State University, the U.S. has averaged 16.4 active shooter incidents annually between the years 2007 and 2013, compared to an average of 6.4 per year from 2000 to 2006.² The communities of Aurora, Colorado, Newtown, Connecticut, Washington, D.C., Los Angeles and others have experienced tragic consequences of targeted violence against civilian populations. Terrorist attacks on U.S. soil have also proven to be a persistent threat over an extended period. According to data gathered by DHS's National Consortium for the Study of Terrorism and Responses to Terrorism, 208 terrorist attacks transpired in the U.S. between 2001 and 2011.³ In very general terms, terrorist attacks may be defined as acts of violence perpetrated in the name of a political, ideological or religious causes.⁴ Some of these attacks were carried out by international terrorist groups, such as Al-Qa'aida, and domestic terror organizations, such as Ku Klux Klan and Minuteman American Defense.⁵ Other were carried out by lone wolf actors such as Nidal Malik Hasan, who killed 13 people and wounded another 31 at Fort Hood Texas in November 2009, and James W. von Brunn who opened fire at the National Holocaust Memorial Museum in July 2009, killing a security guard.⁶ In April 2013, homegrown

¹ J. Pete Blair, and Katherine W. Schweit, *A Study of Active Shooter Incidents, 2000–2013*, (Washington, DC: Texas State University, and Federal Bureau of Investigation, 2014), 6.

² Ibid.

³ Gary LaFree, Laura Dugan, and Erin Miller, *Integrated United States Security Database (IUSSD): Terrorism Data on the United States Homeland, 1970 to 2011, Final Report to the Resilient Systems Division, DHS Science and Technology Directorate, U.S. Department of Homeland Security* (College Park, MD: START Resilient Systems Division, U.S. Department of Homeland Security, Science and Technology Directorate, 2012), 8, http://www.start.umd.edu/sites/default/files/files/publications/START_IUSSDDataTerroristAttacksUS_1970-2011.pdf

⁴ Merriam-Webster, "terrorist attack," accessed March 21, 2015, <http://www.webster-dictionary.org/definition/terrorist%20attack>

⁵ Ibid., 14.

⁶ Ibid.

terrorists detonated two bombs near the Boston Marathon finish line killing three and wounding 261 people.⁷

The resolution of active shooter and other mass casualty incidents requires extensive police and emergency medical resources. There are two primary public safety problems that materialize during acts of mass violence. The first is that law enforcement, or in some circumstances bystanders, must respond quickly to prevent the assailants from harming additional victims. The second is the administration of emergency medical treatment to critically wounded victims. These two problems are interconnected because in most instances the perpetrators are still present when police and emergency medical service (EMS) personnel arrive on scene. The typical active shooter response procedure in the majority of jurisdictions in the U.S. involves the police immediately engaging the assailants while fire and EMS personnel remain on standby in a safe area adjacent to the scene until police have cleared it of all threats. Such was the EMS response to recent active shooting events in Aurora, Colorado (Century Theater in 2012), Washington, D.C., (Washington Navy Yard in 2013), and Los Angeles, California (Los Angeles Airport [LAX] in 2013). This EMS protocol is inadequate because victims in these scenarios typically suffer from penetrating bullet and fragmentation wounds that cause rapid blood loss, and death may occur in a matter of minutes if medical attention is not rendered quickly. It frequently takes law enforcement an hour or longer to clear active shooter scenes, and during this time, it is likely that casualties will exsanguinate if they are not administered medical aid.

The U.S. does not have enough civilian tactical emergency support programs, leaving the nation as a whole unprepared to respond to active shooter and other mass casualty events. The Columbine massacre in 1999, in which two assailants shot 36 high school students and faculty members, exposed gross inadequacies in the way in which police and EMS in the U.S. responded to active shooter events. Although police and emergency medical personnel arrived on scene within minutes of the first 911 calls, and the perpetrators committed suicide less than one hour after the shooting began, it took

⁷ Arthur L. Kellerman, and Kobi Peleg, "Lessons from Boston," *New England Journal of Medicine* 368, no. 21 (2013): 1956–1957, DOI: 10.1056/NEJMp1305304.

SWAT officers four hours to clear the Columbine High School building. During this time, paramedics were forced to wait outside the school, unable to administer first aid to multiple victims. This protracted response led to at least one preventable death.⁸

After the attacks, the governor of Colorado convened the Columbine Review Commission, which determined that both police and emergency medical response to the shootings were exceedingly inadequate.⁹ As a result of Columbine, virtually every police department in the U.S. changed tactics. Rather than waiting for SWAT teams to arrive, police now immediately contact and engage active shooters upon arrival on scene.¹⁰ Although the police response to active shooters has changed markedly since the Columbine tragedy, the emergency medical response methodology to active shooter events has not progressed commensurately and most jurisdictions do not have any formal protocols for getting medical aid to the wounded during these types of situations.¹¹ The lag between police response and when the EMS are allowed to access to the wounded is tragic and unnecessary because there is currently a doctrine that makes provisions for the integration of EMS personnel and police at active shooting events. The genesis of this new and dynamic doctrine comes from the U.S. military's tactical medical methodology.

Over the course of the past two decades, the U.S. military has dramatically changed the modus operandi in which its medics treat casualties on battlefields, and this transformation also has significant implications for the realm of civilian trauma care. The military's contemporary paradigm is called tactical combat casualty care (TCCC), which is centered upon hemorrhage control, force protection for medics, and rapid evacuation of wounded combatants from points of injury to hospitals. Through the development and implementation of TCCC, the U.S. military has made great strides in providing medical care to wounded soldiers. The TCCC program is credited with saving lives of U.S. armed

⁸ Columbine Review Commission, *The Report of Governor Bill Owens*, 2001, State of Colorado, 52–54, <http://www.keystosaferschools.com/Reports/Commission%20Report%20on%20Columbine.pdf>

⁹ *Ibid.*, 127–128.

¹⁰ Elizabeth Chuck, and James Eng, “Swarming Police Response in Mall Shooting Highlights ‘Paradigm Shift’ Since Columbine,” *NBC News*, December 12, 2013, http://usnews.nbcnews.com/_news/2012/12/13/15869486-swarming-police-response-in-mall-shooting-highlights-paradigm-shift-since-columbine?lite

¹¹ Michael S. Schmidt, “In Mass Attacks, New Advice Lets Medics Rush In,” *New York Times*, December 7, 2013, http://www.nytimes.com/2013/12/08/us/in-mass-attacks-new-advice-lets-medics-rush-in.html?_r=0

service personnel wounded on battlefields in Iraq and Afghanistan at an unparalleled rate of 90 percent.¹² This rate is remarkable when compared with survivability rates in previous wars, which in Vietnam was 84 percent, and in World War II was 80 percent.¹³ The essence of TCCC is rapid medical intervention with tourniquets, hemostatic agents, and other medical equipment to address preventable causes of death, such as hemorrhaging, collapsed lungs, and airway obstructions, and followed by immediate evacuation to a medical facility. Additionally, in TCCC, medics go into battle with their own dedicated force protection units and are uniquely trained and prepared to treat the wounded in dangerous environments. While TCCC was designed for military operations, many of its concepts are suitable for and are adaptable to the civilian emergency medical community.

A civilian version of TCCC, known as tactical emergency casualty care (TECC), has been developed in the United States. One TECC program is known as the rescue task force (RTF). In the TECC RTF model, police officers and EMS personnel deploy in integrated teams at mass casualty incidents. TECC RTF programs incorporate specialized equipment, training, and tactics that enable first responders to operate in hostile environments. The Arlington County Fire Department (ACFD) in Virginia created the nation's first RTF program and some public safety agencies in the U.S. have followed suit; however, a relatively small number of public safety agencies have TECC RTFs. The alternatives to TECC RTF programs involve the rendering of emergency medical services by police officers and/or SWAT team medics. While these alternatives have merits, the TECC rescue task force model is optimal because it enables an all-inclusive public safety agency approach to active shooter and terrorist incidents. Without TECC rescue task force actualization, EMS personnel will be prevented from quickly entering the locations where critically injured people lie in need of medical attention.

The need for TECC RTF programs has been made evident by recent mass shooting events during which victims had to wait for long periods of time for medical

¹² Brian Eastridge et al., "Death on the Battlefield (2001–2011): Implications for the Future of Combat Casualty Care," Supplemental version. *Journal Trauma Acute Care Surgery* 73, no. 6 (2012): S431–S432, DOI: 10.1097/TA0b013c3182755dcc.

¹³ Ibid., S431–S432.

care to reach them. For example, in the midst of the Century Theater active shooter incident in Aurora, Colorado, police officers had to rush casualties to hospitals in patrol cars because EMS personnel and ambulances were unable to access areas where wounded victims were being triaged.¹⁴ During the Washington Navy Yard shootings, paramedics remained on standby at a safe distance from the building where victims lay injured, unable to treat them while police conducted security sweeps of the facility. These victims were eventually carried outside to EMS units by law enforcement officers and civilians who were already inside the building.¹⁵ In the November 2013 Los Angeles International Airport (LAX) shooting rampage, paramedics were held on standby just 150 yards away from the location where a critically wounded Transportation Security Administration (TSA) employee lay bleeding for 28 minutes after being shot.¹⁶ These are examples of active shooter events where emergency medical care was lacking because of insufficient protocols and training procedures.

Another critical component in the administering of emergency services at mass casualty events is proximity to hospitals with personnel that are well trained and equipped to handle large numbers of casualties simultaneously. Israel's hospital model is ideal for handling mass casualties stemming from terrorist attacks on civilian populations, and the Israeli system is teachable to other countries. Israeli emergency medical physicians became proficient in the treatment and management of high volumes of trauma patients injured in response to the onset of suicide bombings in the 1990s. Physicians from some hospitals in the United States, such as those at Massachusetts General Hospital in Boston, have turned to Israel to learn best practices in managing large numbers of traumatic injuries.

¹⁴ Ben Brumfield, and Cristy Lenz, "Rescue Workers Weren't Prepared for Chaos of Aurora Shooting" *CNN*, May 2, 2013, <http://www.cnn.com/2013/05/02/us/colorado-aurora-shooting-report>

¹⁵ Metropolitan Police Department, *After Action Report Washington Navy Yard, September 16, 2013, Internal Review of the Metropolitan Police Department* (Washington, DC: Metropolitan Police Department, 2014), 48, http://mpdc.dc.gov/sites/default/files/dc/sites/mpdc/publication/attachments/MPD%20AAR_Navy%20Yard_Posting_07-2014.pdf

¹⁶ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident* (Los Angeles: Los Angeles Fire Department, 2013), 5–6.

A. PROBLEM STATEMENT

The majority of public safety departments across the U.S. are not addressing the need for TECC rescue task force and Israeli hospital trauma programs. Fire and EMS departments do not have the TECC RTF training or standard operating procedures in place that could empower them to enter mass casualty events assimilated with law enforcement. In addition, level 1 trauma hospitals in the U.S. have higher case fatality rates than level 1 trauma centers in Israel,¹⁷ despite the fact that Israel has sustained an extraordinary number of terrorist attacks in recent years.¹⁸ As a result of these systemic deficiencies, the U.S. is particularly vulnerable, and lives could be lost unnecessarily due to the inability to get medical care to the wounded during high threat situations. Public safety officials in many localities cite the high cost and increased risk for firefighter paramedics as justifications against implementation of TECC rescue task force programs.¹⁹ Moreover, some policy makers also point to the relative scarcity of active shooting events as argumentation against the establishment of TECC rescue task forces.

The research conducted for this thesis demonstrates the need for a national standard for TECC rescue task force and Israeli hospital trauma programs. The implementation of these programs requires a commitment by public safety leaders to equip and train public safety and hospital professionals to respond to active shooter and other mass casualty events. Additionally, research is needed to explore possible vectors for program realization. This thesis will recommend a systematic implementation of TECC rescue task force and Israeli hospital trauma methodologies in jurisdictions across the United States. TECC rescue task force programs will save lives by equipping first responders with the training and tools necessary to treat the wounded during or in the immediate aftermath of an active shooter event or terrorist attack. The implementation of

¹⁷ Avraham Rivkind et al., "Trauma Care and Case Fatality during a Period of Frequent, Violent Terror Attacks and Thereafter," *World Journal of Surgery* 30, no. 8 (August 2006), 7, figure 2, DOI: 10.1007/s00268-012-1637-6.

¹⁸ Israeli Security Agency (Shabak), "Analysis of Attacks in the Last Decade," accessed March 8, 2014, <http://www.shabak.gov.il/English/EnTerrorData/decade/Fatalities/Pages/default.aspx>

¹⁹ Paul Atwater, "Force Protection for Firefighters: Warm Zone Operations at Paramilitary Style Active Shooter Incidents in a Multi-Hazard Environment as a Fire Service Core Competency" (master's thesis, Naval Postgraduate School, 2012), 70–71.

Israeli hospital trauma programs in the U.S. are imperative to ensure the provision of definitive medical care to those injured in mass casualty events.

B. RESEARCH QUESTION

Why are tactical emergency casualty care (TECC) rescue task force (RTF) and Israeli hospital trauma programs the best approaches to addressing the current gaps and weaknesses in trauma management in the United States in the context of terrorist attacks and/or active shooter incidents?

C. HYPOTHESIS

TCCC lessons learned are slowly making their way into the civilian emergency medical domain in the U.S. For example, some public safety jurisdictions are using tourniquets, training their personnel on hemorrhage control techniques, and planning for rapid evacuation of trauma victims from volatile environments. A select few jurisdictions have adopted and implemented a civilian version of TCCC called tactical emergency casualty care. Practitioners of TECC have the same objectives as those of TCCC, which is the administering of rapid medical interventions in hostile environments; however, TECC takes additional factors into consideration special populations, such as children, elderly, and the disabled. Also, TECC doctrine considers civilian statutory limitations and liability concerns. Additionally, TECC involves a series of programs that allow for the delivery of emergency medical services in austere environments. These include, but are not limited to urban, wilderness, and maritime settings.

As referenced earlier in this chapter, one aspect of TECC is the creation of rescue task forces.²⁰ In the RTF archetype, firefighter-paramedics train with police officers and deploy in tandem with them at active shooter scenes. RTF paramedics are equipped with ballistic helmets and body armor, and carry tourniquets, hemostatic bandages, and other portable medical implements to treat patients with severe injuries. Although public safety agencies in a few other localities have been proactive in initiating RTFs, most

²⁰ Blake Iselin, and E. Reed Smith, "Arlington County, VA Task Force Rethinks Active Shooter Incident Response," *Journal of Emergency Medical Services* (December 2009), <http://www.jems.com/article/major-incidents/arlington-county-va-task-force>

jurisdictions in the U.S. do not have RTFs or any similar type programs, and therefore they do not address the need to have an integrated police and EMS response to mass casualty events. Deficiencies in existing EMS protocols come to light when active shooter events take place in the U.S. and casualties go untreated for inordinate periods of time. One of the reasons for this takes is complacency. Many decision makers in the field of emergency medical services fail to recognize any correlation between combat casualties and injuries seen in civilian trauma, and therefore they do not see the need for civilian tactical emergency medical programs. Other reasons cited are costs, perceived ineffectiveness, and concern over complications of using military TCCC equipment and methodologies in civilian EMS environments.²¹

What is needed at this time in the U.S. is a paradigm change from the status quo of standby EMS responses at active shooter events to a more dynamic approach modeled after TCCC doctrine. TECC provides the framework for this archetypal transformation. Although esteemed public safety advocacy groups such as the International Association of Firefighters (IAFF)²² and the Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Events²³ laud the concepts of RTFs and tactical emergency casualty care, the majority of cities and towns across the U.S. are ill-prepared to render medical assistance on scene during active shooter and terrorist events. This is because they lack RTF programs.

D. RESEARCH DESIGN

This thesis will examine two interrelated paradigms for the treatment of victims in mass casualty events. These paradigms encompass the rapid dispensation of on-scene emergency medical services and specialized hospitals with highly developed trauma care capabilities. The U.S. military has created a prototype for the delivery of on-scene

²¹ Joseph M. Galante et al., "Identification of Barriers to Adaptation of Battlefield Technologies into Civilian Trauma Care in California," *Military Medicine*, 178, no. 11 (November 2013): 1228–1230, DOI: 10.7205/MILMED-D-13-00127

²² International Association of Firefighters, "IAFF Position Statement: Rescue Task Force Training," accessed July 15, 2014, http://www.iaff.org/Comm/PDFs/IAFF_RTFF_Training_Position_Statement.pdf

²³ Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events: The Hartford Consensus II, "Active Shooter and Intentional Mass-Casualty Events: The Hartford Consensus II," *Bulletin of the American College of Surgeons* 98, no. 6 (2013): 14–16, <http://bulletin.facs.org/2013/09/hartford-consensus-ii/>

emergency medical services in high-threat environments through a program known as tactical combat casualty care. The civilian adaptation of TCCC is TECC. The nation of Israel has developed a model for the provision of trauma care at hospitals during mass casualty situations. Both TCCC modeled programs, such as TECC, and Israeli-style hospitals are essential to save lives during active shooter events and other large-scale casualty incidents.

Case studies provide a basis for this thesis's assertion that TECC RTF and Israeli hospital trauma programs are critically necessary in the U.S. Qualitative analysis of the research material was undertaken in an effort to determine the effectiveness and feasibility of TECC rescue task force programs and the Israeli hospital trauma model in the U.S. The case study method was selected because it allowed the researcher to draw a correlation between the existence of TECC rescue task force programs, the omnipresence of highly evolved trauma centers (such as those in Israel) and victim survivability in mass casualty events (e.g., chances for survival in combat and active shooter situations is improved with rapid medical intervention).²⁴ Analyses of these case studies demonstrate that there is an urgent need for standardized TECC rescue task force programs and Israeli-style trauma centers in the U.S. The purpose of using case studies and qualitative analysis is to illustrate the lack of essential TECC rescue task forces in the U.S. and make recommendations for systemic improvements. Additionally, the thesis includes a comparative analysis of Israeli and U.S. level 1 trauma hospitals. This analysis shows that case fatality rates (CFRs) at Israeli level 1 trauma centers are significantly lower than level-one trauma centers in the U.S.

E. CASE STUDIES

The first case study in this thesis describes the Israeli hospital trauma model. Israel has developed one of the world's preeminent systems for managing high volumes of casualties emanating from terrorist attacks and the Israeli methodology is adaptable to hospitals in the U.S. Next there are three case studies examining emergency medical

²⁴ Russ S. Kotwal et al., "Eliminating Preventable Death on the Battlefield," *Archives of Surgery* 146, no. 12 (2011): 1350, DOI: 10.1001/archsurg.2011.213.

responses to recent mass casualty incidents in the United States: the Century Theater shooting event in Aurora, Colorado, the Boston Marathon bombings, and the LAX active shooter incident that transpired in 2013.

1. The Israeli Hospital Trauma Model

In response to a sustained number of suicide bombings and other terrorist attacks resulting in mass casualties, Israeli hospitals have developed a unique and highly efficient system for treating large numbers of trauma patients. Israeli trauma specialists have discovered that they must balance logistics with medical care when handling high volumes of victims from a terror attack. Emergency management and health officials in some public safety jurisdictions in the U.S., such as those in Boston, Massachusetts, consult with Israeli trauma physicians on a regular basis to learn best practices in mass casualty care. A case study on the Israeli model, detailed in Chapter IV, will explain how Israeli hospitals respond to suicide bombings and other events in which numerous people are traumatically injured.

2. Aurora, Colorado—Century Theater Mass Shooting, July 2012

On July 20, 2012 just after 12:30 a.m. in Aurora, Colorado, a gunman opened fire in a crowded movie theatre wounding 82 people, 12 of whom died.²⁵ Mayhem ensued as 1,200 panicked moviegoers fled the Century Theater complex, while others lay inside theater nine's auditorium, unable to move due to their injuries.²⁶ Although police, firefighters, and ambulances arrived on scene within minutes of the first 911 call, EMS personnel were initially placed on standby by their incident commanders. Another problem manifested when ambulances did attempt to navigate to triage locations but were swarmed by scores of frantic shooting victims and bystanders who were seeking medical assistance. This added to the confusion, making it more difficult for EMS to triage victims and determine which people were most seriously wounded. Because the theater

²⁵ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting: After Action Report For The City Of Aurora* (Arlington, VA: TriData Division System Planning Corporation, 2014), 42, http://www.courts.state.co.us/Media/Opinion_Docs/14CV31595%20After%20Action%20Review%20Report%20Redacted.pdf

²⁶ *Ibid.*, 44.

complex's parking lot was flooded with pedestrians, parked cars, and police vehicles, ambulances had difficulty driving to areas where large numbers of wounded were being triaged. As a direct result of communications breakdowns, fire and EMS officials were also unaware for some 17 minutes that some of the most seriously wounded were at the exterior rear of the Century Theater.²⁷

Due to the fact that a multitude of wounded people were in peril of bleeding to death, police and fire officials made an unorthodox decision to load victims into police cars and rush them to area hospitals. While this quick thinking saved lives, it also exposed weaknesses in Aurora's emergency medical response protocols to mass casualty events. The Century Theater case study illustrates why it is vital to have an integrated police and TECC rescue task forces and hospitals capable of managing mass casualties in the wake of active shooter events.

3. Boston Marathon Bombings, April 2013

On April 15, 2013 at 2:49 p.m., two bombs detonated near the finish line of the Boston Marathon. The scene was one of turmoil as scores of grievously wounded, either lying on the ground helplessly or walking in bewilderment seeking medical assistance. Some people did not survive the blasts, while others did and suffered limb amputations and other life-threatening injuries severed. In fact, victims exhibited similar types of injuries to those previously seen in terrorist improvised explosive device (IED) attacks in Iraq, Afghanistan, and Israel.

Within seconds of the explosions, police officers, emergency medical service personnel, and bystanders (race spectators and participants) mobilized and began tending to the injured. Dozens of emergency service personnel were already prepositioned at aid stations, looking after fatigued runners as they crossed the finish line.²⁸ In the moments after the bombs went off, these EMS, firefighters, nurses, doctors, and bystanders (some

²⁷ Karen Crummy, and Carlos Illescas, "Aurora Theatre Shooting Report Shows Delays in Fire, Ambulance Response," *The Denver Post*, May 1, 2013, http://www.denverpost.com/ci_23143246/aurora-theater-shooting-report-shows-delays-fire-ambulance

²⁸ National Public Radio, *Lessons Learned in Emergency Preparedness after Boston Bombings*, National Public Radio, May 2, 2013, <http://www.npr.org/2013/05/02/180594745/lessons-in-emergency-preparedness-after-boston-bombings>

of whom were military veterans) re-focused their attention on the bombing victims.²⁹ First responders used tourniquets to prevent many of the victims from exsanguinating.³⁰ A pressing issue was time: dozens of victims had to be transported to hospitals before they bled to death and first responders consequently worked to expedite them from the blast sites to trauma centers.

Although the number of casualties was high (261 people were injured and three were killed), many victims were saved because Boston's first responders and hospital staffs had previously studied lessons learned from U.S. military medical practitioners of TCCC and Israeli trauma specialists. Medical officials in Boston also noted the importance of EMS and bystander intervention at the scene of the Marathon blasts. Furthermore, of great importance was the application of direct pressure to open wounds and use of tourniquets to stop bleeding.

The Boston case study demonstrates how immediate EMS response, utilization of hemorrhage control techniques, and rapid transport to hospitals staffed with physicians trained in Israeli trauma protocols saves lives. Although Boston did not have a formal TECC rescue task force program in place prior to the marathon bombings, the use of TCCC techniques and the integrated law enforcement EMS response very closely resembled TECC rescue task force precepts. The emergency medical response to the Boston Marathon bombing was a triumph, albeit a cautionary one. Emergency medical personnel were in the immediate proximity of the bomb's blast zones. Therefore, they were already inside the secure perimeter and had unobstructed access to the wounded. The outcome could have very well been different had there been secondary explosive devices at the scene or had the terrorists decided to target the first responders as they tended to the wounded.

²⁹ Herman B. "Dutch" Leonard et al., *Why Was Boston Strong? Lessons from the Boston Marathon Bombing* (Cambridge, MA: Harvard Kennedy School and Harvard Business School, 2014).

³⁰ Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings: Hospital Readiness and Response," Lessons Learned Information Sharing, accessed March 21, 2014, <https://www.llis.dhs.gov/sites/default/files/Boston%20Marathon%20Bombings%20Hospital%20Readiness%20and%20Response.pdf>

4. Los Angeles International Airport Shooting, November 2013

On November 1, 2013 a gunman opened fire with an assault rifle inside the passenger terminal of LAX, wounding three TSA employees and one civilian. The assailant was subsequently shot and incapacitated by police approximately five minutes into the event. Nevertheless, police continued to address the problem as an ongoing active shooter event for an extended period of time. One of the wounded TSA workers, struck with 12 bullets, lay within 20 feet of an airport exit and bled for 28 minutes before he was loaded into a wheelchair and moved to paramedics waiting on standby outside the airport terminal.³¹ Los Angeles Fire Department (LAFD) paramedics arrived on scene quickly, but they were ordered by their commanders to remain on standby until the police conducted their security sweeps, which was the standard protocol for an active shooter event at that time. This led to delays in getting medical attention to the injured, and police ultimately had to transport victims from inside the terminal building to the LAFD triage area that was set up outside. Prior to the shooting at LAX, the Los Angeles Fire Department (LAFD) was in the process of evaluating a rescue task force model to determine its suitability for the department. As a result of the shootings, the LAFD announced that it was implementing RTF within just weeks of the LAX shootings. This case study will show why an integrated police and EMS responses are critical during active shooter events, and why TECC RTF is among the optimal program designs to deliver emergency medical services in hostile environments.

F. DATA ANALYSIS

A case study of Israeli hospital trauma methodology was conducted for the purpose of demonstrating how that country manages large numbers of casualties in the wake of terrorist attacks. Despite the high numbers of terrorist attacks in Israel in recent years, the mortality rate of patients treated in Israel's six level 1 trauma centers decreased by five percent between 2000 and 2010.³² Israeli hospitals have developed an effective,

³¹ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident*, 5–6.

³² Maya Siman-Tov, Irina Radomislensky, and Kobi Peleg, "Reduction in Trauma Mortality in Israel during the Last Decade (2000–2010): The Impact of Changes in the Trauma System," *Injury* 44, no.11 (2013): 1148, DOI: 10.1016/j.injury.2012.08.054.

systematic approach to treating high volumes of casualties after suicide bombings and other types of terror attacks. The comparative analysis conducted for this thesis shows that on average, level 1 trauma hospitals in Israel have lower case fatality rates (CFRs) than level 1 trauma hospitals in the United States. Recognizing that Israeli hospitals are among the world's most proficient in providing medical care to victims of mass casualty events, leaders from some U.S. hospitals, such as those in Boston, have regularly consulted Israeli trauma specialists over the course of the past decade. Doctors in Boston credited lessons learned from Israel with saving lives of those injured in the Boston Marathon bombing.³³ Evidence of this success can be measured by the number of critically injured bombing victims that were saved by expert medical care.

For each of the three case studies on active shooter and mass casualty events in this thesis, after action reviews and assessments were conducted. Analysis identified patterns, variables, and causes from failures and successes in the treatment of wounded pursuant to active shooter or mass casualty attack. In addition, the research focused upon existing protocols and procedures and appraised the medical outcomes of each incident. Performance was measured by the ability of EMS personnel to access the wounded, administer first aid rapidly, evacuate casualties, and ultimately save lives.

This thesis will identify the critical need for a national standard for TECC rescue task force programs in jurisdictions throughout the United States. The continuing absence of TECC rescue task force programs contributes to the unnecessary loss of life and functionality to lead a productive life. The cost for medical bills and loss of income for those wounded in terror attacks is significant. For instance, one surviving victim of the Century Theater massacre, who was 23 years old at the time of the event, sustained a gunshot through his right eye and suffered a traumatic brain injury, which has left him paralyzed on the left side of his body.³⁴ He has been unable to work or care for himself since the shooting, and it has been estimated that his medical bills could reach \$2

³³ Yvette Alt Miller, "Boston/Israel Collaboration," Aish, April 20, 2013, <http://www.aish.com/jw/id/BostonIsrael-Collaboration.html>

³⁴ Kevin Simpson, "Comedy Helps Pull Caleb Medley through Tragedy of Aurora Shootings," *Denver Post*, July 20, 2014, http://www.denverpost.com/news/ci_26181632/comedy-helps-pull-caleb-medley-through-tragedy-aurora

million.³⁵ Communities across the nation would greatly benefit by the establishment of a national standard for TECC rescue task force implementation. Most jurisdictions in the U.S. still have no set standard for dealing with atypical emergency medical situations, which include, but are not limited to active shooter and mass casualty events. Conversely, there are some public safety agencies that have established TECC rescue programs, such as the Arlington County (Virginia) Fire Department, the fire departments of Orange County, California, and the Los Angeles Fire Department (which established a RTF after the 2013 LAX shooting incident).

Hospital care is another critical component of emergency medical response to mass casualty incidents. While competent emergency medical response on scene is critical, ultimate survivability of trauma victims depends on definitive hospital care. Israel realized this in recent years as the country sustained a devastating spate of suicide bombings and other terrorist attacks. Israeli trauma physicians have determined that logistics and proper planning are just as important as surgical interventions when managing victims of mass casualty events. Although lessons learned from Israel have found their way to some jurisdictions in the U.S., not enough hospitals adhere to Israeli guidelines and therefore are not prepared for large-scale casualty situations.

G. METHODS SUMMARY

A qualitative analysis of the case studies supports the hypothesis that TCCC and TECC programs, such as the rescue task force approach along with highly evolved trauma hospitals, such as those in Israel, are crucial to save the lives of those wounded in mass casualty incidents. The data also indicates that civilian jurisdictions lacking TECC rescue task force programs have experienced great difficulties in responding to active shooting events. This is at variance with those communities that have TECC training, equipment, and a plan for an integrated and multidisciplinary medical response. The next chapter will consist of a review of literature on TCCC, TECC, and the Israeli hospital trauma model for mass casualty incidents.

³⁵ John Blackstone, "Aurora Shooting May Ruin One Victim's Finances," *CBS News*, July 23, 2012, <http://www.cbsnews.com/news/aurora-shooting-may-ruin-one-victims-finances/>

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II. LITERATURE REVIEW

The previous chapter consisted of an overview of military and civilian tactical emergency medical programs, as well as the Israeli hospital model for mass casualty incidents. The last chapter also explained the research questions and methodology of this thesis. The current chapter will be broken down into six sections to review existing literature in the field of tactical emergency medicine.

A. INTRODUCTION

The main body of research on tactical emergency medicine has been conducted over the course of the past two decades by U.S. military physicians. Their research strongly indicates that the treatment of battlefield casualties has improved dramatically with the development of an emergency medical doctrine known as tactical combat casualty care.³⁶ The central tenets of TCCC include rapid, on-site treatment of hemorrhaging injuries, airway obstructions, and collapsed lungs. In TCCC, curative interventions are administered by specially trained medics who work in tandem with force protection units. TCCC was established by the U.S. Special Operations Command (USSOCOM) in the wake of the Battle of Mogadishu in 1993, in which 18 U.S. servicemen died.³⁷ This battle exposed systemic flaws in how combat medics treated soldiers wounded under fire. TCCC was subsequently created and advanced and has become the emergency medical standard for all U.S. combat units. According to Frank Butler and Lorne Blackbourne, TCCC has resulted in lives being saved at a historically high rate.³⁸

³⁶ Frank K. Butler, John Hagmann, and George Butler, "Tactical Combat Casualty Care in Special Operations," *Military Medicine* 161, supplement 1 (1996): 1–16, http://www.valorproject.org/uploads/TCCC_Special_Operations.pdf

³⁷ Robert L. Mabry et al., "United States Army Rangers in Somalia: An Analysis of Combat Casualties on an Urban Battlefield," *The Journal of Trauma Injury, Infection, and Critical Care* 49, no. 3 (2000): 516, DOI: 10.1097/00005373-2000090000-00021

³⁸ Frank K. Butler, and Lorne Blackbourne, "Battlefield Trauma Care Then and Now: A Decade of Tactical Combat Casualty Care," *Journal Trauma and Acute Care Surgery* 73, no. 6, supplement 5 (2012): S395–S402. DOI: 10–1097/TA.0b0133318.

Lessons learned from U.S. military researchers in the field of combat casualty care are making their way to the civilian emergency medical community in the U.S. Acquiring knowledge from the military and recognizing that active shooters and other domestic acts of terror are essentially combat situations, some jurisdictions in the U.S. have implemented tactical emergency medical programs to address the need for treating and evacuating the wounded in high threat situations. A civilian version of the military's TCCC, the TECC, has been implemented in a few jurisdictions in the U.S., including Arlington County in Virginia. The Arlington County Fire Department (ACFD) has a TECC program known as a rescue task force (RTF), which is designed to provide emergency medical care during active shooting incidents and other mass casualty events. In the RTF methodology, firefighter paramedics enter *warm zones* with police force protection units, similar to the manner in which U.S. military medics deploy with force protection details.³⁹

Despite the demonstrated need for TECC rescue task force teams to respond to active shooting events and terrorist attacks, decision makers at public safety departments in the U.S. have failed to see the utility of such programs in the civilian domain. Thus, most communities do not have standardized TECC rescue task force programs. The lack of tactical emergency medical programs means that public safety agencies in most U.S. jurisdictions are underprepared to provide comprehensive medical responses to mass casualty events.⁴⁰

B. CAUSES OF DEATH ON THE BATTLEFIELD AND SYSTEMIC IMPROVEMENTS IN COMBAT CASUALTY MEDICINE

Until the early 1980s, definitive information on the causes of injury and death on the battlefield was scant. According to Brian Eastridge et al., research in the field of combat casualty care consisted of individual observations, along with “compilations of

³⁹ Cynthia Kincaid, “Raise an Alert,” *Journal of Emergency Medical Services*, March 25, 2013, <http://www.jems.com/article/raise-alert>

⁴⁰ Eric Hartley, “In ‘Active Shooter’ Case, O.C. Medics to Go in Sooner,” *Orange County Register*, August 21, 2013, <http://www.ocregister.com/articles/fire-517421-county-paramedics.html>

medical administrative data and post hoc evaluations of data.”⁴¹ Prior to the 1970s, most research on battlefield casualties involved patients who reached the hospital while still alive. Data gathered on these casualties appeared skewed because there was a shortage of information available on the actual causes of death on the battlefield. Then, in 1970, the Joint Technical Coordinating Group for Munitions Effectiveness initiated a study that examined the causes of death of U.S. soldiers killed in Vietnam between 1967 and 1969. This study, which was referred to as the Wound Data and Munitions Effectiveness Team (WDMET) study, revealed that 15 to 20 percent of those killed in action died from one of three potentially preventable causes of death: extremity bleeding, collapsed lungs, and airway obstructions.⁴² This finding was significant because these types of wounds are treatable with rapid medical intervention and transport to a hospital. The WDMET study was among the first foundational inquiries on combat casualty statistics and generated significant interest in the military’s medical community.⁴³ Based on the WDMET statistics, military medical researchers, including U.S. Army Colonel Ronald Bellamy, postulated that if assistance to the wounded on battlefields could be improved, lives would be saved in future martial conflicts.⁴⁴

In 1984, Bellamy wrote a groundbreaking article in the field of tactical emergency medicine entitled “The Causes of Death in Conventional Land Warfare: Implications for Combat Casualty Care Research.” Bellamy opined that previous research about battlefield casualties placed too much emphasis on soldiers who had survived their injuries and not enough attention was focused upon the cases in which mortality occurred. It was his position that the military could learn much about saving lives by analyzing specific causes of death. In doing so, better strategies could be devised for combat casualty care.⁴⁵ Bellamy built his research upon data from the WDMET study

⁴¹ Eastridge et al., “Death on the Battlefield (2001–2011),” S432.

⁴² Iselin, and Smith, “Arlington County, VA Task Force.”

⁴³ Ibid.

⁴⁴ Ronald F. Bellamy, “The Cause of Death in Conventional Land Warfare: Implications for Combat Casualty Care Research,” *Military Medicine* 149, no. 2 (1984): 62.

⁴⁵ Ibid.

and other previous investigations concerning combat casualties,⁴⁶ studying casualty statistics from World War II, the Korean War, and the Vietnam War to determine the effectiveness of combat casualty care. Bellamy found that roughly 50 percent of all combat-related deaths were caused by exsanguination. He contended that survivability of wounded soldiers in combat operations could be drastically improved through a renewed prioritization of medical care at the site of injury, with a special emphasis being placed on the treatment of hemorrhages.⁴⁷ Bellamy was also among the first medical experts to recognize deficiencies in advanced trauma life support (ATLS) in the treatment of casualties on the battlefield. He posited that ATLS provided a sound platform for general care in most medical emergencies, but it required augmentation to address unique problems faced in combat situations such as penetration wounds caused by bullets and explosives.⁴⁸

Bellamy determined that the most frequent cause of death in combat occurred from uncontrolled bleeding⁴⁹ and concluded, “Many combat deaths were potentially preventable, including blood loss from extremity wounds, collapsed lungs and obstructed airways.”⁵⁰ The value of this research was that it categorized the different causes of death in combat and further validated findings that most battlefield deaths occurred from exsanguination. In many cases, hemorrhages are treatable with rapid medical intervention, and Bellamy’s study has proved instrumental in the evolution of tactical emergency medicine.⁵¹ Building on the work of Bellamy, other military researchers started to look for ways to get medical attention to wounded combatants in a more expedient manner, rationalizing that improving blood loss management protocols would undoubtedly save lives.

In 1995, Captain Frank Butler, Jr., (U.S. Navy), Lieutenant Colonel John Haymann (U.S. Army), and Ensign E. George Butler (U.S. Navy) were tasked with assessing the viability of treating battlefield wounds with ATLS. The catalyst for this

⁴⁶ Ibid., 57.

⁴⁷ Ibid., 62.

⁴⁸ Ibid.

⁴⁹ Ibid., 60.

⁵⁰ Lawrence E. Heiskell, “Tactically Trained Medical Personnel are a Critical Element of SWAT Operations,” *Police*, March 2006, <http://www.tacticalmedicine.com/files/policemarch06.pdf>

⁵¹ Iselin, and Smith, “Arlington County, VA Task Force.”

research project was the Battle of Mogadishu in 1993. During this battle, Somali militiamen shot down two U.S. special forces' helicopters, and wounded more than eighty U.S. soldiers, of which 18 died.⁵² At the time that the Battle of Mogadishu transpired, ATLS was used by both civilian and military paramedics to treat a wide variety of injuries, ranging from routine medical emergencies to combat injuries. American combat medics in this engagement found themselves confronted with several problems, the most acute of which was their inability to sufficiently treat hemorrhaging injuries and difficulties in evacuating the wounded to hospitals due to enemy fire. U.S. medics in Mogadishu found that ATLS protocols were insufficient to treat wounded combatants because it did not prioritize bleeding.

At the outset of their research project, Butler and his colleagues examined data from previous combat casualty studies, interviewed emergency medicine subject matter experts and practitioners. In their revolutionary paper "Tactical Combat Casualty Care in Special Operations," Butler, Hagmann, and Butler concluded that ATLS was inadequate for treating wounded soldiers because it failed to make provisions for the delivery of medical services in combat environments. Since most deaths in combat are the result of blood loss, Butler, Hagmann, and Butler deemed hemorrhage control the new top priority. Furthermore, they contended that combat medics were particularly vulnerable because they were not guarded by force protection units while tending to the wounded in volatile situations.⁵³

Another significant shortcoming of the use ATLS protocols on battlefields was that it did not take into consideration the exigent need to evacuate the wounded from points of injuries to fully equipped medical treatment facilities (MTFs).⁵⁴ This research also indicated that an inordinately high number of preventable deaths had transpired in previous military engagements as a result of extremity wounds-injuries that are treatable with proper training, skills, and equipment.⁵⁵ Butler and his colleagues subsequently recommended a new set of standards to treat battlefield casualties, tactical combat

⁵² Mabry et al., "United States Army Rangers in Somalia," 515.

⁵³ Butler, Hagmann, and Butler, "Tactical Combat Casualty Care in Special Operations."

⁵⁴ Ibid.

⁵⁵ Ibid.

casualty care. Butler, Hagmann, and Butler hypothesized that TCCC is an essential tactical, medical, and logistical program that emphasizes, above all else, the control of hemorrhages on the battlefield.

In April 1997, Rear Admiral Tom Richards mandated the Navy SEALs adopt TCCC as the standard of care in all for combat operations, and in 1998, Colonel Stanley McChrystal mandated TCCC as the standard of care for U.S. Army's 75th Ranger Regiment. However, the effectiveness of TCCC was not rigorously tested until the commencement of military engagements in Iraq and Afghanistan.⁵⁶ Military operations in these two countries represented the largest deployment of U.S. combat forces since the Vietnam War, and U.S. casualties in Iraq and Afghanistan were substantial and accelerated the development military of TCCC.

In 2007, U.S. military researchers published two separate white papers on the causes of death on Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). In one of these articles, entitled, "Causes of Death in U.S. Special Operations Forces in the Global War on Terrorism 2001–2004," John Holcomb et al. observed that between October 2001 and November 2004 there were 500 U.S. Special Forces (SOF) casualties, of which eighty-two died. They found that of these eighty-two fatalities, only twelve (fifteen percent of the cohort studied) died of wounds that were potentially survivable, such as extremity wounds.⁵⁷ This study is important because special forces personnel were, at this time, trained in TCCC and the study determined that advances were being in the treatment of combat casualties in Iraq and Afghanistan. The reasons for the improvement of casualty care were that medics were adhering to TCCC doctrine, medics placed emphasis on hemorrhage control, tourniquets were being used with increased frequency, and prioritization was being placed on rapid evacuation from the point of injury on battlefields to full time medical facilities. This study also points to areas in which medical care in the battlefield can be improved through enhanced knowledge, training, and equipment.

Another study on causes of death was undertaken by Joseph F. Kelly et al. These researchers examined nature of death of U.S. 982 servicemen killed in combat during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) from 2003 to 2004 and again in 2006. The purpose of

⁵⁶ Butler, and Blackbourne, "Battlefield Trauma Care Then and Now," S397.

⁵⁷ John B. Holcomb et al., "Causes of Death in U.S. Special Forces in the Global War on Terrorism 2001–2004," *Annals of Surgery* 245, no. 6 (2007): 988–990, DOI: 10.1097/01.sla.0000259433.03754.98.

this was to learn more about specific causes of death in these conflicts and to compare fatalities that transpired in the earlier years of the wars (2003–2004) with those that took place in a later year (in 2006). The goal of this study was to analyze battlefield casualty statistics in order to find areas for improvement. Kelly et al. found that 85 percent of combat deaths in OEF and OIF were the result of hemorrhaging.⁵⁸ They divided the cohort into two groups: those that died of non-survivable wounds (NS) and those that died of potentially survivable (PS) wounds. It was determined that just over 23 percent (232 victims) died from torso hemorrhage, extremity bleeding, or compressible injuries to the neck or groin—all of which are considered to be potentially survivable.⁵⁹ The significance of this study is that it shows areas where combat casualty care can be improved by identifying specific causes of death as many injuries are potentially survivable. Torso hemorrhage can best be treated by rapid evacuation from the battlefield to a hospital where the patient can undergo surgery. Extremity bleeding can be stanching with the use of tourniquets, and wounds to the neck or groin can be dealt with by the application of direct pressure and hemostatic agents and bandages. Kelly et al. found that enemy forces were inflicting more lethal injuries on U.S. service personnel as the wars in Afghanistan and Iraq progressed; however, they also found that a greater number of lives were saved by the implementation of TCCC protocols, such as point of injury care and the use of tourniquets and hemostatic dressings.⁶⁰

In 2011, Russ Kotwal et al. published “Eliminating Preventable Death on the Battlefield,” a study that examined casualties sustained by the U.S. Army’s 75th Ranger Regiment during Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom. Between October 1, 2001 and March 31, 2010, the 75th Rangers carried out 8,000 combat missions and sustained a total of 419 battle casualties with an unprecedentedly high survival rate of 92 percent.⁶¹ Tourniquets were successfully used on 66 of the 419 casualties. The researchers note that tourniquets were used with great frequency and resounding success to save lives in OIF and OEF. Kotwal et al. submitted that military engagements typically result in advancement of medical knowledge due to lessons learned by medics

⁵⁸ Joseph F. Kelly et al., Injury Severity and Causes of Death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003–2004 Versus 2006,” *The Journal of Trauma, Injury, Infection, and Critical Care* 64, no. 2 (2008): S23–S25, DOI: 10.1097/TA.0b013e318160b9fb.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Kotwal et al., “Eliminating Preventable Death on the Battlefield,” 1350.

and physicians through treating large numbers of wounded on the battlefield. Furthermore, Kotwal et al. credits the implementation of TCCC, along with the detailed tracking of each and every casualty in the Joint Trauma Registry and Joint Theater Trauma Registry (JTTR), a web-based pre-hospital trauma registry (PHTR) and Armed Forces Institute of Pathology.⁶² Through the tracking and analysis of this data, medical, and tactical researchers are able to look for ways in which combat casualty care can be improved. TCCC practitioners constantly use data and after action reviews to look for ways in which treatment can be improved, with the ultimate goal of eradicating preventable deaths on the battlefield.

Mabry and McManus submitted that TCCC has “revolutionized the management of combat casualties in the pre-hospital tactical setting.”⁶³ They surmised that improvements were the result of fundamental changes in how soldiers are treated at the point of injury, with emphasis on hemorrhaging and breathing problems. Furthermore, they point out that the tools used by medics to deliver treatment, such as tourniquets, are unsophisticated and portable. Moreover, Mabry and McManus posit that TCCC principles, which emphasize the delivery of emergency medical services in austere environments, can be easily adapted by civilian EMS practitioners during law enforcement actions, terrorist attacks and natural disasters.⁶⁴

In 2011, Frank Butler, one of the creators of TCCC, and Lorne Blackbourne collaborated to assess the effectiveness of TCCC in treating casualties taking place in OEF and OIF. They chronicled the evolution of TCCC from its incipient phases in which its use was limited to U.S. special forces, to later stages when it was adopted by all U.S. military forces and most coalition forces by 2010. They reported that as of 2011, all U.S. combat medics were being taught TCCC protocols. Furthermore, Butler and Blackbourne validate what previous research of TCCC programs indicated: that TCCC saves lives of wounded combatants at an unprecedented rate.⁶⁵

⁶² Ibid., 1356.

⁶³ Robert L. Mabry, and John G. McManus, “Prehospital Advances in the Management of Severe Penetrating Trauma,” *Critical Care Medicine* (2008): S258, DOI: 10.1097/CCM.0b013e31817da674

⁶⁴ Ibid.

⁶⁵ Butler, and Blackbourne, “Battlefield Trauma Care Then and Now.”

In 2012, Brian Eastridge et al. examined 4,596 combat fatalities that occurred in OEF and OIF between October 2001 and June 2011, and determined that fatalities from extremity bleeding dropped sharply with the induction of modern tourniquets and TCCC programs.⁶⁶ Their study is important because it is a comprehensive examination of mortality statistics and shows a correlation between survivability and TCCC programs. In addition, this study also shows the value of using a pre-hospital trauma registry to record and analyze casualties. Data collated in pre-hospital registries is being used to find areas for improvement in battlefield casualty care.

C. DEVELOPMENT OF THE MODERN TOURNIQUET

At the onset of the war in Afghanistan in 2001, the 75th Ranger Regiment and Navy SEALs were the only military entities that had established TCCC programs. In August 2002, U.S. Army Institute of Surgical Research (USAISR) commander John Holcomb (former Army surgeon in Mogadishu) convened a group of medics returning from Afghanistan for recommendations on improvement of casualty care in the field. The consensus was that what medics most needed were effective tourniquets, which heretofore had been unavailable.⁶⁷ Up until 2002, combat medics were still carrying World War II-era tourniquets, which consisted of rubber tubing and straps. These antiquated tourniquets did not adequately stop the flow of arterial bleeding, and the pervasive opinion in the medical community, albeit unscientific, was that they could do as much harm as good because they caused permanent muscle and nerve damage to the patient.

The use of tourniquets has been controversial. In 2003, John Navein, Robin Coupland, and Roderick Dunn point to the tourniquet's reputation as "an instrument of the devil that sometimes saves a life."⁶⁸ In other words, risks and rewards of the device were unclear. They conceded that tourniquets had saved lives in some cases but argued they should only be used as a last resort. Navein Coupland and Dunn noted that scant

⁶⁶ Eastridge et al., "Death on the Battlefield (2001–2011)," S431–S432.

⁶⁷ John F. Kragh et al., "Tragedy into Drama: An American History of Tourniquet Use in the Current War," *Journal of Special Operations Medicine* 13, no. 3 (2011): 10.

⁶⁸ John Navein, Robin Coupland, and Roderick Dunn, "The Tourniquet Controversy," *The Journal of Trauma Injury, Infection, and Critical Care* 54 (2003): S219, DOI: 10.1097/01.TA.0000047202.16935.E9.

historical data was available to determine how much tissue damage occurred, how many limbs needed to be amputated, and how many lives had been actually saved as a result of tourniquets.⁶⁹

The “tourniquet controversy” posited by Navein, Coupland, and Dunn, would soon be resolved by the design of a modern and effective tourniquet, and publication of the first definitive studies on tourniquet effectiveness. As a result of Holcomb’s conference in 2002 and additional feedback from the Afghan and Iraqi wars, the U.S. military set out to develop a modern tourniquet suitable for use the modern battlefield. Several tourniquets were evaluated, and by early 2004, the combat application tourniquet (C.A.T.) was selected and issued to combat troops.⁷⁰ According to Kragh et al., the C.A.T. is highly effective, relatively inexpensive at approximately \$28 per unit, and simple to use. It stops bleeding, and there is a low risk of vascular damage to limbs. This tourniquet has been proven so effective that the military now issues it to all U.S. soldiers serving in combat areas.⁷¹

In 2008 and 2009, Kragh et al. conducted studies involving the use of tourniquets on a total of 499 individuals (both civilian and military personnel) wounded in OIF and OEF. Kragh et al. determined that 87 percent of the 499 casualties treated with tourniquets survived. Also, they found that when tourniquets were applied before the onset of shock, survivability rose to 90 percent. These statistics represent the highest survival rates for wounded combatants in recorded history and validate the effectiveness of the modern tourniquet. What the Kragh et al. studies reveal is that tourniquet application saves lives, particularly when they are used prior to the patient going into shock from blood loss. Tourniquets are effective, but for maximum effectiveness they must be applied quickly. Tourniquets stop hemorrhaging in victims, and extend the transport time necessary for medics to get these victims to the hospital. Furthermore,

⁶⁹ Ibid., S219–S220,

⁷⁰ Kragh et al., “Tragedy into Drama,” 10.

⁷¹ Ibid.

tourniquets can be used with minimal risk of limb morbidity.⁷² Kragh et al.'s research represents the first data-driven, conclusive research into tourniquets ever conducted, and dispelled previously held notions in the medical community that tourniquets were ineffective and harmful.

D. PASSING OF TCCC TO CIVILIAN PUBLIC SAFETY JURISDICTIONS IN THE UNITED STATES

The American emergency medical community continues to look for ways to improve the treatment of casualties on battlefields as well as at domestic terrorist incidents in the U.S. with the ultimate goal of eliminating preventable deaths.⁷³ In addition to being of great benefit to military emergency medicine practitioners, TCCC has made possible the dispersion of combat trauma doctrine to the civilian emergency medical domain in the U.S. Lessons learned from TCCC in Iraq and Afghanistan are gradually making their way into the civilian emergency medical community as military trauma surgeons and medics transition back to civilian practice in America.⁷⁴ Kotwal et al. state that TCCC “is the model for improving pre-hospital trauma care and casualty outcomes on the battlefield and has considerable implications for civilian trauma care systems.”⁷⁵ In addition, they contend that implementation of TCCC programs “may have profound implications for civilian trauma, training, care, and preventable death, especially in light of the fact that equivalent epidemiological studies on potential survivable death from trauma in the civilian pre-hospital environment are sparse.”⁷⁶ They suggest that TCCC has utility in the civilian emergency medical community in the U.S.—specifically in the treatment of casualties in austere environments.

⁷² John Kragh et al., “Practical Use of Emergency Tourniquets to Stop Bleeding in Major Limb Trauma,” *The Journal of Trauma, Injury, Infection, and Critical Care*, February Supplement (2008): S38–S50. DOI: 10.1097/TA.0b013c3186086b1

⁷³ David W. Callaway et al., “The Committee for Tactical Emergency Casualty Care (C-TECC): Tactical Emergency Casualty Care (TECC): Guidelines for the Provision of Prehospital Trauma Care in High Threat Environments,” *Journal of Special Operations Medicine* 11, no. 2 (2011): 104–122.

⁷⁴ David W. Callaway et al., “The Committee for Tactical Emergency Casualty Care (C-TECC): Tactical Emergency Casualty Care (TECC): Evolution and Application of TCCC Guidelines to Civilian High Threat Medicine,” *Journal of Special Operations Medicine* 11, no. 2 (2011): 95–100.

⁷⁵ Kotwal et al., “Eliminating Preventable Death on the Battlefield,” 1350.

⁷⁶ *Ibid.*, 1356.

Butler and Blackbourne also argue for the transition of TCCC doctrine into the civilian domain. They specifically recommend the widespread use of tourniquets and hemostatic agents by civilian trauma practitioners, and they also advocate for TCCC implementation into tactical emergency medical support programs, such as SWAT and specialized tactical emergency medical response teams in the U.S. In addition, Butler and Blackbourne suggest that the first step toward establishing TCCC programs in the U.S. is the development of guidelines based on operational requirements. They recognize that difficulty may arise in the actual implementation of TCCC programs by public safety agencies. Difficulties may include concern over scope of practice, liability, training, and costs necessary to initiate and sustain such programs. Butler and Blackbourne also point out that in the military domain, TCCC development and implementation was notably accelerated after the Committee on Tactical Combat Casualty Care (CoTCCC) was initiated. CoTCCC, is comprised both military and civilian medical officials whose goal has been to support and mature TCCC programs to their full potential. Moreover, CoTCCC works in tandem with groups such as the American College of Surgeons Committee on Trauma and the Prehospital Trauma Life Support (PHTLS) Executive Council, in furtherance of best practices in the application of emergency medicine. Nevertheless, Butler and Blackbourne contend that TCCC should not be limited to the military domain and should be coalesced into the civilian realm.⁷⁷ From the results of this study, the researchers conclude that TCCC is the optimal and suitable approach for both military and civilian environments.

Kurt Grathwohl and Steven Venticinque expound on the great strides made in the field of combat casualty care by military practitioners in Iraq and Afghanistan between 2002 and 2008.⁷⁸ The most significant lesson is the military's ability to get highly trained personnel with fully functional equipment to treat wounded combatants in remote settings. They note the remarkable diminishment of combat fatalities as a result of TCCC and see opportunities to transition lessons learned from the military to the civilian domain. They argue that TCCC principles, such as the use of tourniquets, and

⁷⁷ Butler, and Blackbourne, "Battlefield Trauma Care Then and Now," S399.

⁷⁸ Kurt W. Grathwohl, and Steven G. Venticinque, "Organizational Characteristics of the Austere Intensive Care Unit: The Evolution of Military Trauma and Critical Care Medicine' Applications for Civilian Medical Care Systems," *Critical Care Medicine* 36, no. 36 (2008): S275-S283, DOI: 10.1097/CCM.0b013c31817da825.

ability to treatment of large numbers of casualties are necessary in both martial and domestic trauma care programs.⁷⁹

Joseph Galante et al. wrote an article in November 2013 analyzing the results of a study in which they surveyed a cohort consisting of all 28 of local emergency medical services agency (LEMSA) directors in the state of California regarding the current state of tactical emergency medical programs in each of their respective jurisdictions. Galante et al.'s goal was to determine what barriers (if any) existed to the implementation of TCCC-themed programs in civilian settings.⁸⁰ Of the 28 LEMSAs directors to whom the anonymous electronic survey was sent, 14 (50 percent) responded. The basic premise of this study is that TCCC programs have been used by U.S. military forces in Iraq and Afghanistan over the course of the past decade with great success, and Galante et al. argue that TCCC should be adopted by civilian jurisdictions in the U.S. In particular, they cite the effective use of tourniquets and hemostatic agents at the point of injury. They found that while most LEMSAs directors generally supported the deployment of tactical emergency medics with SWAT or during other specialized law enforcement activities, respondents from only one-third of the jurisdictions surveyed had adopted TCCC tactics. Most of the local EMS directors surveyed indicated they were hesitant to employ modern combat application tourniquets or hemostatic remedies to control bleeding. Among the reasons against transitioning TCCC protocols cited by LEMSAs directors were that injury patterns in civilian trauma cases differ from those seen in combat, and they expressed skepticism about the effectiveness of TCCC implements to treat civilian trauma patients. The directors also stated concern that tourniquets and hemostatic agents could cause complications, such as infection and vascular damage to patients. Galante et al. counter these arguments by stating that the TCCC methodology of triaging injuries and addressing hemorrhaging as a priority has substantial benefits for civilian EMS practitioners—particularly when used in support of law enforcement operations.⁸¹ Such operations could very well involve response to an active shooter event or a terrorist attack. It is worth noting that the Los Angeles Fire Department came under heavy criticism for the extended period of time it took to provide medical attention to wounded TSA officers at LAX International Airport in November 2013 (this will be addressed further in one of the case studies of this thesis).

⁷⁹ Ibid.

⁸⁰ Galante et al., "Identification of Barriers to Adaptation," 1227–1230.

⁸¹ Ibid.

Frank Butler and Richard Carmona point out that some TCCC concepts and practices have already made their way into the civilian emergency medical realm in the U.S. Examples they cite are the mass shootings at Fort Hood in 2009, during which an army medic used a tourniquet to successfully treat a wounded civilian police officer; and the mass shooting in Tucson, Arizona in 2011, where deputy sheriffs used inexpensive and simple medical kits to administer first aid.⁸² When many of these officers were dispatched to the scene, they quickly went to work by using the equipment contained in the kits to stem the flow of bleeding wounds suffered by victims. This shows that basic training and equipment can be used to great effect in active shooting events.

Shortly after the Boston Marathon bombings, Arthur Kellerman and Kobi Peleg published an article in the *New England Journal of Medicine* in which they credit lessons learned from combat medics and trauma surgeons in Afghanistan and Iraq as having had a tremendous impact in the overall response to the bombings.⁸³ Kellerman and Peleg posit that the emergency medical response to the Boston Marathon bombings was exemplary, as evidenced by the fact that almost 99 percent of the 264 people wounded survived. Kellerman and Peleg attribute much of this success to the fact that civilian emergency medical professionals in the U.S. are learning from their military counterparts in Iraq and Afghanistan on how to deal with combat casualties such as blunt trauma shrapnel wounds, burns, and amputations.⁸⁴ Although Kellerman and Peleg laud the medical response and outcome to the bombings, they cautiously note that at least some of the success was happenstance. They point to the fact that the bombs went off near the finish line of the race, where a multitude of emergency medical personnel were prepositioned to aid fatigued runners. Also, blast sites were in close proximity to several of Boston's largest and best hospitals, ensuring that victims had unfettered access to first class trauma care. Kellerman and Peleg argue that stakeholders in the emergency preparedness field need to take a more proactive approach to training and preparing for mass casualty events.⁸⁵

⁸² Frank K. Butler, and Richard Carmona, "Tactical Combat Casualty Care: From The Battlefields of Afghanistan And Iraq To The Streets of America," *The Tactical Edge* (winter 2012): 89-90, <http://ntoa.org/public/Publications/Articles/2167.pdf>

⁸³ Kellerman, and Peleg, "Lessons from Boston."

⁸⁴ Ibid.

⁸⁵ Kellerman, and Peleg, "Lessons From Boston."

E. Reed Smith, one of the founders of Arlington County's rescue task force program, and John B. Delaney make the case for the universal adaptation of the military TCCC program in jurisdictions throughout the U.S. via TECC doctrine. They argue that the first firefighters or EMS personnel on the scene of an active shooter event have the duty to enter warm zones with police to treat and extricate victims.⁸⁶ The ramifications of not doing so will be unnecessary loss of life.

In April 2013, the American College of Surgeons and FBI brought together an elite group of physicians, fire service, and law enforcement professionals and paramedics for a daylong conference in Hartford, Connecticut to discuss strategies to respond to active shooter events in the U.S. The conference culminated with the production of a white paper known as "The Hartford Consensus." The overarching goal of the Hartford Consensus is "to improve survival from active shooter events"⁸⁷ and it recommended an integrated law enforcement, fire/rescue, and EMS response to active shooter events."⁸⁸

Despite the fact that TECC is increasingly recognized as a best practice by fire and police departments across the nation, there is still no standard for its implementation in the U.S. In his 2012 Naval Postgraduate School thesis, Paul Atwater determined that there are several reasons why local governments may be resistant to the implementation of TECC programs, such as rescue task forces (RTFs).⁸⁹ TECC programs are expensive to establish and maintain, as there is a high cost involved with equipping and training tactical medics. Additionally, jurisdictions across the country could face lawsuits if a member of a RTF is injured or killed while trying to treat a casualty under fire in an atypically high threat situation, such as an active shooting event. Atwater also determined that there are political and cultural barriers within public safety jurisdictions that have proven to be hindrances implementation of joint EMS/police escort models at active shooter incidents. It may be difficult for public safety officials to justify costs and

⁸⁶ E. Reed Smith, and John B. Delaney, "Supporting Paradigm Change in EMS' Operational Medical Response to Active Shooter Events," *Journal of Emergency Medical Services* (December 2013), <http://www.jems.com/article/supporting-paradigm-change-ems-operation>

⁸⁷ Joint Committee, "Active Shooter and Intentional Mass-Casualty Events," 1-3.

⁸⁸ Ibid

⁸⁹ Atwater, "Force Protection for Firefighters," 41.

personnel for such TECC-type EMS/police escort programs, and some fire service officials may find it ethically difficult to send firefighters into active shooter scenes.⁹⁰ In his applied research paper for the National Fire Academy, Karl Lieb argues that many fire departments in the country have no established policy or protocols to provide tactical EMS support to police during active shooter events. Lieb also cites the high cost of equipment and liability concerns as the biggest obstacles to the implementation of tactical EMS programs.⁹¹

E. ISRAELI EMERGENCY MEDICAL RESPONSES TO MASS CASUALTY EVENTS

Israel is a country with a highly advanced trauma response system. This system evolved rapidly in the face of increased terror attacks. Between September 29, 2000 (which marked the start of the Al-Aqsa Intifada)⁹² and 2009, a total of 8,022 people were wounded in mass casualty incidents with 1,178 of them dying. Most of the casualties were attributed to suicide bombings (43 percent), firearm projectiles (27 percent), and detonation of explosive devices (eight percent).⁹³ These types of attacks result in extensive penetrating and blunt trauma injuries—similar to those seen in war zones—and without early medical intervention, many victims will die. At the dawning of these attacks, emergency departments at Israeli hospitals were overwhelmed when large numbers of casualties arrived simultaneously. Between 2001 and 2003, Israel experienced a tremendous surge in fatalities as a result of terrorist attacks.⁹⁴ As a result, Israeli trauma surgeons learned through trial and error how to effectively deal with large numbers of injuries. They started classifying bombings by setting (e.g., open space, bus, semi-confined space) and analyzing casualties and the medical responses to each as well as looking for ways to improve medical response and victim survivability. Doctors noted that bombings that occurred indoors or in confined settings caused the most severe

⁹⁰ Ibid., 70–71.

⁹¹ Karl Lieb, *Tactical Emergency Medical Service in Salt Lake City as provided by the Salt Lake City Fire Department*. Emmitsburg, MD: National Fire Academy Executive Officer Program, 2011.

⁹² Israeli Security Agency (Shabak), “Analysis of Attacks in the Last Decade.”

⁹³ Ibid.

⁹⁴ Ibid.

injuries due to overpressure from the blasts. Subsequently, they developed specific protocols provide optimal levels of care in the wake of suicide bombings. In 2004, a group of Israeli trauma surgeons published a research paper titled “Suicide Bombings: Update and Modifications to the Protocol,” in which they detailed specific methodologies for the effective treatment of mass casualties after mass casualty incidents.⁹⁵ This paper lays out a framework for emergency medical response to mass casualty events, and will be described further in chapter four of this thesis.

The Israeli approach toward treating casualties involves training and preparation; collaboration, logistical coordination, and innovative medical expertise. The most seriously wounded must be treated first, while those who are not suffering from life-threatening wounds may have to wait for medical care. The priority is to identify and treat extreme internal and external hemorrhaging injuries first because these are highly lethal if medical intervention is not rendered immediately.⁹⁶ Another study was conducted by Avaraham Rivkind et al., who sought to measure the effectiveness of Israeli hospital trauma protocols by analyzing case fatality rates (CFRs) at Hebrew-Hadassah Hospital Shock Trauma Unit (HHSTU) and comparing them with CFRs at 51 U.S. level 1 trauma centers. Rivkind et al. found that between 1999 and 2003, HHSTU had a CFR of 2.62 percent, compared to a CFR of 5.73 percent in the 51 U.S. trauma centers studied.⁹⁷ One of the important aspects of this study is that it showed that trauma patients, particularly those suffering from gunshot wounds and blast injuries have a higher survival rate at HHSTU than at U.S. level 1 trauma centers. Rivkind et al. undertook a follow-up study in which they compared CFRs at five Israeli level-one trauma centers with CFRs at 51 level 1 trauma centers in the U.S. between 1998 and 2008. They discovered that over this 11-year period, even during junctures where there were high volumes of terrorist attacks, the CFRs in Israel were lower than those in the U.S. This is mainly attributable to

⁹⁵ Gidon Almog et al., “Suicide Bombing Attacks: Update and Modifications to the Protocol,” *Annals of Surgery* 239 no. 3 (2004): 295–303, 10.1097/01.sla0000206418.53137.34

⁹⁶ Ibid.

⁹⁷ Rivkind et al., “Trauma Care and Case Fatality,” 3.

the Israeli approach in which senior trauma physicians oversee all aspects of patient care from the point of injury through hospital admittance.⁹⁸

According to the chief medical writer for the Associated Press, in 2005, Israeli trauma surgeons made the first of several trips to hospitals in the United States to lecture on the efficacy of their newly developed paradigm to treat victims of mass casualty events.⁹⁹ Dr. Pinchas Halpern, director of emergency medicine Sourasky Medical Center in Tel Aviv, instructed medical staffs at Massachusetts General Hospital and Brigham and Women's Hospital in Boston on how to control the flow of wounded by dispersing them to different hospitals (avoiding overcrowding at any one medical center), on triage methods to assess wounds, and on recommendations for best practices to detect multiple injuries that may be present in victims of bombings.¹⁰⁰ This information would later be used by trauma specialists at Boston area hospitals to treat those wounded in the Marathon bombings in April 2013.

In an article published in *New Yorker* magazine shortly after the Marathon bombings, Dr. Gawande Atul, a surgeon at Boston's Brigham and Women's Hospital noted that physicians from Massachusetts General Hospital (MGH) consulted with Israeli doctors prior to the bombings and modeled the MGH emergency department on those in Israel.¹⁰¹ Open source news reports from National Public Radio (NPR) and other media outlets quoted MGH trauma surgeons, who credited their ability to save victims from the marathon attacks with lessons learned from their colleagues in Israel.¹⁰²

⁹⁸ Ibid.

⁹⁹ Marilyn Marchione, "War Medicine is Now Helping Boston Bomb Victims," Associated Press, *U-T San Diego*, April 17, 2013, <http://www.utsandiego.com/news/2013/Apr/17/war-medicine-now-is-helping-boston-bomb-victims/3/?#article-copy>

¹⁰⁰ Ibid.

¹⁰¹ Atul Gawande, "Why Boston's Hospitals Were Ready," *The New Yorker*, April 17, 2013, <http://www.newyorker.com/online/blogs/newsdesk/2013/04/why-bostons-hospitals-were-ready.html>

¹⁰² Janis Siegel, "Israel's First Responders' First-Rate Lessons for Boston," *The Jewish Sound*, May 3, 2013, <http://jewishsound.org/israels-first-responders-first-rate-lessons-for-boston/>

Bruria Adini and Kobi Peleg contend that the Israeli national medical system's "all-hazards approach" is highly effective for dealing with mass casualty events.¹⁰³ In the all-hazards approach, staffs at hospitals do not train differently for suicide bombings, pandemics, or other types of mass casualty incidents. They argue that mass casualty events have common factors, and it is simpler to train broadly rather than to try to tailor different strategies to different types of events. When faced with a mass casualty event, hospital staff can modify protocols based on existing resources.¹⁰⁴ This concept is significant to this because it is one that can be transferred to hospitals in the United States.

Adini et al. describe the all-hazards approach as being made up of "critical building blocks" that include standard operating procedures (SOPs), training and drills, and knowledge of personnel and equipment.¹⁰⁵ Additionally, Adini et al. state that some of these building blocks, such as refined EMS and hospital staff SOPs, training, and drills have a greater positive impact during mass casualty events than knowledge and equipment. The reason for this is that successful medical response to mass casualty events requires preparation, collaboration, and skill. When emergency medical staffs are well trained and know precisely where to go and what to do when mass casualty events occur, the outcomes are more likely to be favorable for the victims.

F. CONCLUSION

The literature shows that over the course of the past two decades the U.S. military has made great strides in the treatment of battlefield casualties through the development of TCCC, as evidenced by historically high survival rates of those wounded in combat. Changes came about when the military medical researchers and practitioners put a renewed emphasis on hemorrhage control, treatment of collapsed lungs and airway obstructions, and the rapid evacuation of casualties from points of injury to full time

¹⁰³ Bruria Adini, and Kobi Peleg, "On Constant Alert: Lessons to be Learned from Israel's Emergency Response to Mass Casualty Events," *Health Affairs* 32, no. 12 (2013): 2179–2185, DOI: 10:1377/hlthaff.2013.0956.

¹⁰⁴ Ibid.

¹⁰⁵ Bruria Adini et al., "Evidence-Based Support for the All-hazards Approach to Emergency Preparedness," *Israel Journal of Health Policy Research* 40 (2012): 1–40, DOI: 10:1186/2015-4015-1-40.

medical facilities where definitive interventions can be performed. The equipment needed for TCCC programs is very basic from a technological perspective and man-portable. Effective hemorrhage control is achieved through the use of modern tourniquets and hemostatic agents; breathing problems resulting from airway obstructions are treated with nasopharyngeal airway devices or emergency airway puncture, and collapsed lungs are addressed with the insertion of thoracic needles into the patient's chest.

The research of Kragh et al. proves that modern combat application tourniquets have been used by medics with great effect to stanch bleeding at the point of injury and pose minimal risk of vascular damage in patients.¹⁰⁶ Tourniquet use essentially buys time for medics to transport patients to hospitals for definitive care. Kotwal and other researchers have demonstrated that TCCC has saved lives of combatants at "unprecedented" rates in Iraq and Afghanistan.¹⁰⁷ Under TCCC protocols, medics have substantially improved the methods in which they address hemorrhage control and breathing difficulties, as well as the speed in which injured soldiers are transported to hospitals.

An examination of the literature on civilian trauma care also shows that the nation of Israel has developed an effective system for managing mass casualties, particularly in the hospital setting. In the Israeli model, logistics go hand-in-hand with medical care and that treatment of multiple casualties requires multi-disciplinary teams assigned to each patient to ensure that each patient receives comprehensive care. Training and drills are also necessary to guarantee that hospital personnel know exactly what actions to take in situations where large numbers of casualties arrive at the emergency department. Israeli emergency medical protocols are adaptable in the U.S., and they were used with great success by hospitals in Boston to save the lives of dozens of people seriously injured in the marathon bombings.

¹⁰⁶ John F. Kragh et al., "Battle Casualty Survival with Emergency Tourniquet Use to Stop Bleeding in Major Limb Trauma." *The Journal of Emergency Medicine* 41, no. 6 (December 2011): 590–597, DOI: 10.1016/j.jemermed.2009.07.022.

¹⁰⁷ Kotwal et al., "Eliminating Preventable Death on the Battlefield," 1350.

In *Thinking in Systems: A Primer*, Donatella Meadows suggests that those seeking to transform systems must find *leverage points within those systems to effect change*.¹⁰⁸ Meadows describes leverage points as “places within a complex system....where a small shift in one thing can create where a small shift in one thing can produce big changes in everything.”¹⁰⁹ One of the leverage points defined by Meadows is a *paradigm change*.¹¹⁰ In the context of this thesis, a paradigm change is needed for public safety agencies across the U.S. to be prepared to provide dynamic emergency medical responses to mass casualty events. This change will not take place spontaneously, and leverage points must be identified within systems of public safety jurisdictions across the U.S. to bring about paradigm change. The next chapter will detail public safety agencies’ responses to recent active shooter and mass casualty events in the United States.

¹⁰⁸ Donella H. Meadows, *Thinking in Systems: A Primer* (White River Junction, VT: Sustainability Institute, 2008), Kindle edition: 145–146.

¹⁰⁹ Donella H. Meadows, “Leverage Points: Places to Intervene in a System,” Donella Meadows Institute, accessed January 1, 2015, <http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/>

¹¹⁰ Meadows, “Thinking in Systems: A Primer,” 162–163.

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III. INCREASES IN ACTIVE SHOOTER AND MASS CASUALTY EVENTS IN THE UNITED STATES AND PUBLIC SAFETY AGENCIES' RESPONSES

The last chapter consisted of a review of the existing literature on the U.S. military's tactical combat casualty care (TCCC) program, civilian tactical emergency medical programs such as tactical emergency casualty care (TECC), and the Israeli hospital trauma model. This chapter will be organized into four sections to discuss: (A) the increase of active shooter and mass casualty incidents in the United States problems with the delivery of emergency medical services; (B) police and emergency medical responses to active shooter and mass casualty incidents; (C) the International Association of Firefighters (IAFF), U.S. Fire Administration, and Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events' positions on tactical emergency casualty care in response to active shooter and mass casualty incidents; and (D) the lack of TECC rescue task force implementation and practice in the U.S.

The rising frequency and lethality of active shooter and mass casualty incidents in the United States in recent years have made it necessary for public safety agencies to develop dynamic tactical and medical emergency response plans. Since the Columbine High School massacre in 1999, there has been a drastic shift in police response to active shooter and mass casualty incidents. Rather than waiting for SWAT team arrival, responding police officers in most jurisdictions will attempt to apprehend or otherwise engage the assailants to prevent them from harming additional victims. While this is an essential step in bringing an active shooter and mass casualty events to a conclusion, the other phase pertains to the emergency medical treatment of wounded at the scene. During high threat tactical situations, the application of emergency medicine has proven to be problematic because EMS personnel in most U.S. jurisdictions typically stage outside the secure perimeter and wait for police to render the scene safe. Such stage and wait, or standby, procedures are inadequate because casualties in such events require immediate medical attention. At the active shooter incidents that transpired at Century Theater in

Aurora, the Washington Navy Yard, and Los Angeles International Airport, EMS personnel were held outside secure perimeters and away from victims while police worked to clear the scenes of potential threats. The protocol of keeping EMS providers on standby proved problematic in each of these instances because it created lengthy delays in the provision of medical treatment to those people who were injured.

There are mechanisms to deliver emergency medical care to victims of mass violence in hostile environments. In 2007, the Arlington County Fire Department in Virginia established the first rescue task force (RTF) program in the U.S. RTF's involve joint firefighter-police officer deployments at active shooter incidents to administer medical aid to victims and then the rapid evacuation of casualties to hospitals. The ACFD RTF is a TECC program modeled after the U.S. military's TCCC doctrine. Whereas both programs address the exigent need to treat casualties in high threat environments, the RTF system takes into account special populations such as pediatric and geriatric patients, scope of practice, and liability issues. A select few other jurisdictions in the nation have followed suit and created RTFs so that they will be prepared to deliver emergency medical services during mass casualty situations. However, most public safety departments in the U.S. do not have RTFs. The U.S. Fire Administration, International Association of Firefighters, and public safety advocacy groups have recommended the establishment TECC programs such as RTFs. However, as of the present date, most public safety jurisdictions do not have such task forces. The most prevalent justification against implementation of TECC programs cited by public safety officials are the heightened risks posed to firefighters and EMS at active shooter and other volatile situations.¹¹¹ Notwithstanding, the risks faced by firefighters participating in TECC programs are outweighed by the loss of human life at mass casualty events. Unless emergency medical services are administered promptly to victims of shootings and IED attacks quickly, people will die unnecessarily.

¹¹¹ Smith, and Delaney, "Supporting Paradigm Change in EMS' Operational Medical Response."

A. THE INCREASE IN ACTIVE SHOOTER AND MASS CASUALTY INCIDENTS IN THE UNITED STATES

Active shooter incidents have increased at an alarming rate in the past fifteen years in the U.S.¹¹² According to data collected by researchers at Texas State University and the Federal Bureau of Investigation, 67 active shootings events transpired between 2000 and 2008, with an average of over seven events per year.¹¹³ However, these figures have surged in the past five years to an average of more than 18 incidents annually, and 93 active shooting incidents between 2009 and 2013.¹¹⁴ There have also been disturbing trends in the scale and lethality of active shootings. In the 2012 shootings in Aurora, Colorado, 82 people were wounded, 12 fatally, when a gunman stormed the Century Theatre movie complex.¹¹⁵ Later that same year, 26 people, including 20 children, were shot to death at Newtown Elementary School in Connecticut.¹¹⁶ Additionally, in April 2013, 264 people were injured in the Boston Marathon bombings, three of whom died on scene.¹¹⁷

Active shooter and mass casualty incidents present several problems for public safety agencies, the first of which is celerity of police response. The speed at which police can get to the scene of appears to have tremendous impact on active shooter events, and there is a direct correlation between police response time and event duration.¹¹⁸ On average, active shooter incidents last approximately 12 minutes although 37 percent end in five minutes or less.¹¹⁹ Once police arrive, perpetrators typically turn

¹¹² Blair, and Schweit, *A Study of Active Shooter Incidents*, 6.

¹¹³ *Ibid.*, 8.

¹¹⁴ *Ibid.*, 42.

¹¹⁵ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 42.

¹¹⁶ Susan Candiotti, Greg Botelho, and Tom Watkins, "Newtown Shooting Details Revealed in Newly Released Documents," *CNN*, March 29, 2013, <http://www.cnn.com/2013/03/28/us/connecticut-shooting-documents/>

¹¹⁷ Sydney Lupkin, "Drills That Readied Boston Hospitals, EMS for Bombings Face Funding Cuts," *ABC News*, April 26, 2013, <http://abcnews.go.com/Health/emergency-drills-readied-boston-bombings-face-funding-cuts/story?id=19044714>

¹¹⁸ Katherine W. Schweit, "Addressing the Problem of the Active Shooter," *FBI Law Enforcement Bulletin* (May 2013) <http://leb.fbi.gov/2013/may/addressing-the-problem-of-the-active-shooter>

¹¹⁹ *Ibid.*

their attention to police or commit suicide.¹²⁰ Regardless, police arrival mitigates additional loss of life as police prevent the assailants from accessing further victims.¹²¹

Another notable problem manifested at active shooter events is inadequate emergency medical response. In most instances, firefighter and paramedics are required to stay outside the secure perimeter while police clear the scene of the threat.¹²² This is a process that can take several hours, as was the case with the Columbine,¹²³ the Washington Navy Yard shootings,¹²⁴ and the LAX active shooter event of 2013.¹²⁵ While police are preoccupied with assailants at active shooting scenes, those wounded desperately wait for medical attention. Unfortunately, in some instances, people die because of lengthy delays in EMS personnel reaching them.¹²⁶

B. POLICE AND EMERGENCY MEDICAL RESPONSES TO ACTIVE SHOOTER AND MASS CASUALTY INCIDENTS IN THE UNITED STATES

The event in American history that exposed gross inadequacies of police and emergency medical services (EMS) responses to active shooter situations was the Columbine High School (CHS) massacre. On April 15, 1999, two heavily armed students initiated a targeted assault at the school. The assailants shot 36 people, killing 13 of them.¹²⁷ The first 911 call was made at 11:19 a.m., and most victims were wounded within the next 17 minutes. Police officers arrived on scene at 11:23 a.m., but per

¹²⁰ Peter J. Blair, and M. Hunter Martaindale, *United States Active Shooter Events from 2000 to 2010: Training and Equipment Implications* (San Marcos, TX: Texas State University, 2013), 8, <http://alert.org/files/research/ActiveShooterEvents.pdf>

¹²¹ Schweit, “Addressing the Problem of the Active Shooter.”

¹²² Schmidt, “Officials, Experts Recommend Immediate EMS Care.”

¹²³ Timothy Harper, “Shoot to Kill,” *The Atlantic Monthly*, October 1, 2000, http://www.theatlantic.com/magazine/archive/2000/10/shoot-to-kill/305313/?single_page=true

¹²⁴ Andy Campbell, “The Navy Yard Shooting Timeline,” *The Huffington Post*, September 17, 2013, http://www.huffingtonpost.com/2013/09/17/navy-yard-shooting-timeline_n_3940925.html

¹²⁵ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption, A Review of Response Operations* (Los Angeles, CA: Los Angeles World Airports, 2014), 69, <http://www.lawa.org/uploadedFiles/LAX/LAWA%20T3%20After%20Action%20Report%20March%2018%202014.pdf>

¹²⁶ “Judge Dismisses All but One Columbine Lawsuit,” *CNN*, November 27, 2001, <http://edition.cnn.com/2001/LAW/11/27/columbine.lawsuit/>

¹²⁷ Harper, “Shoot to Kill.”

departmental protocols, waited outside the school until a special weapons and tactics (SWAT) team arrived at 12:06 p.m. SWAT team member were the first officers to clear CHS of the threat. The perpetrators killed themselves two minutes later, 49 minutes after the first 911 call, but this was not readily apparent to law enforcement. Consequently, it took the police over three hours to conduct a thorough safety sweep and secure the school. Some of the wounded were not evacuated until 3:22 p.m.,¹²⁸ over four hours after the first shots were fired.¹²⁹ Emergency medical personnel followed established procedures by remaining outside the school until police finalized their security sweep. At least one person, teacher Dave Sanders, slowly bled to death from gunshot wounds that were likely survivable. Sanders had waited for over four hours for paramedics to administer first aid to him. By this time, it was far too late because he had already exsanguinated.¹³⁰

After the Columbine shooting, the governor of Colorado convened a review commission to investigate events leading up to the massacre, as well as to assess the police and emergency medical responses to the event. The Columbine Review Commission concluded that although the police personnel followed established protocols, engagement rules for what is now known as active shooter events were too slow and needed to be changed.¹³¹ The typical active shooter response for most police departments in the country prior to Columbine called police to establish a security perimeter around a threat area and wait for SWAT teams to arrive and make entry. As a result of Columbine, virtually every police department throughout the U.S. changed its tactics within 18 months.¹³² Now, rather than waiting for SWAT teams, the first officers on scene of an

¹²⁸ Ibid.

¹²⁹ Angela Sanders v. The Board of County Commissioners of the County of Jefferson, Colorado, the Sheriff's Department of the County of Jefferson et al., Case No. 00-B-791 (United States District Court, Denver, Colorado 2001), *Cert denied*: 6.

¹³⁰ Harper, "Shoot to Kill."

¹³¹ Columbine Review Commission, *The Report of Governor Bill Owens*, 60–64.

¹³² Amy Donahue and Robert Tuohy, "Lessons We Don't Learn: A Study of the Lessons of Disasters, Why We Repeat Them, and How We Can Learn Them," *Homeland Security Affairs* 2, no. 2 (July 2006): 12, <http://www.hsaj.org/?article=2.2.4>

active shooting will make contact with the assailants to apprehend or otherwise neutralize.¹³³

Some of these new rapid response and engagement tactics are credited in helping police mitigate casualties, such as the December 2012 mall shooting in Clackamas Town Center outside Portland, Oregon.¹³⁴ Mark Lomax, executive director of the National Tactical Officers Association points to what has changed since Columbine:

There's been a paradigm shift...in the past, it was the standard protocol if there was a shooting incident or barricade suspect or hostage situation, the first responder would secure and contain the crime situation until the SWAT team or negotiators or bomb techs would arrive...School shootings highlighted a need to teach first responders to handle situations before those specialized units arrival.¹³⁵

This response is necessary to end active shooter events swiftly by preventing perpetrators from harming additional people.

The Columbine Review Commission also found that there were lengthy delays in getting medical help to injured victims trapped inside the CHS building.¹³⁶ The commission recommended that SWAT teams have more emergency medical technicians (EMTs) to enhance emergency medical capabilities at active shooter events.¹³⁷ While this is a sensible recommendation, in many cases, there would still be a time gap between first responders arriving at a scene and SWAT team deployment. It takes time for SWAT teams to mobilize, and as is often the case, the active shooter event is over before SWAT team arrival.¹³⁸ Furthermore, people sustaining penetrating and blunt force trauma wounds require immediate medical attention. It is imperative that victims of shootings

¹³³ Iselin, and Smith, "Arlington County, VA Task Force."

¹³⁴ Chuck, and Eng, "Swarming Police Response in Mall Shooting."

¹³⁵ Ibid.

¹³⁶ Columbine Review Commission, *The Report of Governor Bill Owens*, 127.

¹³⁷ Ibid., 128.

¹³⁸ Kincaid, "Raise an Alert."

and IED attacks receive immediate care because death from extreme blood loss can take place in two to three minutes unless treated properly.¹³⁹

Currently, there are still precarious delays between law enforcement securing active shooting scenes and emergency medical personnel having access to treat the wounded at active shooter events in the U.S. At an active shooter event, the primary goal law of enforcement is to stop the shooter from inflicting additional casualties. However, there is also a need to get medical assistance to victims as quickly as possible, and time becomes a critical factor: penetrating wounds caused by ballistic projectiles cause severe bleeding and breathing problems. Death from blood loss can occur in two to three minutes, airway obstruction in four to five minutes, and a collapsed lung in 10 to 15 minutes.¹⁴⁰ Therefore, emergency medical personnel have a limited amount of time to administer casualty care. In recent mass casualty events, such as the Century Theater (Aurora, Colorado) and LAX active shootings, the time it took to deliver emergency services to victims exceeded these limits. Paramedics need to be able to quickly access and treat victims on scene, and they cannot always wait for the police to conduct an exhaustive search for the perpetrators of active shootings.

In contrast to police organizations, most fire/EMS departments do not have established protocols for treating the wounded at active shooter situations.¹⁴¹ The typical response is for fire personnel and paramedics to remain on standby until the scene has been declared safe by police.¹⁴² As referenced in the introductory and literature review chapters of this thesis, officials in some jurisdictions, such as the Arlington County Fire Department (ACFD), have seen the need for a more proactive approach. In 2007, ACFD established the nation's first RTF.¹⁴³ The RTF is based on the military's TCCC protocols. RTF consists specially equipped firefighter paramedics who team up with police officers to respond to active shooter or other atypical medical emergencies. Other

¹³⁹ Iselin, and Smith, "Arlington County, VA Task Force."

¹⁴⁰ Ibid.

¹⁴¹ Ibid.

¹⁴² Joel Rubin, and Dan Weikel, "LAPD to Investigate Allegation of Delayed Medical Aid to TSA Agent," *Los Angeles Times*, November 16, 2013, <http://articles.latimes.com/2013/nov/16/local/la-me-1117-tsa-agent-20131117>

¹⁴³ Iselin, and Smith, "Arlington County, VA Task Force."

fire departments, such as those in Orange County¹⁴⁴ and Los Angeles, California have also recently established rescue task forces after active shooting events have transpired in each of their respective jurisdictions.¹⁴⁵ Although the establishment of these rescue task forces is a positive development, the majority of public safety departments in the U.S. do not have the standard operating procedures, equipment, or trained personnel to effectively deal with medical emergencies during active shooter and mass casualty incidents. It often takes a cataclysmic event, such as the Los Angeles International Airport shooting in November 2013, to demonstrate why TECC rescue task force programs are necessary.¹⁴⁶

C. INTERNATIONAL ASSOCIATION OF FIREFIGHTERS, U.S. FIRE ADMINISTRATION, AND JOINT COMMITTEE TO CREATE A NATIONAL POLICY TO ENHANCE SURVIVABILITY FROM MASS CASUALTY SHOOTING EVENTS' RECOMMENDATIONS ON TACTICAL EMERGENCY

Several prominent organizations in the U.S. have recommended the establishment of formalized tactical emergency programs. The International Association of Firefighters (IAFF), a fire service advocacy group with over 300,000 members, has issued Position Statements recommending the establishment of TECC,¹⁴⁷ and Rescue Task Force programs.¹⁴⁸ The Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events, an ad-hoc group medical emergency professional which includes representatives from the American College of Surgeons, fire service officials and Federal Bureau of Investigation (FBI) also recommends the adoption of tactical casualty combat care programs by state and local public safety agencies.¹⁴⁹ According to this committee, TCCC programs are quintessential in improving

¹⁴⁴ Hartley, "In 'Active Shooter' Case."

¹⁴⁵ Robert J. Lopez, and Ben Welsh, "L.A. Fire Department Dramatically Overhauls Response to Shootings," *Los Angeles Times*, December 22, 2013, <http://articles.latimes.com/2013/dec/22/local/la-me-ems-response-20131223>

¹⁴⁶ *Ibid.*

¹⁴⁷ International Association of Firefighters, "IAFF Position Statement: Active Shooter Events," accessed January 15, 2014, http://www.iaff.org/Comm/PDFs/IAFF_Active_Shooter_Position_Statement.pdf

¹⁴⁸ *Ibid.*

¹⁴⁹ Joint Committee, "Active Shooter and Intentional Mass-Casualty Events."

survivability of victims in active shooting events because they make provisions for tandem response of fire, EMS, and law enforcement personnel.¹⁵⁰

In September 2013, the U.S. Fire Administration issued a formal recommendation that public safety agencies across the U.S. look to TECC programs to provide comprehensive response to active shooter and mass casualty events: “training, equipment and protocols around use of TECC for medical first responders should be explored, considered and implemented when feasible.”¹⁵¹ The Committee-Tactical Emergency Casualty Care (C-TECCC), which is comprised of emergency medical experts from over 55 agencies, is working to expedite the transition of TCCC precepts to the civilian domain. C-TECC recommends and works with agencies all over the U.S. to advocate and assist with implementation of TECC programs.¹⁵²

D. CONCLUSION

Despite the declared need for tactical emergency medical programs by emergency medical professionals and public safety officials across the U.S., there is still no national policy for the implementation of programs such as rescue task forces. In fact, most jurisdictions in the U.S. currently have no standardized tactical emergency programs. As is often the case, TECC rescue task force programs have been only been implemented after calamities involving loss of life occur.¹⁵³ The dearth of TECC rescue task force programs in the U.S. are typically exposed in the wake of mass casualty events, and consequently, after action reviews almost always recommend a more integrated police, firefighter, and EMS response to a mass casualty event. Obstacles to implementation include increased risks to EMS personnel, the high costs equipment and training, and liability concerns.¹⁵⁴

¹⁵⁰ Ibid.

¹⁵¹ U.S. Fire Administration, *Fire/Emergency Medical Services Department Operational Considerations and Guide for Active Shooter and Mass Casualty Events*, September 2013, 8, http://www.usfa.fema.gov/downloads/pdf/publications/active_shooter_guide.pdf

¹⁵² Callaway et al., “The Committee for Tactical Emergency Casualty Care (C-TECC),” 95–100.

¹⁵³ Hartley, “In ‘Active Shooter’ Case.”

¹⁵⁴ Atwater, “Force Protection for Firefighters,” 67–74.

This chapter covered the rise in active shooter incidents in the United States in recent years, police and emergency response to these incidents, and the support that TECC and rescue task force programs have among some public safety organizations. Rapid on-site treatment at mass casualty events is crucial to increasing victim survivability and TECC rescue task forces offers the best way to ensure that emergency medical services are administered in high-threat environments. The other vital component in emergency casualty care is accessibility to a highly skilled and trained hospital workforce capable of managing a large-scale medical event. It takes a concerted effort to effectively manage these calamities. First responders and hospital personnel must work in unison to help mass casualty victims at the point of injury, during transport, and eventually at the hospital. An example of a country that has developed a paradigm for care of numerous casualties simultaneously is Israel. Israeli emergency medical practitioners combine speed of transport, intermediate and definitive medical interventions, and logistics to save the lives of those wounded by IEDs and other terrorist attacks. The following chapter is a case study that illustrates the Israeli model for mass casualty events. Israeli hospitals have grown adept in treating large numbers of casualties emanating from terrorist attacks on its civilian population, and an examination of the Israeli model is illuminative for trauma care practitioners in the United States.

IV. THE ISRAELI EMERGENCY MEDICAL RESPONSE MODEL FOR MASS CASUALTY EVENTS

The preceding chapter detailed the why tactical combat casualty care (TCCC) and tactical emergency casualty care (TECC) programs are necessary to provide medical services in volatile situations and mass casualty incidents. The U.S. military has developed the preeminent system—TCCC—for on-site care and evacuation of wounded people in high threat environments. Some public safety organizations in the U.S. have adopted TECC programs to address medical emergencies at the scenes of active shooter events. This chapter will explain the Israeli hospital paradigm for the management of victims wounded in mass casualty incidents. Mass casualty events are challenging under any circumstances; therefore, hospital personnel must be uniquely trained and prepared for them. Israel has sustained numerous terrorist attacks over the course of the past two decades, and out of necessity, trauma surgeons in Israel have developed a robust emergency medical system for handling victims of mass casualty events. Hospitals are the focal point of the Israeli trauma care archetype. Between 2000 and 2009, the nation experienced 146 suicide attacks, resulting in 516 deaths, and 8,022 injuries.¹⁵⁵ In response to these attacks, Israeli hospitals developed a prototype for emergency medical responses to mass casualty events by adopting what Bruria Adini and Kobi Peleg call a “flexible all-hazards approach.”¹⁵⁶ Israelis trauma specialists have discovered that the medical procedures that work for well terrorist attacks have applicability to other types of mass casualty situations.¹⁵⁷ Israeli paramedics, physicians, and nurses train and prepare for worst-case scenarios, and they do not use drastically different procedures for bombings, shootings, chemical, or biological attacks.¹⁵⁸ They employ certain core elements and skills to aid those wounded in any type of mass casualty incidents.¹⁵⁹ For example, hospital admittance sites and personnel assigned to work them are pre-

¹⁵⁵ Israeli Security Agency (Shabak), “Analysis of Attacks in the Last Decade.”

¹⁵⁶ Adini, and Peleg, “On Constant Alert: Lessons to be Learned,” 2179.

¹⁵⁷ Ibid.

¹⁵⁸ Ibid., 2181.

¹⁵⁹ Adini, and Peleg, “On Constant Alert: Lessons to be Learned,” 2181.

designated; medical teams are predetermined and additional supplies and equipment are stored at hospitals anticipation of emergencies.¹⁶⁰ Other core elements at Israeli hospitals include the establishment of standard operating procedures (SOPs), surge capacities (e.g., utilization of additional medical personnel and emergency room space), a clear chain of command, training exercises, and drills. Israeli trauma experts have also conceptualized a method of managing those injured in terrorist attacks called the *accordion approach* in which a *surgeon in charge* directs the treatment plans of victims in a hyper-triage fashion.¹⁶¹ Another major asset in the Israeli trauma system is its national trauma registry, which is a repository of information on casualties that can be studied for ways in which medical care can be improved. Each of these concepts will be discussed in depth in this chapter.

A. STANDARD OPERATING PROCEDURES, TRAINING, AND DRILLS

Israel's Ministry of Health requires that all hospitals and health care providers have formal plans in place to treat victims of mass casualty events based on their available resources. Israel's Supreme Health Authority, a subcommittee of the Ministry of Health, mandates that each hospital develop its own standard operating procedures (SOPs) and regularly participate in training and drill programs to improve preparedness for different emergency scenarios.¹⁶² These SOPs and training drills are deemed to be "fundamental critical blocks" that improve readiness and performance during actual mass casualty events.¹⁶³ Additionally, emergency service personnel in Israel use uniform terminology and common language, which simplifies communications in stressful situations.¹⁶⁴ According to Adini et al., the use of SOPs, training, drills, and common language have a proven record of improving emergency medical personnel performance during influxes of large numbers of casualties.¹⁶⁵ During mass casualty events medical

¹⁶⁰ Adini et al., "Evidence-Based Support for the All-hazards Approach," 2.

¹⁶¹ Ibid., 300.

¹⁶² Adini, and Peleg, "On Constant Alert: Lessons to be Learned," 2180.

¹⁶³ Adini et al., "Evidence-Based Support for the All-hazards Approach," 6.

¹⁶⁴ Adini, and Peleg, "On Constant Alert: Lessons to be Learned," 2180.

¹⁶⁵ Adini et al., "Evidence-Based Support for the All-hazards Approach," 6.

professionals perform in accordance to how they practice and prepare. Scenario-based training helps first responders and hospital personnel know exactly where to go and what to do when disaster strikes.¹⁶⁶

B. ESTABLISHMENT OF TRIAGE ON SCENE AND AT EMERGENCY DEPARTMENTS

The Israeli model emphasizes concepts of coordinated triage at the scene and the evacuation of casualties quickly from the points of injury to hospitals as quickly as possible. Paramedics from Magen David Adom (MDA), Israel's national emergency and ambulance service, are trained to rapidly assess and treat those wounded on the scene to address life-threatening injuries and in the hasty evacuation of victims from points of injury to hospitals. MDA paramedics only administer the most basic first aid procedures on scene, such as hemorrhage and airway control. During transport MDA paramedics treat patients with intravenous fluids or intubation if necessary.¹⁶⁷ They also use "scoop and run" maneuvers to rush wounded to the hospital and to avoid becoming casualties of any secondary explosive devices left behind by terrorists.¹⁶⁸ The goal of the MDA paramedics is to conduct only essential life-saving treatments at the scene of injury and then expedite victims to area hospitals. After arrival at hospitals, paramedics assist trauma surgeons by providing them with initial diagnostics for each patient.

Israeli medical personnel have discovered that logistics are just as important as administering medical treatment to victims in mass casualty events. This means that emergency responses to mass casualty events require planning and organization. As patients begin to arrive at emergency rooms, all aspects of the treatment plan need to be managed, and each patient is assigned to a specifically designated medical team. This is necessary because victims of bombings are usually inflicted with multiple injuries, including extensive penetrating injuries from shrapnel, burns, and blunt force trauma.¹⁶⁹

¹⁶⁶ Ibid., 5.

¹⁶⁷ Greg Friese, "Principles of Mass Casualty: Response to Terrorist Attacks," *EMS World*, October 1, 2007, <http://www.emsworld.com/article/10321585/principles-of-mass-casualty-response-to-terrorist-attacks>

¹⁶⁸ Nadav Morag, *Comparative Homeland Security* (Hoboken, NJ: John Wiley and Sons, Inc., 2011), 296–297.

¹⁶⁹ Almog et al., "Suicide Bombing Attacks," 299–300.

A dedicated emergency medical team is necessary to ably triage and monitor each shooting or bombing casualty after arrival at the emergency room so that all injuries are detected.¹⁷⁰

C. ISRAELI HOSPITALS

All hospitals in Israel are required by the Ministry of Health to have surge amplitudes of 20 percent beyond their normal operating capacities. This means that additional staffing and equipment are available at hospitals at a moment's notice in the wake of mass casualty events. One way hospitals in Israel accomplish this is by storing additional beds and then moving them to hallways when needed to accommodate an overflow of patients when the need arises. The corridors of Israeli hospitals are equipped with electrical outlets and oxygen lines so that their space can be fully utilized during times when the hospital's resources are heavily burdened.¹⁷¹ Additionally, physicians from a variety of disciplines, along with hospital support staff, are expected to remain on duty for as long as necessary beyond their normal shifts to assist with high volumes of casualties.¹⁷² During mass casualty scenarios, elective surgery is postponed throughout the hospital so that operating rooms and medical personnel are available to deal with the critically wounded as they arrive en mass.

Emergency departments in Israeli hospitals are designed for practicality. For example, essential equipment is mounted to the ceilings to accommodate personnel who need to move without impediment. In order to alleviate any potential confusion when numerous casualties arrive at hospitals, Israeli emergency departments (EDs) have a simple floor plan with a straight path running from the arrival area to the emergency room.¹⁷³ The ingress areas at the exterior of the ED as well as the floors are marked with

¹⁷⁰ Ibid., 297.

¹⁷¹ Kobi Peleg, and Arthur L. Kellerman, "Enhancing Hospital Surge Capacity for Mass Casualty Events," *Journal of American Medical Association* 302, no. 5 (2009) 566, DOI: 10.1001/jama.2009.1119.

¹⁷² Adini, and Peleg, "On Constant Alert: Lessons to be Learned," 2182.

¹⁷³ Matthew Bell, "Israeli Doctor Paved the Way for Emergency Response in Boston," April 26, 2013, <http://www.pri.org/stories/2013-04-26/israeli-doctor-paved-way-emergency-response-boston>

painted lines, and there is ample signage posted to make navigation easier.¹⁷⁴ Israeli physicians have also developed a triage system known as “look, touch, feel” method.¹⁷⁵ Because wounds suffered as a result of improvised explosives consist of multitudinous penetration and blunt trauma wounds, the process of injury detection can be arduous, and doctors need to physically examine each patient with the utmost thoroughness to find the sources of life threatening injury. The *look, touch, feel* mnemonic is a system that guides doctors in a literal sense as they try to determine the number and types of injuries suffered by bombing victims.

D. THE ACCORDION APPROACH

Between October 1, 2000 and September 1, 2004, Israel experienced an acute number of terrorist attacks spurred by the Second Intifada.¹⁷⁶ During this span, there were 93 mass casualty events as a result of strikes on the nation’s civilian population, with 33 of these attacks taking place in Jerusalem.¹⁷⁷ As the only level 1 trauma facility in Jerusalem, the Hadassah-Hebrew University Medical Center’s Shock Trauma Unit (HHSTU) provided care for those critically injured in the attacks. The hospital treated 541 victims and admitted 208 of them.¹⁷⁸ The severity, frequency, and volume of incoming casualties over this extended period led to the acquisition of invaluable experiences in the treatment of trauma patients at HHSTU. Trauma surgeons learned that not only was it advantageous to reinforce the emergency department staff with personnel from the intensive care unit, but also of the need to have a clear chain of command to manage tumult in the aftermath of mass casualty event. Israeli medical officials also recognized the need to organize medical teams and treatment protocols when receiving multiple casualties simultaneously.

¹⁷⁴ Friese, “Principles of Mass Casualty.”

¹⁷⁵ Bell, “Israeli Doctor Paved the Way for Emergency Response in Boston.”

¹⁷⁶ Amos Harel, and Avi Issacharoff, “Years of Rage,” *Haaretz*, October 1, 2010, <http://www.haaretz.com/weekend/week-s-end/years-of-rage-1.316603>

¹⁷⁷ Gabriella Aschkenasy-Steuer et al., “Clinical Review: The Israeli Experience: Conventional Terrorism and Critical Care,” *Critical Care* 9, no. 5 (2005): 490, DOI: 10:1186/cc3762.

¹⁷⁸ *Ibid.*, 491.

Hospital resources can be overwhelmed without special planning and preparations for these events. In response to suicide bombings, Israeli hospitals, and the HHSTU in particular, developed archetypical emergency department procedures based on existing guidelines for trauma management. Physicians and nurses from multiple disciplines, such as pediatrics, anesthesiology, orthopedic surgery, neurosurgery, and other specialties, are expected to report to the emergency departments and be part of teams that will triage and render medical assistance to victims.¹⁷⁹

Israeli medical experts have found that one of the key elements in response to mass casualty events is the designation surgeons in charge (SIC) to continually monitor each patient and control emergency room activity. A SIC, who is a seasoned trauma surgeon, oversees triage and prioritization of victims from the time that they arrive at the hospital until the time they are stabilized and admitted. Those patients with the most life threatening injuries (e.g., massive bleeding and internal trauma) receive immediate treatment, while those with less serious injuries will be treated later. The SIC is responsible for monitoring each patient's condition and treatment protocols until that patient can be stabilized. Each patient is assigned their own medical team, which is important, as victims of bombings often suffer both obvious and insidious injuries.¹⁸⁰

HHSTU trauma physicians, such as Gidon Almogy and Avarham Rivkind et al., conceptualized a system known as the "accordion approach" to efficiently manage the flow of large numbers of victims in the emergency department after a mass casualty event.¹⁸¹ The accordion approach involves the facilitation of patients through a series of treatment protocols under the supervision and guidance of SIC. It is the SIC's responsibility to continually assess and re-assess the treatment plan of each patient until he or she has been stabilized and admitted to the hospital. The accordion approach consists of seven key stages: evacuation, triage, primary evaluation/initial treatment, re-assessment, continued evaluation/definitive treatment, re-assessment, and admission. In a

¹⁷⁹ Almogy et al., "Suicide Bombing Attacks," 298.

¹⁸⁰ Ibid., 300.

¹⁸¹ Ibid.

collaborative series of “dispersals” and “convergences,” the SIC prescribes the medical plan for each patient.¹⁸²

In the evacuation phase, paramedics treat patients on scene and then transport to a medical facility as quickly as possible because every moment counts in a traumatic injury situation. Evacuation is followed by the triage phase, in which paramedics continue to treat victims during transport to the hospital. Immediately after arrival at the emergency room, each patient is evaluated during triage, and the exact nature of injuries is determined. Upon arrival at the emergency department, the patient then undergoes a series of primary evaluations, including an assessment by the SIC. Since bombings typically result in multiple and complex injuries, some injuries may be obvious, while others may be latent and difficult to diagnose. Patients may display obvious life-threatening injuries, such as shrapnel or extremity amputations, and they may also have internal damage, which may be more difficult for medical personnel to detect, such as blast lung injury (BLI)¹⁸³ or blast abdominal injuries that do not always have external manifestations.¹⁸⁴ For Israeli trauma surgeons, “undertriage is unavoidable” as mass casualties flood into emergency rooms.¹⁸⁵ The surgeons operate under the assumption that a piece of shrapnel or some other type of injury could be missed during initial examinations and therefore, re-assessments are administered frequently. As shown in Figure 1, the SIC orchestrates all phases of the care of acute patients in the emergency department.

¹⁸² Ibid.

¹⁸³ Ibid.

¹⁸⁴ Aschkenasy-Steuer et al., “Clinical Review: The Israeli Experience,” 498.

¹⁸⁵ Almog et al., “Suicide Bombing Attacks,” 300.

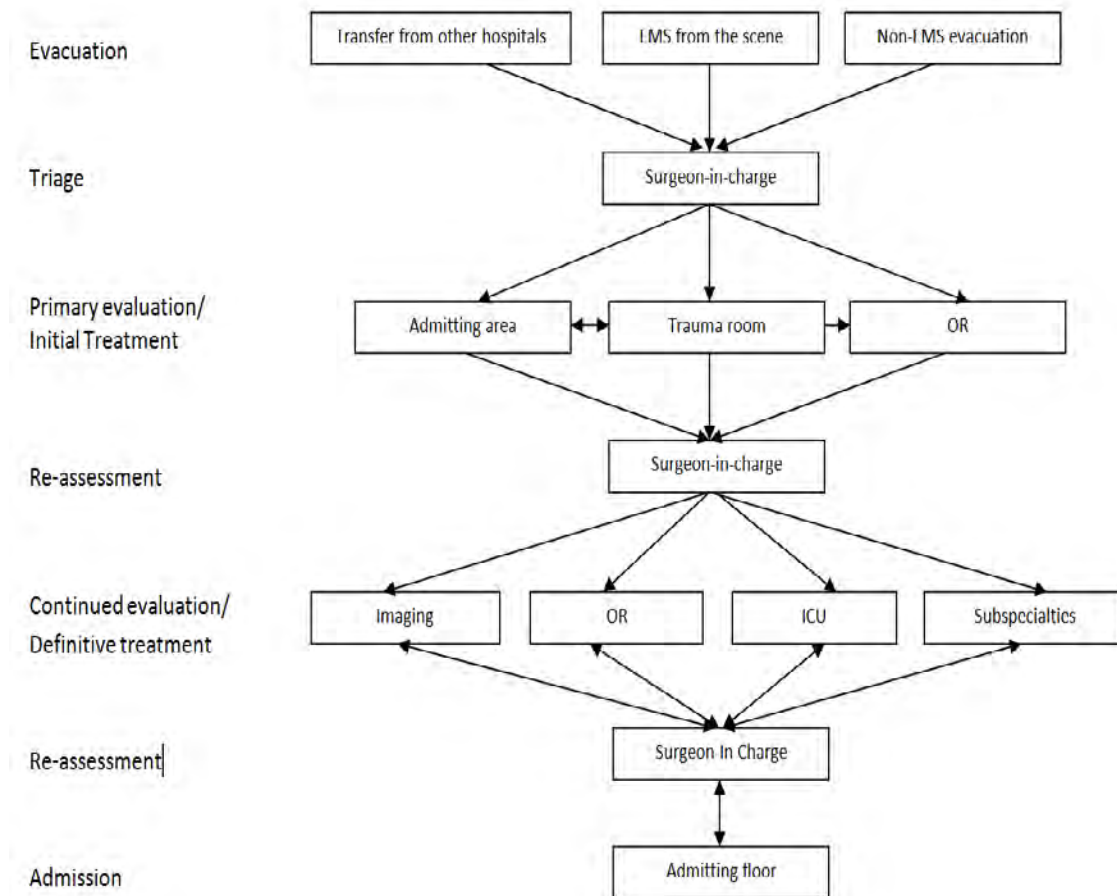


Figure 1. Accordion Approach¹⁸⁶

E. ISRAEL NATIONAL TRAUMA REGISTRY

The Israel National Trauma Registry (ITR) is another major asset in the nation's health care system. The ITR was created in 1995 upon a recommendation of a special committee of the ministry of health, and it mandates that all hospitals report trauma injury data.¹⁸⁷ With the ultimate goal of improving survivability, the ITR is used to record and analyze the data on patients injured in traumatic events. Data recorded in the ITR includes injury typology and resultant medical treatments administered. Researchers have found that over time, certain epidemiological patterns emerge that help researchers

¹⁸⁶ Ibid., 301.

¹⁸⁷ Limor Aharonson-Daniel et al., "A Decade of the Israel National Trauma Registry," *Israel Medical Association Journal* 9, no. (2007): 347, <http://www.ima.org.il/FilesUpload/IMA/J/0//46/23018.pdf>

identify emergency medical techniques that can be corrected or improved upon to save lives.¹⁸⁸

The ITR has been used to measure certain variables and outcomes on a national level that can be used by policy makers to implement systematic advancements. Peleg et al. conducted a study of 7,423 severe trauma patients admitted to Israeli hospitals between January 1, 1997 and December 31, 2001 and found that mortality rates decreased from 21.6 percent to 14.7 percent during this period of time.¹⁸⁹ There were several factors that led to this reduction. One reason is that trauma care protocols from were improved at Israeli trauma centers. Also, during this same period, ambulance dispatch centers in Israel more than doubled from 47 to 98, and the number of paramedics employed by Magen David Adom grew from 100 to 350, which enhanced the ability of EMS personnel to expedite sick and injured people to hospitals. Additionally, the nation's advanced life support (ALS) ambulance fleet was expanded from 47 to 98 units to provide greater coverage.¹⁹⁰ Other positive factors consisted of an increased number of hospital shock trauma beds, as well as the introduction of better training and equipment at emergency departments.¹⁹¹ The results of this study indicate that enhanced field triage, rapid transport of trauma patients to definitive care, and improved hospital care protocols resulted in a significant decrease in the mortality rates of trauma victims in Israel.

Researchers also use ITR data to conduct studies on the epidemiology of unique injuries occurring in terrorist attacks.¹⁹² Heldenberg et al. studied a cohort consisting of all patients entered into the ITR from September 2000 to December 2005 and found that due to high explosives and penetrating fragmentation, vascular injuries are much more prevalent in terrorist attacks than in non-terror related trauma events.¹⁹³

¹⁸⁸ Aharonson-Daniel et al., "A Decade of the Israel National Trauma Registry," 349.

¹⁸⁹ Kobi Peleg et al., "Increased Survival among Severe Trauma Patients," *Archives of Surgery* 139, no. 11 (2004): 1231, DOI: 10.1001/archsurg.139.11.1231.

¹⁹⁰ Peleg et al., "Increased Survival among Severe Trauma Patients," 1235.

¹⁹¹ Ibid.

¹⁹² Aharonson-Daniel et al., "A Decade of the Israel National Trauma Registry," 349.

¹⁹³ Eitan Heldenberg et al., "Terror Attacks Increase the Risk of Vascular Injuries," *Frontiers in Public Health* 2 no. 47 (2014): 1, DOI: 10.3389/fpubh.2014.00047.

Extensive vascular injuries were suffered in 9.9 percent of trauma cases, compared to 1.1 percent in non-terror related trauma cases. As these types of injuries are complex, Heldenberg et al. recommend that emergency departments have an expanded complement of vascular surgeons on staff as part of the response to terror attacks.¹⁹⁴ Studies such as this attest to the ITR's utility in helping guide research into of these types of mass casualty incidents by placing emphasis on the special of wounding patterns and the types of medical specialties needed to treat them.

In the United States, the only national repository for trauma injury data is the National Trauma Data Bank (NTDB), which was established by the American College of Surgeons (ACS) in 1989.¹⁹⁵ However, one of the limitations of the NTDB is that only level 1 trauma centers in the U.S. are required to report data. For all other trauma centers and hospitals, reporting of injury data is voluntary, which means much of the data on trauma injuries occurring in the U.S. is not available for study and assessment in the U.S.¹⁹⁶

F. ANALYSIS

The Israeli model for emergency response to mass casualty events has become world-renowned for its effectiveness. Israeli techniques have evolved over recent years and have saved many lives. Maya Siman-Tov, Irina Radomislensky, and Kobi Peleg conducted a study of all severe trauma patients treated at Israel's six level 1 trauma centers between 2000 and 2010 and found that inpatient mortality decreased from 16 percent to 11 percent.¹⁹⁷ Given the high number of terrorist attacks Israel has experienced during this same period, these statistics reflect extraordinary results.

Between 1993 and 2004, Hebrew University-Hadassah Hospital Shock Trauma Unit treated (HHSTU) more victims of suicide bombings than any other hospital in

¹⁹⁴ Ibid.

¹⁹⁵ Adil H. Haider et al., "Influence of the National Trauma Data Bank on the Study of Trauma Outcomes: Is it Time to Set Research Best Practices to Further Enhance Its Impact," *Journal of the American College of Surgeons* 214, no. 5 (2012): 757, DOI: 10.1016/j.jamcollsurg.2011.12.013.

¹⁹⁶ Ibid., 762.

¹⁹⁷ Siman-Tov, Radomislensky, and Peleg, "Reduction in Trauma Mortality in Israel," 1148.

Israel.¹⁹⁸ In adaptation to high casualty counts emanating from these attacks, doctors at HHSTU developed a dynamic approach (referred to as the “accordion approach” by Almogy et al. (as depicted in Figure 1¹⁹⁹) that involves the activation of multi-disciplinary medical teams working under the direct supervision of senior trauma physicians.²⁰⁰ Dr. Avraham Rivkind and other physicians at the HHSTU measured the impact of their approach by conducting an extended multi-phase study examining trauma patient case fatality rates (CFRs) at level 1 trauma centers in Israel and the United States during specific periods.²⁰¹

For the first phase of their study, Rivkind et al. conducted an inquiry into the CFR’s of 8,127 trauma patients admitted to HHSTU from 1999 to 2003. This period is significant because it was during the midst of the Second Intifada in which there was a particularly high number of suicide bombing and other terrorist attacks in Israel. Rivkind et al. examined the survivability and fatality rates of the 8,127 trauma patients treated at HHSTU, of whom 190 died within a 30-day period after being admitted. The 190 deaths represent a CFR of 2.3 percent of all trauma casualties treated. The researchers then compared the HHSTU CFR with CFRs of 51 level 1 trauma centers in the U.S. (roughly half of the 100-plus level 1 trauma centers in the U.S.) between 1999 and 2003, using the same criteria by which they measured HHSTU CFRs (total number of deaths of trauma patients within 30 days of admittance to hospitals).²⁰² During this five-year period, a total 265,902 trauma patients were admitted to the 51 U.S. level 1 trauma centers queried, with 15,237 deaths occurring,²⁰³ constituting a CFR of 5.73percent. This is notable because this percentage is more than twice that of trauma patients treated at HHSTU.²⁰⁴

¹⁹⁸ Rivkind et al., “Trauma Care and Case Fatality,” 4.

¹⁹⁹ Almogy et al., “Suicide Bombing Attacks.”

²⁰⁰ Rivkind et al., “Trauma Care and Case Fatality,” 6.

²⁰¹ Ibid.

²⁰² American College of Surgeons, “397 Verified Trauma Centers Matching Your Search,” accessed January 7, 2014, <https://www.facs.org/search/trauma-centers?country=United%20States>

²⁰³ The data on the 51 level 1 trauma centers in the U.S. that were studied was provided by National Trauma Data Bank (NTDB) of the American College of Surgeons.

²⁰⁴ Rivkind et al., “Trauma Care and Case Fatality,” 3.

Injuries and deaths for both the Israeli and American cohorts were categorized by type (e.g., motor vehicle-crashes, falls, burns) and severity levels. An important aspect of the study is that the researchers were able to compare data on patients in both countries who were injured by what are classified as *blast-firearms-gunshot wound* (GSW) injuries.²⁰⁵ At HHSTU from 1999 to 2003, there were 611 people treated for blast-firearms-GSW injuries (7.5 percent of all traumatic injuries recorded), with 47 fatalities transpiring, which represents a CFR of 7.7 percent. At the 51 level 1 trauma centers in the U.S., 25,561 patients (9.7 percent of all trauma patients) were injured by blast-firearms-GSW, with approximately 4,089 dying, which constituted a CFR of 16.0 percent.²⁰⁶ This data shows that the proportion of blast-firearms-GSW injuries in Israel and the U.S. are similar in relation to the overall number of trauma injuries recorded over a five-year span. More importantly, this data indicates that the survivability rates of patients treated for blast-firearms-GSW at HHSTU was more than double that of 51 level 1 trauma centers in the U.S.

For a second phase of their study, Rivkind et al. measured the CFR averages of HHSTU with the CFR averages of the 51 level 1 trauma centers in the U.S. from 1999 through 2003 and then continued to measure HHSTU's CFRs through 2009. CFRs were divided into two categories based on injury severity scores: severe and all trauma injury categories in general. Table 1 illustrates the results of this inquiry.

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
HHSTU - CFRs for severe trauma injuries	18.4	14.4	13.6	13.4	11.5	12.5	12.3	8.5	12.3	9.4	9.9
U.S. Level I trauma centers' CFRs for severe trauma injuries	19.7	20.9	20.2	20.5	19.6						
HHSTU - CFRs for all trauma injury categories	3.2	2.6	2.7	2.9	2.1	2.4	2.2	1.7	2.6	1.9	2.1
U.S. Level I trauma centers - CFRs for all trauma injury categories	5.3	5.8	5.5	5.8	6.7						

Table 1. Case Fatality Rates at HHSTU and U.S. Level 1 Trauma Centers from 1999 through 2003 and at HHSTU through 2009²⁰⁷

²⁰⁵ Ibid., 6.

²⁰⁶ Ibid., table 2.

²⁰⁷ Ibid., 6.

As Table 1 depicts from the study of Rivkind et al., in 1999, Israeli level 1 trauma center's CFRs for severe injury categories was 18.4 percent, which was closely aligned with the 19.7 percent CFR of 51 level 1 trauma centers in the U.S.; however, by 1999, the severe injury CFR at HHSTU dropped four points to 14.4 percent, while level 1 trauma centers in the U.S. increased to 20.9 percent. Over the course of 11 years examined, the CFRs at HHSTU decreased significantly through 2009, when the CFR for severe injuries was 9.9 percent, which is roughly half of what the HHSTU CFR was in 1999 (it was 18.4 percent).²⁰⁸ This shows that improved medical treatment protocols led to drastically improved survivability of trauma victims at HHSTU and superior results when compared to level 1 trauma centers in the U.S.

Rivkind et al. also evaluated CFR trends at five Israeli level 1 trauma centers (including HHSTU) in comparison to 51 level 1 trauma centers in the U.S. between 1998 and 2008, and they found that the Israeli centers consistently exhibited lower CFR's for trauma patients, including those with severe injuries, as shown in Table 2.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Israeli Level I trauma centers' CFRs for severe trauma injuries	38	39.5	33.6	27.5	26.5	23.3	21.2	22.8	17.3	26.8	18.6
U.S. Level I trauma centers' CFRs for severe trauma injuries	34.6	33.7	29.1	27.9	31.7	25.2	27.1	26	28.6	21.1	21.5
Israeli Level I trauma centers' CFRs for all trauma injury categories	7.3	1.8	1.8	1.7	1.2	1.2	2.7	3.2	0	1	1.6
U.S. Level I trauma centers - CFRs for all trauma injury categories	5.7	6.1	6.1	5.4	5.9	5.1	5.3	5.5	4.4	4.7	2.6

Table 2. Case Fatality Rates at Israeli and U.S. Level 1 Trauma Centers from 1998 to 2008²⁰⁹

While both the U.S. and Israeli level 1 trauma centers assessed have continually improved CFRs for all injury categories, Israeli level 1 trauma centers have continually surpassed their U.S. counterparts in terms of lives saved. This is attributable to the

²⁰⁸ Ibid.

²⁰⁹ Ibid., 7, figure 2.

nation's systemic approach to trauma care that focuses upon speed of transport to the hospital and a collaborative approach of emergency department care that entails multi-disciplinary medical teams supervised by senior trauma physicians.

Israel's methods are adaptable to the United States. In fact, the HHSTU was established in 1992 and was modeled after the concept developed by American doctor R. Adams Cowley and other physicians of the Maryland Institute of Emergency Medical Services System (MIEMSS). In the MIEMSS, experienced trauma surgeons oversee all aspects of medical treatment—from care at the point of injury—through definitive treatment at the emergency department.²¹⁰ What distinguished Israel from other developed countries such as the U.S. is the pervasive incidence of terrorist attacks that have occurred over a protracted period. And as a result of experience gained in treating mass casualties over the course of recent years, the Israeli paradigm had evolved into one of the world's preeminent trauma care systems.

The victims of the Boston Marathon bombing were direct beneficiaries of the Israeli emergency medical paradigm. Boston area hospitals conducted numerous training exercises and drills in the years leading up to the attacks. After consultations with Israeli physicians, doctors at Massachusetts General Hospital improved their emergency department triage protocols and updated their response plans for large-scale casualty events.²¹¹ When they learned of the bombings and massive casualties, emergency department personnel at Massachusetts General Hospital, Brigham and Women's Hospital, and other trauma centers activated their emergency response plans according to Israeli-type protocols. Emergency rooms were cleared of any patients with non-life threatening ailments, and elective procedures at the hospitals were postponed. All available physicians, nurses, and medical technicians reported to emergency departments. Experienced doctors were designated to evaluate patients in ambulances as they arrived at

²¹⁰ Ibid., 4.

²¹¹ Miller, "Boston/Israel Collaboration."

emergency rooms.²¹² In some instances, hospitals staffs re-applied tourniquets to victims whose legs were damaged or amputated.²¹³ Doctors from Massachusetts General Hospital in Boston conveyed to the media that consultations with Israeli trauma doctors enhanced their ability to treat victims of the marathon bombings. These lessons learned from Israel served Boston hospitals extremely well in the aftermath of the marathon bombings.

The Israeli all-hazards approach is not limited to the management of terrorist attack casualties. Their protocols can also be used to treat victims of automobile accidents, train derailments, plane crashes, and natural disasters. Additionally, the all-hazards approach can be scaled up or down based on the size of the mass casualty event. Lessons learned from Israel can save lives and can be replicated in jurisdictions across the U.S. In recognition that Israeli model can be constantly improved upon, researchers from Israel continually seek to learn from the emergency responses from mass casualty events across the globe, including the earthquakes in Haiti and even the Boston Marathon bombings.²¹⁴ What is not evident is whether all jurisdictions in the United States are prepared to respond to mass casualty events in the way that hospitals in Israel and Boston have demonstrated.

The next chapter is a case study of the police and emergency medical response to the active shooter event that took place in Aurora, Colorado at the Century Theater in July 2012. The purpose of this chapter is to provide analysis of what procedures worked and which failed as police, fire, and EMS personnel converged on at the theater complex after being notified that an active shooter situation was underway. Law enforcement had to contend with an active shooter, crowd control, and perimeter security, while

²¹² Liz Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham," *The Boston Globe*, July 28, 2013, <http://www.bostonglobe.com/lifestyle/health-wellness/2013/07/27/aurora-shooting-schooled-brigham-and-women-hospital-treating-onslaught-bombing-victims/V0nJitQ0qCeeB3SwmAcfxN/story.html>

²¹³ Edward J. Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned from Combat Casualty Care and the Applicability to Boston's Terrorist Attack," *The Journal of Craniofacial Surgery* 24, no. 4 (2013): 1063. DOI: 10.1097/SCS.0b013e31829ff967.

²¹⁴ Adini, and Peleg, "On Constant Alert: Lessons to be Learned," 2183.

firefighters and EMS personnel had to deal with a multitude of casualties spread out over a wide area at the scene of the mass shooting in Aurora.

V. CASE STUDY, AURORA CENTURY THEATRE MASS SHOOTING, JULY 20, 2012

The past chapter described the systematic Israeli trauma method for treating victims of terror attacks. The current chapter is the first of three case studies on recent mass casualty events in the United States. It will examine the response of public safety agencies to the mass murder incident that took place at the Century Theater in Aurora, Colorado in July 2012. The Century Theater incident necessitated a massive law enforcement and emergency medical service response to a fluid active shooter scene in which dozens of people were injured. This was a complex situation in which medical aid was rendered in a hostile environment as the perpetrator was still on scene when police, fire and EMS arrived.

A. DESCRIPTION OF EVENT

On July 20, 2012, over 400 people were attending a midnight premier of *The Dark Knight Rises* inside cinema nine of the Century 16 movie theater complex in Aurora, Colorado. At approximately 12:38 a.m., a heavily armed 24-year-old man entered theater nine through an emergency exit door at the back of the auditorium that he had previously propped open. The gunman would later be identified as James E. Holmes of Aurora, Colorado.²¹⁵ Holmes was wearing a gas mask, a ballistic helmet, and body armor while wielding a Smith and Wesson M & P 15 (military and police) assault rifle loaded with .223 caliber bullets, a Glock .40 caliber pistol, and a Remington 870 shotgun.²¹⁶ Shortly after entering the theater, Holmes tossed at least one tear gas canister into the crowd and then started shooting unsuspecting spectators in rapid succession.²¹⁷ Initially, some moviegoers thought the shooting was part of the show, but were soon

²¹⁵ Pete Williams, and Bill Dedman, "Aurora Suspect James Holmes was Buying Guns, Dropping out of Grad School," *NBC News*, July 20, 2012, http://usnews.nbcnews.com/_news/2012/07/20/12854157-aurora-suspect-james-holmes-was-buying-guns-dropping-out-of-graduate-school?lite

²¹⁶ James Dao, "Aurora Gunman's Arsenal: Shotgun, Semiautomatic Rifle and, at the End, a Pistol," *The New York Times*, July 23, 2012, http://www.nytimes.com/2012/07/24/us/aurora-gunmans-lethal-arsenal.html?_r=0

²¹⁷ Tom Watkins, and Dana Ford, "Police: Evidence of 'Calculation,' 'Deliberation' in Colorado Shooting," *CNN*, July 21, 2012, <http://www.cnn.com/2012/07/21/justice/colorado-theater-shooting/>

horrified to learn that assailant's weapons were loaded with live ammunition. Starting at approximately 12:38 p.m. and continuing for several minutes, the assailant fired dozens of rounds into the crowd, striking 70 people.²¹⁸ As the shooting unfolded, panicked victims and bystanders rushed out of the cinema nine and into the theater's parking lots and lobby areas. Additional people from adjacent theaters at the complex fled outside as well, a factor that complicated EMS rescue efforts. The first police officers were dispatched at 12:39 a.m. and arrived on scene approximately 85 seconds later.²¹⁹ The first ambulance arrived on scene at 12:43 a.m. and the first fire company at 12:45 a.m.²²⁰ Subsequently, a large contingent of police, fire, and EMS personnel arrived at the theater complex.²²¹ First responders encountered a chaotic and frenetic scene and observed multiple victims at the theater complex bleeding from gunshot wounds. James Holmes was taken into custody just outside the theater at approximately 12:46 a.m. and did not resist the police officers arresting him.²²² A total of 82 people were injured at the Century Theater incident, with 70 suffering gunshot wounds.²²³ Ultimately, 12 of them died, with the victims ranging in ages from six to 51.²²⁴ An additional 12 people were hurt while fleeing the shooter.²²⁵

B. POLICE, FIRE, AND EMS RESPONSE

Initial 911 calls from inside Century Theater nine to the Aurora Public Safety Communications Center were received at 12:38 a.m., which immediately dispatched Aurora Police, Aurora Fire Department (AFD) and Rural Metro ambulance units to the

²¹⁸ Crummy, and Ilescas, "Aurora Theatre Shooting Report Shows Delays,"

²¹⁹ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 14.

²²⁰ Aurora Fire Department, *Century Theatre Shooting: Aurora Fire Department Preliminary Incident Analysis* (Aurora, CO: Aurora Fire Department, City of Aurora, 2012), 8, <https://www.auroragov.org/cs/groups/public/documents/document/015169.pdf>

²²¹ *Ibid.*

²²² Watkins, and Ford, "Police: Evidence of 'Calculation,' 'Deliberation' in Colorado Shooting," *CNN*, July 21, 2012, <http://www.cnn.com/2012/07/21/justice/colorado-theater-shooting/>

²²³ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 42.

²²⁴ Crummy, and Ilescas, "Aurora Theatre Shooting Report Shows Delays,"

²²⁵ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 42.

scene. The first APD officers were on scene in less than two minutes,²²⁶ Rural Metro ambulance in five minutes,²²⁷ and AFD was on site in fewer than eight minutes.²²⁸ Police were tasked with apprehending the shooter, searching the area for additional suspects and explosive devices, and setting up a secure perimeter around the theater complex. AFD and Rural Metro paramedics were responsible for providing medical care to those wounded at the theater.

The first shooting victim was encountered by an APD officer outside the theater at 12:41 a.m.²²⁹ In the moments that followed, APD and AFD personnel came into contact with dozens of seriously injured people. The assailant was taken into custody at 12:46 a.m. (eight minutes after the first 911 call), and police made entry into theater nine at 12:47 a.m. (eleven minutes after the first 911 calls).²³⁰ Inside theater nine, police found many wounded civilians, including 10 deceased victims. Many others inside were triaged as critical and needed immediate medical care and needed to be rushed to area hospitals. Police inside the theater made the first request for AFD EMS personnel inside the theater at 12:48 a.m. When this assistance did not materialize, APD made several follow-up calls for assistance. These requests for EMS assistance inside the theater went unanswered for an extended period. Due to confusion concerning scene safety, AFD paramedics did not enter theater nine until approximately 1:14 a.m., which was 36 minutes after the first 911 call reporting the shooting.²³¹ By this time, the only victims remaining inside the theater were those who had already died. At 1:16 p.m., AFD paramedics conducted a secondary triage of the 10 deceased victims inside the theater and confirmed the initial assessments of these victims, which was conducted by APD.²³²

²²⁶ Ibid., 138.

²²⁷ Aurora Fire Department. *Century Theatre Shooting*, 8.

²²⁸ Ibid., 8.

²²⁹ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 140.

²³⁰ Ibid., 144.

²³¹ Ibid., 162.

²³² Ibid., 57.

Although a total of 82 people were injured at the Century Theater incident,²³³ the Arapahoe District Attorney is only charging the assailant, James E. Holmes, with harming 75 people, including 12 homicides.²³⁴ A probable explanation of this discrepancy is that Holmes is being charged for crimes against those people who he most severely wounded.

Seventy victims sustained gunshot wounds with severity ranging from superficial to fatal. According to AFD and Rural Metro paramedics and medical directors, victims who died suffered wounds that were “non survivable,”²³⁵ meaning that even with immediate EMS care, they would have succumbed. Another 43 victims had life threatening injuries and were in danger of bleeding to death from internal lacerations, extremity wounds, or both.²³⁶ Twenty-one of these 43 were assessed as critical by first responders and hospitals and required emergency surgery at the hospitals. An additional 22 patients were triaged with wounds that were categorized as “gunshot wounds/complex,” which means they had wounds to more than one anatomical organ system and required immediate medical attention.²³⁷ Those most seriously wounded would, in all likelihood, have succumbed to hemorrhaging if they were not rescued and transported to hospitals within a finite amount of time. Table 3, excerpted from the TriData after action report, provides a breakdown of types of injuries and number of persons afflicted in the Century Theater shooting:²³⁸

²³³ Ibid., 42.

²³⁴ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 69.

²³⁵ Ibid., 42

²³⁶ Ibid., 61.

²³⁷ Ibid., 70.

²³⁸ James Edward Holmes has been charged with wounding 75 people. This figure represents those most seriously injured.

Injury Severity	Number
Death	12
Gunshot Wound/Critical	21
Gunshot Wound/Complex	22
Gunshot Wound/Soft Tissue	18
Orthopedic	9
Chemical Irritation	5
Total	75*

*75 reflects the number of people who were most seriously wounded in the attack. It is also the number of people that James E. Holmes is charged with injuring.

Table 3. Patient Type and Severity²³⁹

Ambulances from Rural Metro and Denver Health, under the direction of AFD, were responsible for transporting the wounded at the Century Theater shooting to hospitals. Twenty-four ambulances responded to the Century Theater shootings.²⁴⁰ However, ambulances and EMS personnel were unable to provide care to many of those wounded due to several factors: concerns about scene safety, inability to maneuver ambulances through the congested parking lots adjacent to the theater, and confusion as to where many victims were located. In fact, only 12 ambulances were used to transport victims to hospitals, and in most cases, ambulances only took one victim per trip.²⁴¹ Ambulances transported 20 victims to hospitals, many of whom were in critical condition. APD transported 27 victims to hospitals, and 25 of whom were triaged with a “red” classification, meaning they were gravely injured.²⁴² In all probability, these victims would not have survived if police and fire officials not made a quick decision to deviate from existing protocols, which under ordinary circumstances would have prohibited police from transporting casualties. Doctors who treated these patients stated that many of them would have died if they had not been expedited to hospitals for

²³⁹ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 70, table 8.

²⁴⁰ Aurora Fire Department. *Century Theatre Shooting*, 8–10.

²⁴¹ Ibid.

²⁴² TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 57.

definitive care.²⁴³ An APD SWAT team paramedic medic also factored heavily into the positive outcome of the emergency response. This medic was able to triage victims inside theater nine and ensure that several critical patients were expedited to hospitals.²⁴⁴ This should serve as an exemplar of a military TCCC protocol applied in a civilian emergency medical situation.

Eighteen survivors had gunshot wounds categorized as soft tissue wounds, which were not deemed to be life threatening. Another 14 victims had orthopedic or chemical-induced ailments, the latter of which was likely from the tear gas dispersed inside the theater by the assailant.²⁴⁵ Table 4 provides a list of the numbers of victims who were triaged and transported to one of six Aurora hospitals.

Injury	Triaged	Treated	Transported
Gunshot	70	60	54
Other	12	12	6
Total	82	72	60

Table 4. Triaged, Treated, and Transported²⁴⁶

The first police officers were on scene just after 12:40 a.m.,²⁴⁷ ambulances at 12:43 a.m.,²⁴⁸ and fire personnel at 12:45 a.m.,²⁴⁹ and APD made the first “contact” with a victim on the street outside theater at 12:42 (four minutes into the incident).²⁵⁰ The assailant was taken into custody at 12:46 a.m.,²⁵¹ and police made entry into theater nine

²⁴³ Ibid., 18.

²⁴⁴ Ibid., 46.

²⁴⁵ Ibid., 70.

²⁴⁶ Ibid., 61, table 2.

²⁴⁷ Ibid., 138.

²⁴⁸ Ibid., 45.

²⁴⁹ Aurora Fire Department. *Century Theatre Shooting*, 8.

²⁵⁰ Ibid., 140.

²⁵¹ Ibid., 143.

at 12:47 a.m.,²⁵² and shortly thereafter requested medical assistance for numerous victims.²⁵³ APD cleared all of the 16 auditoriums at the theater complex by 12:55 a.m. (17 minutes after the first 911 calls), but this was not readily apparent to AFD personnel at the scene due to communication problems.²⁵⁴ In addition, emergency medical response to the Century City cinema was hampered by vehicular traffic, 1,200 panicked moviegoers, and disjointed communications between police and fire officials. Scores of wounded victims were scattered in eight different geographic locations spread out over a wide area, including one inside theatre nine.²⁵⁵ The other seven were scattered in a group of locations outside the theater complex: near the front entrance of the theater to the northwest; in the parking lot in front of Dillard's department store over 500 feet from the entrance of the theater; at the immediate northwest side of the theater; at the immediate northeast side of the theater; at the intersection of Sable Boulevard and Exposition Avenue—over 700 feet southeast from the rear of the theater); at the intersection of Sable Boulevard and Centrepont Drive over 900 feet from the rear northeast of the theater; and on Alameda Avenue—over 1100 feet from the north side of the theater.²⁵⁶ Triage sites were established by first responders at each of these locations.

Ambulances had difficulty navigating through the parking lot of the theater because it heavily congested with parked police cars, civilian vehicles, and 1,200 pedestrians.²⁵⁷ This created a perilous situation for those wounded that were still inside the secure perimeter because it delayed initial medical treatment to many of the victims. As a consequence of ambulance immobility, APD officers, rather than AFD paramedics, had to treat many of the victims. This was problematic because the majority of APDs officers had limited training in treating trauma victims and were not supplied with

²⁵² *Ibid.*, 144.

²⁵³ *Ibid.*, 145.

²⁵⁴ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 49.

²⁵⁵ Aurora Fire Department. *Century Theatre Shooting*, 19.

²⁵⁶ *Ibid.*

²⁵⁷ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 18.

medical supplies.²⁵⁸ Nevertheless, APD officers worked earnestly to provide first aid at the scene.

At 12:48 a.m., APD officers were ordered by one of their supervisors to start moving victims out of the theater nine's auditorium.²⁵⁹ Also at 12:48 a.m., APD initiated their first victim transport from an exterior location outside the theater complex.²⁶⁰ Other patients were triaged by AFD paramedics at several locations outside the theater and were subsequently transported by Rural Metro ambulances to area hospitals. During this time, police officers located a group of 10 seriously wounded victims at the rear exterior of the theater that had not been previously located by first responders. Apparently, in the mayhem ensuing outside the theater, this group had somehow been overlooked. APD officers advised their dispatchers persistently over the course of the next seven minutes that they needed medical assistance for multiple victims at the rear of the theater. However, most EMS personnel did not come to this location due to communications breakdowns and the inability of ambulances to navigate to this area due to vehicular and pedestrian congestion.²⁶¹ An AFD paramedic who had made his way to the exterior rear of the theater told a police lieutenant that he did not think ambulances could access patients at that location because a clear path was blocked by vehicles and pedestrians.²⁶² At 12:54 a.m., APD and AFD officials made a joint decision to load multiple victims into police cars for transport to area hospitals. Although this was a deviation from established departmental procedures, police and fire commanders at the scene jointly agreed to authorize officers to drive the wounded to medical facilities in police cars.²⁶³ The reason this made sense is that police cars, which are smaller and more maneuverable than ambulances, were able to make their way through the congestion surrounding the theater complex. This was not optimal because the majority of APDs officers had limited

²⁵⁸ Ibid., 17.

²⁵⁹ Ibid., 145.

²⁶⁰ Ibid.

²⁶¹ Crummy, and Ilescas, "Aurora Theatre Shooting Report Shows Delays."

²⁶² Ibid.

²⁶³ Ibid.

training in treating trauma victims and were not equipped with medical supplies.²⁶⁴ Nevertheless, APD officers worked earnestly to provide first aid at the scene, and their patrol cars were able to maneuver through narrow spaces in the parking lots areas where ambulances and fire trucks were unable to drive. One APD officer alone made four trips from the Century Theater complex to the hospital with victims.²⁶⁵

According to the TriData after action report on the Century Theater shooting, APD transported between 27 and 28 victims to hospitals, ambulances took 20, and another 13 to 14 victims were driven in privately owned vehicles.²⁶⁶ Below is a breakdown of patients by mode of transportation from Century Theater to Aurora hospitals:

Number Transported to Hospital	Mode
20	Ambulance
27-28	Police Vehicle
13-14	Private Vehicle or Walked (one)
60	Total

Table 5. Modes of Transportation for Victims²⁶⁷

Getting medical assistance to casualties inside theater nine proved to be one of the more problematic aspects of the public safety response to the Century Theater incident. APD made an initial request for victim medical assistance inside theater nine at 12:47 a.m. (19 minutes after the first 911 call).²⁶⁸ APD made follow up requests for medical

²⁶⁴ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 17.

²⁶⁵ Denver Post Editorial Board, "What Can Be Learned from Aurora Theater Shooting Response?" *The Denver Post*, January 13, 2013, http://www.denverpost.com/ci_22351129/what-can-be-learned-from-aurora-theater-shooting

²⁶⁶ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 63.

²⁶⁷ *Ibid.*, 63, table 3.

²⁶⁸ *Ibid.*, 144.

assistance inside theater nine at 12:50 a.m.,²⁶⁹ 12:54 a.m.²⁷⁰ and at 12:58 a.m.²⁷¹ At 1:13 a.m., an Aurora Public Safety Communications dispatcher notified AFD command that an APD lieutenant was requesting paramedics at the front of the theater.²⁷² At approximately 1:14 a.m., 36 minutes after gunshots were reported, AFD paramedics entered theater nine for the first time.²⁷³ At this juncture, the only remaining victims inside the theater were those that were deceased.²⁷⁴ AFD paramedics subsequently re-triaged the 10 victims inside theater nine, and confirmed the grim initial assessment (conducted by APD officers) that these individuals were dead.²⁷⁵ Post event analysis conducted by the Tridata Corporation, which included interviews of paramedics, EMS medical directors, attending physicians at Aurora hospitals, and coroner's office staff, indicates that none of the fatalities could have been saved by EMS due to the devastating nature of their injuries.²⁷⁶ However, 36 minutes from the first 911 call to EMS personnel entry into theater nine was an inordinate period of time for paramedics to enter theater nine. This delay placed AFD officers, most of whom had limited training and first aid equipment, in the role of primary medical caregiver to multiple victims during the incident. The public safety agency response was sufficient for this particular crisis, but it could have resulted in adverse consequences had there been additional casualties. Given the number of weapons and amount of ammunition of which James Holmes was in possession, the latter would have been easily attainable.²⁷⁷ However, Holmes' assault rifle malfunctioned, and he was unable to fire all of the ammunition he had in his

²⁶⁹ Ibid., 146.

²⁷⁰ Ibid., 149.

²⁷¹ Ibid., 152.

²⁷² Ibid., 162.

²⁷³ Ibid.

²⁷⁴ Ibid., 57.

²⁷⁵ Ibid.

²⁷⁶ Ibid., 153.

²⁷⁷ Gary Strauss, "Aurora Officers Describe Arresting James Holmes," *USA Today*, January 8, 2013, <http://www.usatoday.com/story/news/nation/2013/01/08/james-holmes-aurora-hearing/1816875/>

possession before police arrived at the theater.²⁷⁸ At the time James Holmes was arrested by Aurora police officers, he was reported to be carrying over 200 rounds of unspent ammunition, and could he could have undoubtedly harmed a great many more people.²⁷⁹

It is important to note that Aurora firefighters, along with Rural Metro and Denver Health ambulance personnel, worked diligently to triage and treat those victims that they could access outside the theater complex. There were a total of 24 ambulances on scene.²⁸⁰ The first ambulance transport took place at 12:57 a.m., followed by 11 other ambulance transports, with the last patient being cleared from the scene at 1:33 a.m.²⁸¹ In all, AFD triaged 100 people at the theater complex, many of whom were seriously wounded.²⁸² APD, Rural Metro, and Denver Health transported all critically injured victims to hospitals within 52 minutes after the first 911 calls.²⁸³

As referenced earlier in this chapter, prior to the Century Theater shooting incident, most APD officers did not have any advanced training in trauma care and were not equipped with any medical supplies.²⁸⁴ This placed them at a disadvantage when trying to provide aid to those wounded at the theater complex. As a result of the shooting and in anticipation of future mass casualty incidents, APD officers now receive training in hemorrhage control techniques based on the U.S. military's TCCC methodology.²⁸⁵ APD and AFD have also developed a joint high risk extraction protocol (HREP) for any future mass casualty events.²⁸⁶ In the HREP, firefighters will enter *warm zones* under police escort to treat casualties. The HREP appears to be a version of the Arlington County Rescue Task Force model.

²⁷⁸ Susan Candiotti, "Colorado Shooter's Rifle Jammed During Rampage," *CNN*, July 22, 2012. <http://www.cnn.com/2012/07/22/us/colorado-shooting-investigation/>

²⁷⁹ Strauss, "Aurora Officers Describe Arresting James Holmes."

²⁸⁰ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 63.

²⁸¹ Aurora Fire Department. *Century Theatre Shooting*, 10.

²⁸² TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 44.

²⁸³ *Ibid.*

²⁸⁴ *Ibid.*, 42.

²⁸⁵ Megan Verlee, "Outgoing Aurora Police Chief Reflects on his Time at the Department," *Colorado Public Radio*, May 31, 2014, <http://www.cpr.org/news/story/outgoing-aurora-police-chief-reflects-his-time-department>

²⁸⁶ *Ibid.*

The Century Theater complex is within close proximity to six trauma centers, which was also a significant survivability factor. It meant that victims received definitive medical care within minutes of being evacuated from Century Theater. Most of the shooting victims went to the Medical Center of Aurora or the University of Colorado Hospital, which are located within three miles of the theater.

In scenarios where transport distances are longer than just a few miles, victims suffering from traumatic injuries in terrorist attacks will need expert emergency care while in transit and this care may best be provided by paramedics in ambulances. However, in circumstances where ambulances are not available, police vehicles can and be used, as was the case in Aurora. However, it is optimal to have paramedics or police officers trained in trauma care ride in these cars to administer first aid. A TECC-type rescue task force would have been able to enter theater nine to administer medical care to patients immediately after APD officers concluded their cursory sweep. The rescue task force model also ensures an integrated police and fire response to active shooter and mass casualty incidents.

C. HOSPITAL RESPONSE

The University of Colorado Hospital (UCH) received the highest number of victims, receiving 23 for definitive care. Another 21 victims were transported to the Medical Center of Aurora (TMCA), six to Children's Hospital, and five went to Denver Medical Health (DMH).²⁸⁷ Swedish Medical Center (SMC) and Parker Adventist Hospital also treated victims.²⁸⁸ The staff on duty at University of Colorado Hospital on the night of the shootings noted that all but three of the 23 victims they received arrived via police cars.²⁸⁹ One emergency room doctor described observing gunshot wounds that looked like something she expected could only happen in a "war zone" because patients

²⁸⁷ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 69.

²⁸⁸ *Ibid.*

²⁸⁹ Carolyn Sanders, and Patrick Conroy, *When Disaster Strikes: University of Colorado Hospital's Response to the July 20, 2012 Aurora Shooting*, University of Colorado Hospital, June 2013, http://www.aone.org/conference2013/Handouts/2013_concurrent_handouts/Sat_6_605_L_13.pdf

were struck by large caliber bullets that caused extensive injuries to their torsos, limbs, and heads.²⁹⁰

The chairman of the department of emergency medicine at the University of Colorado described multiple victims arriving at the facility's emergency department (ED) simultaneously. Officials at the hospital activated a mass casualty alert and an announcement was broadcast throughout the hospital. Physicians, nurses, and medical technicians from other departments subsequently reported to the ED in a coordinated effort to perform triage and surgeries for the shooting victims;²⁹¹ hospital custodians were recruited to assist as well.²⁹²

Hospital staffs were well prepared to handle casualties from the Century Theater shooting. According to Dr. Comilla Sasson, one of the attending emergency room physicians at the UCH, "Everyone who had a pulse while being transported to the hospital is alive today."²⁹³ Medical personnel at Aurora hospitals were able to save the lives of multiple victims, including those that arrived at the hospital in "code red" condition.²⁹⁴ Code red is a triage classification that EMS personnel use to assess patients who are in grave danger of expiring due to respiratory and cardiac failure.²⁹⁵ These "red" classified patients would have died had they not received immediate medical treatment on scene followed expert trauma care at the hospitals.

²⁹⁰ Tim Darragh, "Lessons from Aurora, Colo., Shooting: Lehigh Valley EMS Workers Told to Be Prepared but Flexible," *The Morning Call*, May 21, 2013, http://articles.mcall.com/2013-05-21/news/mc-theater-shootings-er-20130521_1_colorado-theater-shooting-squad-cars-movie-theater

²⁹¹ Oren Dorel, "Monthly Training Helped Prepare Medical Staff for Casualties," *USA Today*, July 22, 2012, <http://usatoday30.usatoday.com/news/nation/story/2012-07-22/colorado-shooting-medical-response/56420542/1>

²⁹² Kirk Mitchell, "Aurora Theater Shooting: Trauma Rooms Scrambled to Save Lives," *The Denver Post*, July 20, 2012, http://www.denverpost.com/ci_21121488/aurora-theater-shooting-trauma-rooms-scrambled-save-lives

²⁹³ Comilla Sasson, "Aurora Theater Shooting Doctor: Tired of Treating Gun Wounds," *The Denver Post*, March 7, 2013, http://www.denverpost.com/ci_22732875/aurora-theater-shooting-doctor-tired-treating-gun-wounds.

²⁹⁴ Aurora Fire Department. *Century Theatre Shooting*, 8–9.

²⁹⁵ *Ibid.*, 6.

D. PREVIOUS TRAINING AND EXERCISES

The staff at Aurora area hospitals trained and prepared for mass casualty events. According to Aurora trauma physicians, hospitals in the Denver area changed their response protocols after the Columbine High School massacre and the September 11 terror attacks.²⁹⁶ Mass casualty events such as these led hospital leaders to realize that the existing procedures, which allowed for the treatment of relatively small numbers of patients at one time, were inadequate for mass casualty incidents. A paradigm change involved improved training and increased emergency room capacity for mass casualty events. For example, UCH holds monthly drills in which hospital personnel train and prepare their responses to atypical, high volume casualty events, such as bombings and active shootings.²⁹⁷ This training readies medical professionals for highly stressful, resource intensive situations involving multiple victims who suffer from life threatening injuries.²⁹⁸

Prior to the Century Theater shooting, public safety officials in Aurora also participated in large-scale training exercises. In 2010, 2011, and 2012, APD and AFD collaborated with officials from Aurora's school district to conduct active shooter drills that were centered on school campus-based scenarios and athletic events.²⁹⁹ In September 2011, 100 public safety agencies in Denver's metropolitan area, which includes Aurora, participated in a day long, full scale exercise designed to assess the law enforcement, fire service, and emergency medical community's capacity to respond to and mitigate a "Mumbai-style terrorist attack," should one ever occur in the Colorado North Central Region (NCR). In November 2008, a series of well-coordinated terrorist attacks took place in Mumbai, India over a three-day period in which 166 people were killed and over 300 more were wounded.³⁰⁰ This NCR exercise, dubbed Operation

²⁹⁶ Dorel, "Monthly Training Helped Prepare Medical Staff for Casualties."

²⁹⁷ Ibid.

²⁹⁸ Ashley Powers, and Amina Khan, "Colorado Theatre Shooting Plunged Hospitals into Turmoil," *Los Angeles Times*, July 25, 2012, <http://articles.latimes.com/2012/jul/25/nation/la-na-colorado-doctor-20120725>

²⁹⁹ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 4.

³⁰⁰ Ajay H. Bhandarwar et al., "Mortality Pattern of the 26/11 Mumbai Terror Attacks," *Journal of Trauma and Acute Care Surgery* 72, no. 5 (2012): 1329, DOI: 10.1097/TA.0b013e31824da04f

Mountain Guardian (OMG), involved a series of coordinated mock attacks at locations throughout the Denver area. One of the venues was the Community College of Aurora where a simulated terrorist bombing took place in which multiple people were killed or wounded.³⁰¹ Various entities from Aurora participated, including Aurora dispatch, police, fire, and Rural Metro Ambulance. After OMG concluded, a summary report was issued that detailed several aspects of mass casualty incident response protocols in need of improvement, such as communications and triage/pre-hospital treatment.³⁰²

E. ANALYSIS

In Aurora, despite the difficulties encountered by first responders in reaching many of the wounded, fire and police officials demonstrated keen initiative by making a snap decision to break existing regulations: police officers transported wounded to hospitals in their cars when ambulances were unable to do so. This was done to prevent victims of the shooting from bleeding to death on scene, as exsanguination can occur in as little as two to three minutes without medical intervention.³⁰³ It is evident that the police transports saved the lives of at least 25 people who were in critical condition (those classified as triage “reds”).³⁰⁴ Though this was effective, it was not ideal because while victims were in the police cars they did not receive medical treatment. The speed of transportation to hospitals is why this improvisation worked. The average time of transports in police vehicles was approximately four minutes and fifty-three seconds.³⁰⁵ Although more than 20 ambulances were on scene at the incident, only 12 transported patients to hospitals, and in most instances, ambulances that made transports were not filled to capacity.³⁰⁶

³⁰¹ Colorado North Central Region, *Executive Summary, Operation Mountain Guardian (2010) Exercise and Training Series* (Centennial, CO: North Central All-Hazards Region, 2011), <https://www.denvergov.org/Portals/428/documents/OMG%20Executive%20Summary%20Public%20Release.pdf>, 12.

³⁰² Ibid.

³⁰³ Iselin, and Smith, “Arlington County, VA Task Force.”

³⁰⁴ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 57.

³⁰⁵ Aurora Fire Department. *Century Theatre Shooting*, 8–10.

³⁰⁶ Ibid.

The optimal EMS response to the Century Theater shooting would have been for the victims of the shooting to be triaged on scene by a TECC rescue task force, consisting of teams of paramedics and police officers, and then placed in ambulances where they could continue receive medical attention from paramedics while in transit to the hospital. This could have been accomplished by paramedics equipped with ballistic body armor and helmets working in unison with police as part of a rescue task force, entering Century Theater nine at 12:47 a.m. after police had cleared and secured it of any additional threat. In actuality, AFD paramedics waited outside until approximately 1:14 a.m., 36 minutes after gunshots were first reported.³⁰⁷

Another benefit to ambulatory transport is that upon arrival at the hospital, paramedics can fully apprise emergency department personnel of each patient's triage status. However, in large-scale casualty incidents, police cars may be used to expedite casualties from the point of injury to hospitals because it is vital that victims get to definitive care as quickly as possible. The combined efforts of APD, AFD, and Rural Metro ambulance saved the lives of 43 seriously injured victims. Other jurisdictions in the U.S. can learn from the Century Theater shooting in Aurora to better coordinate police and fire department resources to mass casualty events through the use of TECC rescue task forces. They should also should plan on utilizing police vehicles to transport victims when ambulances are unavailable; however, to better address victim's injuries, paramedics should also ride in the vehicle to render medical attention.

The outcome of the Century Theater shooting could have been far worse if victims had not been rushed to hospitals in police cars, or if there had been more than a lone perpetrator. The shooting involved just one assailant, who surrendered within minutes to police without offering any resistance; however, the actions of this one assailant wreaked havoc on the community and public safety agencies in Aurora. If the incident at Century Theater had involved multiple attackers, the results would have undoubtedly resulted in more casualties and greater confusion at the scene.

³⁰⁷ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 162.

Aurora teaches us that TECC rescue task forces consisting of police and fire personnel are necessary to provide a joint EMS-law enforcement response to mass casualty incidents. This is critical to get medical aid victims of active shooter incidents quickly. The placement of paramedics on standby for inordinate periods of time at mass casualty events is an antiquated practice that is detrimental to victims. It is vital that first responders have capabilities to provide rapid, unimpeded transport from the point of injury to the hospital. The EMS response to Aurora was successful because TECC concepts, such as rapid on-scene medical care and rapid evacuation to hospitals, were effected. However, because public safety agencies in Aurora did not have a TECC rescue task force program in place at the time of the shootings, there were delays in getting medical care to the wounded. The ideal response at Century Theater would have been for the victims of the shooting to be triaged on scene by rescue task force paramedics, then transferred in ambulances where they could receive medical attention from paramedics during the drive to the hospital. Another benefit to ambulatory transport is that once they arrive at the hospital, paramedics can fully apprise emergency department doctors, nurses, and technicians of each patient's status.

Although expedited transport was imperative in this situation, victims continued to lose large quantities of blood during the drive to the hospital,³⁰⁸ and had the distance to the hospitals been greater than it was in Aurora, some would have likely exsanguinated before receiving definitive medical care. However, transportation by police is also a viable option when ambulances are unavailable. The key to saving victims of gunshot wounds and IEDs is to get them triaged on scene to stop bleeding and then expedited to the hospital as quickly as possible. TECC rescue task forces or high-risk extraction protocols, the latter of which is which is being implemented by APD and AFD (post-Century Theater shooting), are necessary to deliver emergency medical services at mass casualty events.

Another lesson learned from the Century Theater shooting incident is that communities can plan and train for mass casualty events. Training and exercises enhance

³⁰⁸ Todd Neff, "A Night in the ED," *UCH Insider* 6, no. 3 (2014): 2, <http://www3.uch.edu/uchinsider/theater%20shootings%20ed%20response.pdf>

first responders' abilities to provide casualty care to multiple casualties under adverse conditions. APD and AFD benefited from active shooter training, and Aurora hospital professionals proved themselves to be well prepared to treat victims of the massacre. On a cautionary note, if there had been additional assailants or more victims at Century Theater, the outcome could have been worse.

The next chapter will detail the emergency medical response to Boston Marathon bombings in April 2013, which represented the largest terrorist event, in terms of the number of casualties, on U.S. soil since the September 11 hijackings. The Boston Marathon bombing is unique because firefighters, EMS personnel, doctors, and nurses were prepositioned in the area in which two improvised explosive devices were detonated. First responders and hospitals used lessons learned from the U.S. military and Israel to save the lives scores of victims of the marathon bombings.

VI. CASE STUDY, BOSTON MARATHON BOMBINGS, APRIL 15, 2013

We in Boston have taken many lessons from our surgical colleagues treating the war injured and have learned that timely and effective interventions can be strung together along the chain of transport to provide excellent care.³⁰⁹

—Doctors at Brigham and Women’s Hospital
after the Boston Marathon Bombings.

The previous case study was on the July 2012 shooting that took place in Aurora, Colorado. This event demonstrates the need for TECC rescue task forces at mass casualty events. The Aurora case study also shows how well trained and prepared hospital staffs can have a significantly positive impact on victim survivability at mass casualty occurrences. The Boston Marathon bombing case study that comprises this chapter shows the advantages of an effective integrated public safety response a mass casualty incident.

A. DESCRIPTION OF THE EVENT

On April 15, 2013, at 2:49 p.m., two homemade bombs detonated near the finish line of the Boston Marathon within 12 seconds and 550 feet of each other.³¹⁰ These improvised explosive devices were pieced together from pressure cookers, black powder explosives,³¹¹ nails, metal fragments, and pellets.³¹² The initial scene was one of chaos and confusion with scores of grievously wounded spectators lying helplessly on the ground while others moved about dazed in search of medical assistance. Many yelled out in agony. It was readily apparent that some people did not survive the blasts while many others who were bleeding profusely were in grave danger of dying. Over a dozen victims

³⁰⁹ Caterson et al., “Boston Bombings: A Surgical View of Lessons Learned,” 1066.

³¹⁰ James F. Tracy, “Boston Marathon Bombing Timeline,” Global Research, August 18, 2013, <http://www.globalresearch.ca/boston-marathon-bombing-timeline/5345924>

³¹¹ Bill Hutchinson, and Chelsea Rose Marcus, “Boston Marathon Bomber Tamerlan Tsarnaev Bought Three Pounds of Black Powder from N.N. Fireworks Store,” *New York Daily News*, April 24, 2013, <http://www.nydailynews.com/news/national/tamerlan-bought-bombs-article-1.1325504>

³¹² Sylvia Herbst-Bayliss, “Boston Marathon Amputations: Faced with Legs Mangled by Bombs, Doctors Had to Amputate,” *The Huffington Post*, April 16, 2013, http://www.huffingtonpost.com/2013/04/17/boston-marathon-amputations-legs_n_3095747.html

had severed legs while the remainder suffered from a combination of internal trauma, burns, and shrapnel wounds.³¹³

In the moments after the blasts, multitudes of emergency medical personnel and police officers already prepositioned at various locations along the racecourse immediately mobilized and aided the wounded.³¹⁴ A considerable number of bystanders also rushed to the sides of the stricken to assist with first aid.³¹⁵ Rescuers sought out those in most obvious need of assistance. At 3 p.m., Boston firefighters located two badly injured children among the dozens of victims on Boylston Street. These children were eight-year old Martin Richard and his seven-year old sister Jane. Tragically, Martin did not exhibit any signs of life and was deemed by first responders to be beyond resuscitation. However, Jane was still alive, though her condition was rapidly deteriorating due to multiple injuries that included the traumatic amputation of her left leg below the knee, which resulted in uncontrollable bleeding.³¹⁶ One of the firefighters lifted Jane and summoned a passing ambulance in an effort to get her to the hospital before she exsanguinated. The ambulance was already filled to capacity, but the vehicle's crew made room for Jane and sped her to Boston Children's Hospital.³¹⁷ During transport, paramedics quickly affixed a tourniquet to her leg, which prevented further blood loss and likely prevented her from exsanguinating.³¹⁸ It is noteworthy that tourniquet use is one of the tenets of both TCCC and TECC doctrines. Once she arrived at the hospital, doctors there were able to conduct a series of surgical interventions to save her life.³¹⁹ This is just one example of the many instances of victims being rescued by expert medical aid and prompt transport to hospitals in the aftermath of the bombings.

³¹³ Kay Lazar, and Sarah Schweitzer, "A Year Since Marathon Attacks, Many of Wounded Struggle," *The Boston Globe*, April 15, 2014, <http://www.bostonglobe.com/metro/2014/04/14/year-after-marathon-bombings-survivors-struggle-with-invisible-injuries/NOJ8kKRewvPxjK7LZ3tjJP/story.html>.

³¹⁴ National Public Radio, "Lessons Learned in Emergency Preparedness."

³¹⁵ Leonard et al., "Why Was Boston Strong?" 7.

³¹⁶ David Abel, "For Richard Family, Loss and Love," *The Boston Globe*, April 13, 2013, <http://www.bostonglobe.com/metro/2014/04/12/loss-and-love/a19pcWz6WF5nNozPPItwYI/story.html>

³¹⁷ Ibid.

³¹⁸ Tracy, "Boston Marathon Bombing Timeline."

³¹⁹ Ibid.

A total of 264 people were injured and three were killed in the Boston Marathon blasts.³²⁰ There could have likely been many more fatalities. However, many of those seriously wounded were saved because Boston emergency teams and hospitals had previously studied exemplars of emergency medical responses to mass casualty events from around the globe.

B. POLICE, FIRE, AND EMS RESPONSE

Boston's police officers, firefighters, and EMS personnel were already performing marathon race day duties—crowd control and first aid administration to runners—when the bombs exploded. In the moments after the blasts, these rescuers navigated the scene and assisted the wounded without hesitation. Because the bombs had been placed on the ground, many spectators sustained severe lower extremity wounds such as amputated or maimed legs. Others suffered from shrapnel penetrations, burns, and barotrauma,³²¹ the latter of which consisted mainly of lung, ear, and gastrointestinal damage caused by the blasts' shock waves.³²² Many victims bled profusely from their injuries, presenting a problem for emergency medical personnel that needed to be managed posthaste. To prevent exsanguination, first responders used tourniquets, and bandage applications with direct pressure (e.g., hands placed directly onto wounds) to control hemorrhaging. Some of the tourniquets were professionally manufactured devices carried by Boston EMS technicians, while others were improvised from belts or pieces of clothing.³²³ It was readily apparent that survivors needed to be transported to hospitals without delay, and first responders worked diligently to expedite them from the disaster site to Boston trauma centers.

³²⁰ Kellerman, and Peleg, "Lessons From Boston."

³²¹ Eric Goralnick, and Jonathan Gates, "We Fight Like We Train," *New England Journal of Medicine* 368, no. 21 (2013): 1961, DOI: 10.1056/NEJMp1305359.

³²² Markus Torkki et al., "Triage in a Bomb Disaster with 166 Casualties," *European Journal of Trauma* 32 no. 4 (2008): 375, DOI: 10.1007/S00068-006-6039-8.

³²³ Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings."

First responders also collaborated to triage and identify the most seriously wounded people, prioritizing those with life-threatening injuries.³²⁴ Some EMS personnel used indelible markers to write the letter “T” and a time on the foreheads of victims on whom tourniquets were affixed to let physicians know so that they could loosen or re-apply the tourniquets at the hospital.³²⁵ This is a concept taken from TCCC. Ambulances were used to bring the most serious casualties to level 1 trauma centers and other medical facilities.³²⁶ When ambulance resources were exhausted, victims were loaded into police cars and were taken to hospitals.³²⁷ While this is not typical or ideal, it is necessary to utilize alternate vehicles when ambulance resources are stretched beyond normal operating capacity during mass casualty events.

A large medical tent staffed with a full contingent of physicians, nurses, and paramedics had been set up in Copley Square near finish line for race participant first aid. Soon after the blasts, the tent was converted to a triage area for the wounded. Health care professionals working at the tent used their skills to help treat people suffering from poly-traumatic injuries by helping EMS apply tourniquets and affix splints to broken bones.³²⁸ The presence of physicians, nurses, and medical supplies near the bombing site was fortunate and proved beneficial to the casualty care efforts in the wake of the bombings.

All of the most seriously wounded patients received stabilizing treatment at the scene and were then expedited to hospitals within twenty-two minutes of the explosions.³²⁹ The prompt and expert medical attention of first responders at the points of injury resulted in lives being saved. There was a direct correlation between the emergency medical response to the Boston Marathon bombings, tactical combat casualty

³²⁴ Ibid.

³²⁵ Matt Pueschel, “Military Trauma Care Skills Proved Beneficial to Boston Doctor,” *Dialogo*, May 20, 2013, http://dialogo.americas.com/en_GB/articles/rmisa/features/humanitarian_operations/2013/05/20/feature-ex-4163

³²⁶ American College of Surgeons, “8 Verified Trauma Centers Boston,” accessed September 2, 2014, <https://www.facs.org/search/trauma-centers?city=Boston>

³²⁷ Leonard et al., “Why Was Boston Strong?” 7.

³²⁸ Sushrut Jangi, “Under the Medical Tent at the Boston Marathon,” *New England Journal of Medicine* 368 no. 21 (2013): 368, DOI: 10.1056/NEJMp1305299.

³²⁹ Leonard et al., “Why Was Boston Strong?” 8.

care, and the Israeli hospital system.³³⁰ Had it not been for lessons learned from the U.S. military and Israeli trauma surgeons over the course of the past decade, the mortality rate of the bombings would have been far greater.

C. HOSPITAL RESPONSE

The first patients started arriving at Massachusetts General Hospital at 3:04 p.m. and at Brigham and Women's Hospital at 3:08 p.m.³³¹ Some of the trauma surgeons at these facilities stated that had any time been wasted in getting victims to emergency rooms, they would not have survived.³³² Brigham and Women's took in multiple patients and eventually received almost 40 bombing victims-the most of any hospital.³³³ The first patient undergo surgery was a man who had a leg severed in the attack and had lost a great deal of blood. He was treated on the scene by EMS technicians with a tourniquet and had another tourniquet applied at the emergency department by hospital personnel; he subsequently went into the operating room just 35 minutes after he was injured.³³⁴ Table 6 is a breakdown of the numbers of seriously wounded victims treated at each level 1 trauma center in Boston:

Level 1 Trauma Center	Number of Patients Treated
Brigham and Women's Hospital	38
Massachusetts General Hospital	37
Boston Medical Center	29
Tufts Medical Center	28
Beth Israel Deaconess Medical Center	24
Boston Children's Hospital	8

Table 6. Patients Treated at Level 1 Trauma Centers in Boston³³⁵

³³⁰ Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned," 1063.

³³¹ Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham."

³³² Ibid.

³³³ Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned," 1063.

³³⁴ Ibid.

³³⁵ Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings."

Some victims who sustained non-life threatening injuries, such as hearing loss and superficial contusions from blast and shrapnel,³³⁶ were treated at St. Elizabeth's Medical Center, Carney Hospital, and the Faulkner Hospital.³³⁷ These facilities are not verified level 1 trauma centers by the American College of Surgeons but nonetheless have emergency departments capable of treating mass casualties.

Upon notification of the bombings and of large numbers of incoming casualties, hospitals in Boston cleared out their emergency rooms and postponed elective medical procedures to make room for those seriously wounded.³³⁸ As patients arrived, surgeons triaged them to ensure that those in greatest need of medical care were treated first.³³⁹ In some cases, doctors re-applied tourniquets to ensure that hemorrhaging did not resume.³⁴⁰ As a precautionary measure, patients arriving from the bombing site were searched for hidden explosive devices before they entered the emergency department,³⁴¹ a practice derived from Israeli hospitals.

In one seemingly miraculous event, a female patient arrived at Massachusetts General Hospital (MGH) without any blood pressure, as she had lost virtually all of her body's blood supply. Physicians gave her blood transfusions and were able to revive her in large part because of the swiftness in which she was taken from the bombing site to the hospital.³⁴² Dr. Alistair Conn, director of emergency services at MGH stated, "If these victims had spent even a few more minutes at the scene they would not be alive today."³⁴³ The astute observation by Dr. Conn emphasizes the need to get victims suffering from hemorrhaging injuries to a medical facility as quickly as possible so that

³³⁶ Goralnick, and Gates, "We Fight Like We Train," 1961.

³³⁷ "It Takes a Team: The 2013 Boston Marathon: Preparing for and Recovering from a Mass Casualty Event," special issue, *The Journal of Bone and Joint Surgery, and the Journal Orthopedic & Sports Physical Therapy* (March 2014): 23, <http://sites.jbjs.org/ittakesateam/2014/report.pdf>

³³⁸ Radiological Society of North America, "Radiology Gives Front-line Aid to Boston Bombing Victims," July 1, 2013, <http://www.rsna.org/NewsDetail.aspx?id=9469>

³³⁹ Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham."

³⁴⁰ Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned," 1063.

³⁴¹ Leonard et al., "Why Was Boston Strong?" 29.

³⁴² Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham."

³⁴³ Herbst-Bayliss, "Boston Marathon Amputations."

doctors can surgically repair damaged limbs and internal organs. Using another lesson learned from TCCC, Beth Israel Deaconess Medical Center staff used indelible pens to write directly onto the chest of each marathon bombing victim, which is a means of denoting exactly what type of injuries each victim had and what type of treatment plan was needed resolve them.³⁴⁴ Hospital staffs also had to administer intravenous fluid resuscitations to patients who experienced significant blood loss and shock.³⁴⁵ The highly successful hospital community response in this event may be directly attributed to Israeli best practices in trauma treatment.

D. AFTER ACTION REVIEWS

During the bombing close to 300 people were hurt, but just three were killed. As Dr. Arthur Kellerman points out, this mortality rate represents just one percent of those injured.³⁴⁶ 164 of the most seriously wounded were taken to level 1 trauma centers in Boston, including Massachusetts General and Brigham and Women's.³⁴⁷ As a result of knowledge passed on from Israel, these hospitals were poised to treat large numbers those injured in the Boston Marathon bombings.

Over 40 people suffered serious leg injuries, including 16 whose legs were severed or required surgical amputations at the hospital;³⁴⁸ some lost both of their legs.³⁴⁹ Many, if not all of these individuals were saved because EMS and bystanders used tourniquets and other means, such as applying direct pressure to wounds to prevent them from bleeding to death. Another critical determinant in survivability was the ability of EMS to expedite the wounded to hospitals.³⁵⁰

³⁴⁴ Pueschel, "Military Trauma Care Skills Proved Beneficial to Boston Doctor."

³⁴⁵ Yvonne Wenger, "Seven Months after Boston Marathon Bombing, Local Victim Walking," *The Baltimore Sun*, November 9, 2013, <http://www.baltimoresun.com/news/maryland/bal-bs-md-erika-brannock-profile-20131110-htmlstory.html>

³⁴⁶ ArthKellerman, and Peleg, "Lessons From Boston."

³⁴⁷ Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings."

³⁴⁸ "Victims of The Boston Marathon Bombings," accessed May 31, 2013, http://www.boston.com/news/local/massachusetts/specials/boston_marathon_bombing_victim_list/

³⁴⁹ Lazar, and Schweitzer, "A Year Since Marathon Attacks, Many of Wounded Struggle."

³⁵⁰ Leonard et al., "Why Was Boston Strong?" 29.

All of the wounded who showed vital signs when admitted to hospitals ultimately survived the blasts. The three fatalities likely died near-instantaneously and could not have been saved due to the catastrophic nature of their injuries.³⁵¹ The police, EMS, and bystander response demonstrated that lessons from the American military community serving in Iraq and Afghanistan have made their way to the U.S. civilian emergency medical community.³⁵² Although Boston did not have a TECC rescue task force in place at the time of the bombings, the integrated response and of police and EMS personnel at the scene very closely resembled the TECC rescue task force approach.

Doctors at Brigham and Women's, which treated the highest number of survivors of all of the hospitals,³⁵³ stated that the initial triage and treatment at the scene of the bombings provided by first responders was a major factor in saving lives. Another facet was rapid transport from the scene of the bombings to hospitals.³⁵⁴ Boston hospital officials cited lessons learned from Iraq, Afghanistan, and Israel as playing major roles in the successful medical outcome of the bombings.³⁵⁵ Boston EMS and medical trauma professionals know that in the immediate aftermath of a mass casualty incident, it is crucial to stop victims from bleeding and rush them to the hospital. EMS used tourniquets and hemostatic agents, along with any other means available (e.g., hands pressed tightly on wounds) to apply direct pressure to stop any type of extremity hemorrhaging. Some of the internal injuries were treated initially with tranexamic acid (TXA), a medication that may slow or stop bleeding and can increase chances of survivability of trauma victims.³⁵⁶ Upon arrival at emergency rooms, trauma victims were evaluated and expedited into surgery.³⁵⁷ All of these components of the rescue effort helped save numerous lives.

³⁵¹ Gawande, "Why Boston's Hospitals Were Ready."

³⁵² Kellerman, and Peleg, "Lessons From Boston."

³⁵³ Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings."

³⁵⁴ Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned," 1066.

³⁵⁵ Gawande, "Why Boston's Hospitals Were Ready."

³⁵⁶ Caterson et al., "Boston Bombings: A Surgical View of Lessons Learned," 1065.

³⁵⁷ Joint Committee, "Active Shooter and Intentional Mass-Casualty Events," 1–3.

E. PREVIOUS TRAINING AND EXERCISES

In the years preceding the 2013 Boston Marathon, hospital officials and public safety personnel engaged in extensive planning and preparations in anticipation of mass casualty events. In the wake of the 9–11 attacks, some trauma specialists in Boston, such as Dr. Alisdair Conn, Director of Emergency Services at MGH, came to the realization that area emergency rooms were only capable of treating relatively low numbers of mass casualties of no more than three to five at a time. Any disaster generating a greater number of casualties would be problematic for hospitals to manage. Subsequently, Dr. Conn and his associates consulted emergency medical experts in Israel who had gained experience in treating large numbers of casualties after suicide bombings and other terrorist attacks.³⁵⁸ Starting in 2005, medical experts from Tel Aviv Medical Center made the first of several trips to Massachusetts General and other Boston hospitals with the stated purpose of teaching hospital staff how to treat large numbers of mass casualties.³⁵⁹ The focus of this training was on triage treatment on injuries typically seen after the detonation of improvised explosive devices.³⁶⁰ Lessons on mass casualty trauma care learned from Israel are credited with saving the lives of many of those wounded in the marathon bombings.³⁶¹

In addition to the instruction hospital staffs received from Israeli medical experts on how to treat mass casualties, public safety, and health officials from Boston participated in several large scale training exercises.³⁶² In 2009, some 750 emergency medicine professionals in Boston had the opportunity to attend the “Tale of Our Cities” conference, hosted by the Federal Emergency Management Agency (FEMA). This symposium featured lecturers (mainly physicians) from Israel, the United Kingdom, and India, who related their experience in treating those wounded in terrorist attacks in Tel

³⁵⁸ Miller, “Boston/Israel Collaboration.”

³⁵⁹ Ibid.

³⁶⁰ National Public Radio, Lessons Learned in Emergency Preparedness.”

³⁶¹ Miller, “Boston/Israel Collaboration.”

³⁶² “Israel-trained Medical Team Responded to Boston Attack,” *The Times of Israel*, April 16, 2013, <http://www.timesofisrael.com/israel-trained-medical-team-responded-to-boston-attack/>.

Aviv, London, and Mumbai.³⁶³ And in 2011, hospital personnel in the Metro Boston Homeland Security Region (MBHSR) participated in Operation Falcon II—a scenario-based exercise that sought to measure the ability of medical centers to respond to mass casualty events.³⁶⁴

Dr. Paul Biddinger, Medical Director of Emergency Department Operations at Massachusetts General Hospital (MGH), who treated victims of the bombings,³⁶⁵ expounded on the import roles played by both professional first responders and bystanders at the scene of the Marathon blasts.³⁶⁶ He described how they used tourniquets and the direct application of pressure to control hemorrhaging. Biddinger said,

It's actually one of the most important lessons, in the civilian medical community, we've learned from the wars in Iraq and Afghanistan. And, actually, as a result of it, the Boston EMS ambulances carry tourniquets just like the military tourniquets on their ambulances. They were used at the finish line. I have no doubt they saved lives.³⁶⁷

The success in the treatment of Boston Marathon bombing victims may be directly attributed to the recently acquired knowledge and skills passed on from the U.S. military, such as the use of tourniquets combined with rapid transport to the permanent medical facilities.³⁶⁸

Some doctors at Brigham Women's emergency department also studied the emergency medical response to the Aurora, Colorado mass shooting in 2012,³⁶⁹ where 82 people were wounded.³⁷⁰ In Aurora, large groups of survivors arrived simultaneously at

³⁶³ Kellerman, and Peleg, "Lessons From Boston."

³⁶⁴ Brigham and Women's Hospital, "BWH Participates in City-Wide Emergency Exercise," *BWH Bulletin*, April 15, 2011, http://www.brighamandwomens.org/about_bwh/publicaffairs/news/publications/DisplayBulletin.aspx?articleid=5205

³⁶⁵ National Public Radio, "Lessons Learned in Emergency Preparedness."

³⁶⁶ *Ibid.*

³⁶⁷ *Ibid.*

³⁶⁸ Kellerman, and Peleg, "Lessons From Boston."

³⁶⁹ Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham."

³⁷⁰ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 42.

local hospitals, which presented logistical difficulties for emergency room personnel at University of Colorado Medical Center and others. Brigham and Women's Hospital staff came to the realization that if such an event occurred in Boston, they would be underprepared. As a result of lessons learned from Aurora, Brigham and Women's executive leadership bolstered their emergency response plans for treatment of victims for mass casualty events from four or five teams of physicians and support staff to fifteen teams.³⁷¹

In addition to medical training, public safety officials in Boston participated in several large-scale exercises. In 2011, a Joint Counterterrorism Awareness Workshop Series (JCTAWS) event was held in Boston. This event, hosted by the Department of Homeland Security (DHS) and Federal Bureau of Investigation (FBI) brought together 200 local, state, and federal law enforcement, fire, and emergency service agencies to discuss and plan responses for large-scale terrorist attacks.³⁷² In both 2011 and 2012, MBHSR used Department of Homeland Security grants to fund and conduct Urban Shield Boston, which is a 24-hour exercise in which first responders from 50 public safety agencies collaborated to test the effectiveness of existing protocols to respond to large scale emergency situations.³⁷³

In the weeks and months leading up to the Boston Marathon, a series of meetings and planning events were held. One of these was particularly fortuitous: on March 14, Massachusetts State Emergency Operations Center (SEOC) held the annual pre-marathon tabletop exercise.³⁷⁴ Participants, including representatives from local, state, and federal

³⁷¹ Kowalczyk, "Mass Shooting in Colorado Offered Lessons for Brigham."

³⁷² Federal Emergency Management Agency, "Lessons Learned: Boston Marathon Bombings."

³⁷³ *Ibid.*

³⁷⁴ Federal Emergency Management Agency, "Lessons Learned: The Boston Marathon Bombings: The Positive Effect of Planning and Preparation on Response," Lessons Learned Information Sharing, 2014, accessed October 15, 2014, http://media.cygnus.com/files/cygnus/document/EMSR/2014/APR/fema-boston-marathon-lessons-l_11406794.pdf. 3.

agencies,³⁷⁵ were put run through several mass casualty scenarios, one of which was an IED attack at the Boston Marathon.³⁷⁶

F. ANALYSIS OF EMERGENCY MEDICAL RESPONSE

Lessons learned from combat medics and military trauma surgeons over the course of the past decade have made their way to the emergency medical community in Boston. Every branch of the U.S. military practices a doctrine known as tactical combat casualty care to treat wounded on the battlefield. The most significant contribution of TCCC course is the emphasis on hemorrhage control. The TCCC lessons applied at the marathon bombings included immediate on-site treatment of injuries, the use of tourniquets, and expeditious transport to trauma centers.³⁷⁷ It is also noteworthy that virtually all hospitals in Boston have medical professionals on their staffs with combat casualty care experience gained in Iraq or Afghanistan, and this greatly benefits the medical community as a whole.³⁷⁸

Paramedics and medical technicians also had unobstructed access to victims because they were in the immediate area in which the bombs were detonated. In addition, ambulances had clear paths to reach and then transport victims to hospitals. The bombings took place within relative close proximity to Boston's eight level 1 trauma centers (five adult and three children's), which also contributed to the successful medical outcome of the event.³⁷⁹ According to the data from the American College of Surgeons (ACS), Boston has one of the highest apportionments of level 1 trauma centers in the nation; there are fewer than 150 in the entire U.S.³⁸⁰ To be verified as a level 1 trauma center, a hospital must be criteria established by the ACS including the capability of handling mass casualties at short notice.

³⁷⁵ Ibid.

³⁷⁶ Scott Malone, "Planning for Boston Marathon Security Included Bombing Scenarios," Reuters, April 24, 2013, <http://www.reuters.com/article/2013/04/24/us-usa-explosions-boston-scenarios-idUSBRE93N1F620130424>

³⁷⁷ National Public Radio, "Lessons Learned in Emergency Preparedness."

³⁷⁸ Gawande, "Why Boston's Hospitals Were Ready."

³⁷⁹ Leonard et al., "Why Was Boston Strong?" 8.

³⁸⁰ American College of Surgeons, "FAQs," accessed August 15, 2014, <https://www.facs.org/search/trauma-centers?country=United%20States>

First responders were already on scene, and the rescue effort commenced immediately. An estimated 264 people were treated for wounds ranging from easily treatable soft tissue lacerations to life threatening injuries. Additionally, 164 of the most seriously wounded were distributed amongst six of Boston's eight level 1 trauma hospitals, while other less serious injured patients went to other area medical facilities.³⁸¹ At least 67 people were deemed to have life-threatening wounds, necessitating immediate definitive care.³⁸² These victims had severe lower extremity injuries, arterial wounds, vascular damage, and internal injuries.³⁸³ In addition, 16 people had lower extremity wounds that resulted in amputations.³⁸⁴ Three victims died near the locations of the blasts, and they are believed to have died almost instantaneously on scene. No one who made it to the hospital showing vital signs died.³⁸⁵

Although Boston did not have an established TECC rescue task force program instituted at the time of the bombings, the EMS response encompassed many TECC elements. There was virtually no delay in getting aid to casualties at the Boston marathon bombing sites as emergency medical personnel, first responders, and bystanders went to work on victims within seconds of the blasts. All critical patients were evacuated within 22 minutes,³⁸⁶ and the first victim of the bombings reached a hospital within eleven minutes, and the most badly injured arrived within 20 to 30 minutes of the explosions.³⁸⁷ The quick emergency response, followed by rapid transport to definitive care, likely saved at least 67 of the most critically wounded.

Boston's medical community is in contrast with jurisdictions where EMS personnel do not carry tourniquets, where regular training and drills for mass casualty

³⁸¹ "It Takes a Team: The 2013 Boston Marathon," 23.

³⁸² Diane Schneidman, "Surgeons Put Planning, Preparation, Past Experience to Work in Efforts to Save Boston Marathon Bombing Victims," *Bulletin American College of Surgeons* (September 2013): 11–13.

³⁸³ *Ibid.*, 12.

³⁸⁴ Lazar, and Schweitzer, "A Year Since Marathon Attacks, Many of Wounded Struggle."

³⁸⁵ Schneidman, "Surgeons Put Planning, Preparation," 10.

³⁸⁶ Leonard et al., "Why Was Boston Strong?" 28.

³⁸⁷ Schneidman, "Surgeons Put Planning, Preparation," 11.

events do not take place, and where accessibility to level 1 trauma centers is not as prevalent. Public safety agencies in Boston prepared for mass casualty attacks,³⁸⁸ and prior training, drills, and exercises proved extremely useful at the Marathon bombing. Other jurisdictions in the U.S. should learn from the Boston by adopting best practices in treating mass casualties developed by the U.S. emergency medical community serving in Iraq and Afghanistan, as well as from trauma surgeons from the country of Israel. These procedures include the emphasis of hemorrhage control, effective triage, and immediate transport to a hospital. The next critical phase of treatment began upon arrival at the emergency room, where experienced doctors evaluated patients and continued the triage efforts initiated by EMS in the field. Each patient was then assigned her or his own individual medical team to ensure that comprehensive treatment was effected.³⁸⁹ Another reason that resulted in the favorable medical outcome was that EMS had immediate access to victims, and they were not placed on standby by their commanders.

Other factors weighed in favor of the first responders, such as the fact that the blasts did injure any police, firefighter, or EMS personnel, and none of the first aid stations near the finish line were damaged. The bombs were relatively crude devices made with low yield, black powder explosives, and they were set off outdoors, which likely dissipated the blasts, which resulted in fewer and less severe casualties than had they been detonated indoors.³⁹⁰ Furthermore, there were no secondary IEDs or attackers targeting first responders, though this is an issue that has presented problems in other countries and could occur in future terrorist attacks on U.S. soil.³⁹¹ Public safety jurisdictions in the U.S. need to prepare for more dynamic attacks in which medical treatment of victims is must be administered while threats still exist. A TECC rescue task force is the ideal approach to guarantee that medical care is rendered in volatile situations.

³⁸⁸ Kellerman, and Peleg, "Lessons From Boston."

³⁸⁹ Leonard et al., "Why Was Boston Strong?" 28.

³⁹⁰ Ibid., 33.

³⁹¹ National Counter Terrorism Center, Department of Homeland Security, and Office of Naval Intelligence, *NCTC Special Analysis Report 2012-34a: Worldwide: IED Targeting of First Response Personnel-Tactics and Indicators* (Washington, DC: National Counter Terrorism Center, Department of Homeland Security, and Office of Naval Intelligence, 2012), <https://info.publicintelligence.net/NCTC-FirstResponderIEDs.pdf>, 3.

Even before something happened, hospital staffs in Boston had proactively sought knowledge about treating victims of bombings and other mass casualty events from medical experts in Israel. They were taught how to clear out emergency rooms after mass casualty events by postponing elective medical procedure and how to effectively triage multiple victims. They also learned the importance of having dedicated medical teams assigned to each patient.³⁹²

After the bombs exploded and the smoke began to clear, professional first responders and bystanders (many of whom are military veterans of the Iraqi and Afghanistan campaigns) mobilized to treat victims and then worked expeditiously transport survivors to area hospitals.³⁹³ EMS personnel had unfettered access to victims, and police ensured roadways were kept clear for survivors of the bombings to be expedited to hospitals.³⁹⁴ Such unrestricted access of EMS personnel to the wounded without delay is one of the primary tenets of TECC rescue task force methodology. Although Boston did not have a rescue task force program in place prior to the marathon bombings, the response between police and EMS personnel was integrated because they were pre-positioned along the racecourse to provide first aid to runners. The medical response to the Boston Marathon bombings provides an exemplar from which other jurisdictions can learn. The response to the Boston Marathon bombings should also be further studied for areas in which protocols can be improved. It is worth noting that since the Boston Marathon bombings, Boston EMS and police authorities have established a rescue task force program based on the Arlington County (Virginia) model and are now prepared to respond to active shooter incidents as part of integrated EMS-police teams.³⁹⁵

The emergency medical response to the Boston Marathon bombings was effective for three primary reasons. The first was the transference of expertise and knowledge from the U.S. military's tactical combat casualty care program coming out of Afghanistan and

³⁹² Leonard et al., "Why Was Boston Strong?" 29.

³⁹³ Ibid., 8.

³⁹⁴ Ibid.

³⁹⁵ Ricky Kue, and Brendan Kearney, "Transitioning to Warm Zone Operations," "When Time Matters Most," supplemental issue of *Journal of Emergency Medical Services* (October 2014): 24, <http://www.jems.com/article/major-incidents/boston-ems-transitions-warm-zone-operati>

Iraq. While Boston did not have a formal TECC rescue task force program prior to the marathon bombings, public safety agencies had embraced some TECC methodologies, such as the use of tourniquets to control blood loss stemming from extremity injuries. The second reason was that hospitals adopted Israeli from trauma protocols. Third, and no less important, Boston's first responders and hospital staffs executed their duties with the utmost skill and proficiency. In the ensuing chapter, the emergency response to the active shooter event that took place at the Los Angeles International Airport in November 2013 will be examined.

VII. CASE STUDY, LAX MASS SHOOTING, NOVEMBER 1, 2013

The previous chapter appraised the emergency medical response to the Boston Marathon bombings. The marathon bombings resulted in the highest number of casualties of any terrorist attack on U.S. soil since the 9–11 hijackings and necessitated a massive emergency medical effort. This next chapter will delve into the public safety agency reaction to the LAX active shooter event that transpired on November 1, 2013 with the purpose of evaluating the emergency medical response to this incident.

A. DESCRIPTION OF EVENT

On Friday, November 1, 2013 at 9:18 a.m., a 24-year old individual named Paul Ciancia walked into Terminal 3 at Los Angeles International Airport (LAX) carrying a duffel bag concealing an Smith and Wesson M & P 15 assault rifle,³⁹⁶ five 30-round magazines and hundreds of additional bullets contained in boxes.³⁹⁷ At approximately 9:20 a.m., Ciancia removed the rifle from his duffel bag and began shooting at TSA officers and passengers inside the terminal.³⁹⁸ TSA officer Gerardo Hernandez was struck by 12 .223 caliber bullets from Ciancia's weapon.³⁹⁹ Ciancia also shot two more TSA officers—James Speer and Tony Grigsby—and a traveler named Brian Ludmer.⁴⁰⁰ Another unidentified man was injured when he jumped from the second story of the Terminal 3 to the ground level to escape the gunfire. At 9:20 a.m., officers from the Los Angeles World Airport Police Department (LAWAPD) and Los Angeles Police Department (LAPD) 911 centers started receiving numerous phone calls reporting a shooting at LAX. By 9:22 a.m., LAWAPD, LAPD, and Customs and Border Protection

³⁹⁶ Alexis Shaw, and Michael S. James, "LAX Suspect Paul Ciancia Told Officials He Acted Alone in Airport Shooting," *ABC News*, November 3, 2013, <http://abcnews.go.com/US/lax-suspect-paul-ciancia-told-officials-acted-airport/story?id=20770658>

³⁹⁷ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 8

³⁹⁸ *Ibid.*, 1.

³⁹⁹ County of Los Angeles, Department of Coroner, *Case Report and Autopsy Report*, Case No. 2013–07561 (Los Angeles, CA), November 2, 2013, http://msnbcmedia.msn.com/i/MSNBC/Sections/NEWS/A_U.S.%20news/US-news-PDFs/tsa-agent-autopsy.pdf, 6–18.

⁴⁰⁰ David Simpson, "LAX Shooting: Latest on Suspect, Victims and Warning That May Have Come Too Late," *CNN*, November 5, 2013, <http://www.cnn.com/2013/11/04/justice/lax-shooting/>

(CBP) officers assigned to the airport coalesced into “contact teams” and rushed to Terminal 3 to interdict the assailant.⁴⁰¹ At approximately 9:25 a.m., the responding officers fired on, struck, and incapacitated Ciancia,⁴⁰² and shortly thereafter, LAWAPD officers radioed their dispatchers that the perpetrator was down (in this case meaning injured and incapacitated) and in custody at Gate 35 of Terminal 3.⁴⁰³ Police were concerned that there were additional assailants at large inside the airport’s terminal complex, so they initiated an exhaustive search. While this search was underway, some police officers began administering first aid to the victims of the assault.⁴⁰⁴ Citing unnamed law enforcement sources, media reporters indicated Officer Hernandez awaited medical assistance for 33 minutes⁴⁰⁵ and laid incapacitated, bottom of an escalator in the general ticketing area of Terminal 3,⁴⁰⁶ only 20 feet from an airport exit while police searched the terminal buildings.⁴⁰⁷ During this event, LAFD paramedics were staged approximately 150 yards away from Hernandez’s location because they were told by police officials that the terminal was not safe for them to enter any of the airport buildings.⁴⁰⁸ According to media reports, at 10:53 a.m., police officers inside Terminal 3 used a wheelchair to move Hernandez to the triage area located outside Terminal 2 where paramedics were waiting on standby. An LAFD ambulance subsequently rushed Hernandez to the Harborview-UCLA Medical Center, arriving at 10:15 a.m.⁴⁰⁹

⁴⁰¹ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 1.

⁴⁰² Tami Abdollah, “LAX Shooting: TSA Officer Hernandez Bled for 33 Minutes at Scene Report,” *NBC News*, November 15, 2103, <http://www.nbcnews.com/travel/lax-shooting-tsa-officer-hernandez-bled-33-minutes-scene-report-2D11603430>

⁴⁰³ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 2.

⁴⁰⁴ *Ibid.*, 9.

⁴⁰⁵ Jason Kandel, “TSA Officer Bled For 33 Minutes in LAX Shooting,” *NBC Los Angeles*, November 15, 2013, <http://www.nbclausangeles.com/news/local/TSA-Officer-Bled-For-33-Minutes-In-LAX-Shooting-232062361.html>

⁴⁰⁶ Lopez, and Welsh, “L.A. Fire Department Dramatically Overhauls Response to Shootings.”

⁴⁰⁷ Abdollah, “LAX Shooting.”

⁴⁰⁸ Kandel, “TSA Officer Bled for 33 Minutes in LAX Shooting.”

⁴⁰⁹ Abdollah, “LAX Shooting.”

Paramedics, physicians, and medical support staff worked diligently but were unable resuscitate Hernandez, and he was pronounced dead at the hospital at 11:00 a.m.⁴¹⁰

B. POLICE, FIRE, AND EMS RESPONSE

The first 911 calls were received by public safety dispatch centers at 9:20 a.m., and the police responded swiftly. By 9:22 a.m., teams of officers from LAWAPD, LAFD, and CBP made their way to Terminal 3 and engaged the assailant. At 9:25 a.m., LAWAPD officers notified their dispatch center that the shooter was down and in custody.⁴¹¹ Concerned that there were additional suspects, police proceeded to search the entire central terminal complex of the airport.

At 9:32 a.m. PST, an incident command post (ICP) was established by LAWAPD at the east end of Terminal 3. LAFD officials on scene were concerned that the police ICP was too close to the active shooter site and decided to establish their own separate ICP at the east end of Terminal 2, a considerable distance away from Terminal 3.⁴¹² LAFD officials later told the Public Safety Working Group, a committee convened after the shootings, that at the time of the incident, they had safety concerns about the location of the LAWAFD ICP because of apprehensions that there were additional active shooters and improvised explosive devices inside Terminal 3.⁴¹³ In addition to setting up an ICP, LAFD established a curbside triage area outside Terminal 2.⁴¹⁴ A large contingent of firefighters and paramedics assembled at this location, but incident commanders ordered them to stay outside the airport terminals because a search for an active shooter was underway inside the airport terminal building and adjacent areas.⁴¹⁵ Communications were hampered by the fact that the responding public safety agencies at LAX did not set up a unified command post until 10:14 a.m., 46 minutes after the first shots were fired by

⁴¹⁰ Lopez, and Welsh, “L.A. Fire Department Dramatically Overhauls Response to Shootings.”

⁴¹¹ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 9.

⁴¹² *Ibid.*

⁴¹³ *Ibid.*

⁴¹⁴ *Ibid.*

⁴¹⁵ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 9.

Ciancia.⁴¹⁶ LAFD ultimately deployed over 50 vehicles, including ambulances and fire apparatuses to the scene.⁴¹⁷ The first ambulance arrived at LAX at 9:35 a.m., and its crew was advised by LAPD officers that the situation was still “active,” meaning that a threat still existed inside of Terminal 3. By 9:45 a.m., dispatchers broadcasted that LAWAPD had declared the scene safe, and that there was a seriously injured victim still inside Terminal 3.⁴¹⁸

C. HOSPITAL RESPONSE

The LAX shooting was not a large-scale mass casualty event and thus did not require hospitals in the Los Angeles area to take extraordinary measures to provide extra staffing or to expand their operational capabilities. A total of six victims were taken by Los Angeles Fire Department ambulance to level 1 trauma centers. Three victims, including the perpetrator of the active shooting, were transported to UCLA Medical Center in Los Angeles, and two patients, including TSA officer Gerardo Hernandez were transported to Harbor UCLA Medical Center in Torrance, California. The transport times ranged from 13 to 30 minutes.⁴¹⁹ TSA officer Tony Grigsby, who was shot in the foot, was also treated and released from a Los Angeles area hospital.⁴²⁰

All patients except one survived. The single fatality in the shooting, TSA officer Gerardo Hernandez, was in full cardiac arrest when police officers reached him inside of Terminal 3. Police officers brought Hernandez to LAFD paramedics staged at the triage area outside of Terminal 2. Hernandez had been struck by 12 gunshots, causing massive internal injuries.⁴²¹ LAFD paramedics and medical staff at Harbor UCLA Medical Center tried to revive Hernandez but were unsuccessful. An autopsy conducted by a medical examiner from the County of Los Angeles Coroner’s Office determined that Hernandez

⁴¹⁶ Ibid., 19.

⁴¹⁷ Lopez, and Welsh, “L.A. Fire Department Dramatically Overhauls Response to Shootings.”

⁴¹⁸ Ibid.

⁴¹⁹ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident*, 5–6.

⁴²⁰ Tami Abdollah, “James Speer, Tony Grigsby Identified as TSA Victims in LAX Shooting,” *Huffington Post*, November 4, 2013, http://www.huffingtonpost.com/2013/11/04/james-speer-tony-grigsby-tsa_n_4211727.html

⁴²¹ County of Los Angeles, Department of Coroner, *Case Report and Autopsy Report*, 6–18.

died from multiple gunshot wounds that caused massive internal bleeding. The medical examiner determined that Hernandez had been hit with 12 bullets, and located 40 separate bullet fragments inside his body.⁴²² Despite the fact the Hernandez's prospects for survival were grim, the consensus of police, fire, and TSA officials was that he should have been rescued far sooner. All other victims were eventually treated and released.⁴²³ This included Brian Ludmer, who remained in the hospital for several weeks after the shooting with a severe leg injury.⁴²⁴ Table 7 illustrates the injuries and emergency response times for each victim.

Victim Name	James Speer	Brian Ludmer	Gerardo Hernandez	Unidentified	Paul Ciancia	Tony Grigsby
Victim Number		2	3	4	5	6
Injury	GSW chest	GSW left leg	Multiple GSWs	Unspecified injuries from fall	GSW mouth	GSWs right foot
Age/Gender	54 yrs/male	29 yrs/male	39 yrs/male	44 yrs/male	23 yrs/male	36 yrs/male
Rescue Unit/Ambulance	Rescue 51	Rescue 62	Rescue 63	Rescue 66	Rescue 64	Unknown
Time of Dispatch	0929 hrs	0933 hrs	0933 hrs	0953 hrs	0953 hrs	Unknown
Enroute LAX	0930 hrs	0934 hrs	0934 hrs	0954 hrs	0953 hrs	Unknown
Arrive at LAX	0953 hrs	0946 hrs	0940 hrs	0954 hrs	1004 hrs	Unknown
Contact made with patient	0947 hrs	0946 hrs	0946 hrs	0955 hrs	1016 hrs	Unknown
Depart LAX	0950 hrs	0958 hrs	0953 hrs	1015 hrs	1045 hrs	Unknown
Arrive Hospital	1008 hrs	1016 hrs	1023 hrs	1038 hrs	1057 hrs	Unknown
Transport Time	18 minutes	18 minutes	30 minutes	23 minutes	12 minutes	Unknown
Transport Distance	13.3 miles	11.6 miles	13.3 miles	11.6 miles	11.6 miles	Unknown
Hospital	Harbor UCLA	UCLA Medical Center	Harbor UCLA	UCLA Medical Center	UCLA Medical Center	Unknown
Outcome	Survived	Survived	Deceased	Survived	Survived	Survived

GSW= gunshot wound

Table 7. Injuries and Emergency Response Times for each casualty of the LAX active shooter incident, November 1, 2013⁴²⁵

A seventh unidentified victim was triaged at the scene by LAFD for ringing in his ears but was not transported to a hospital due to the superficial nature of his injury.⁴²⁶

⁴²² Ibid.

⁴²³ Greg Botelho, and Michael Martinez, "FBI: 23-Year Old L.A. Man is Suspect in Airport Shooting that Kills TSA Officer," *CNN*, November 1, 2013, <http://www.cnn.com/2013/11/01/us/lax-gunfire/>

⁴²⁴ Eric Hong, "Exclusive: Lake Forest Native Brian Ludmer Recalls Deadly LAX Shooting," *ABC News*, December 23, 2014, <http://abc7chicago.com/archive/9370608/>

⁴²⁵ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident*, 5–6.

⁴²⁶ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 4.

D. AFTER ACTION REVIEWS

Officials from the Los Angeles World Airports (LAWA) and the Los Angeles Fire Department (LAFD) conducted their own after-action reviews of the event, and both determined that police and EMS integration at the scene was lacking. Even before any after action review of the LAX shooting had been completed, the Los Angeles Fire Department released a training bulletin that announced and outlined a dramatic change in the way the department would respond to any future tactical law enforcement situations, including active shooter, barricaded suspect, and hostage situations.⁴²⁷ The new protocol established in the November 2013 LAFD training bulletin states that henceforth, rescue task forces (RTFs) will mobilize at the scene of any tactical law enforcement occurrence (e.g., active shooter, hostage situation or barricaded suspect).⁴²⁸ These task forces are to consist of a minimum of two firefighters and two police officers, working in tandem, who will enter “warm zones” to render medical assistance to casualties.⁴²⁹ RTFs can be expanded in size for situations requiring additional EMS and police personnel.

According to the LAFD after action review, the first ambulances were on scene at LAX within six minutes of being dispatched.⁴³⁰ After they arrived, LAFD incident commanders placed ambulances and paramedic crews on standby until police could deal with potential threats in Terminal 3. Police officers also had to transport victims from the interior of Terminal 3 to the exterior of Terminal 2, where LAFD had established their triage area for the site. The LAFD after action report states that Rescue 63 (one of the LAFD ambulance units) made “contact” with wounded TSA officer Gerardo Hernandez at 9:46 a.m., administered treatment on scene for seven minutes, and then transported him to Harbor UCLA in Torrance, California.⁴³¹ Hernandez was in full cardiac arrest when paramedics first assessed him, and he remained in this condition during transport to the hospital. LAFD’s account of how long it took for paramedics to treat Hernandez is at

⁴²⁷ Ibid.

⁴²⁸ Ibid.

⁴²⁹ Lopez, and Welsh. “L.A. Fire Department Dramatically Overhauls Response to Shootings.”

⁴³⁰ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident*, 5–6.

⁴³¹ Ibid.

odds with media accounts of the event. According to LAFD call logs, paramedics made contact with Hernandez 28 minutes after the shooting started,⁴³² not 33 minutes as news outlets, including *NBC*, reported.⁴³³ Nevertheless, there was a lengthy delay in providing casualty care at the LAX after the shooting.

LAFD paramedics also treated a 54-year old male (identified in the LAFD AAR as Patient 1) with a gunshot wound to the chest and a 29-year old male (identified as Patient 2) with a bullet wound to his left leg. The perpetrator of the attack, Paul Cianci (identified as Patient 5) was shot by police several times, including once in the mouth. He, too, received medical attention from LAFD paramedics. A 44 year old man (identified as Patient 4) sustained unspecified life threatening injuries when he jumped from the second floor of the terminal. One additional individual (Patient 6) was treated for ringing of the ears (due to the sound of gunfire) and was released at the scene.⁴³⁴ Inexplicably, LAFD's after action report does not indicate that any medical treatment was administered to wounded TSA officer Tony Grigsby, age 36-years old, although the report does state that a total of three TSA officers were injured in the LAX shooting incident.

In a memorandum to Los Angeles' Board of Fire Commissioner's dated June 27, 2014, LAFD Interim Fire Chief James G. Featherstone stated, "The most significant gap in performance was the late 'unification' of LAFD and Los Angeles Police Department (LAPD) into a collocated Unified Command Post."⁴³⁵ Chief Featherstone stated that delays (such as those that transpired at the LAX shooting) could have adverse implications for the department's ability to treat wounded during active shooter situations. To improve LAFD's response to future mass casualty events, departmental

⁴³² Ibid.

⁴³³ Abdollah, "LAX Shooting."

⁴³⁴ Los Angeles Fire Department, *After Action Review: LAX Shooting Incident*, 5–6.

⁴³⁵ James G. Featherstone, *Los Angeles International Airport Shooting Incident*, File No. 14–070, June 27, 2014, http://ens.lacity.org/lafd/lafdreport/lafdlafdreport186488607_06272014.pdf

leadership enacted a tactical emergency medical support (TEMS) protocol by adopting the rescue task force (RTF) model.⁴³⁶

E. PREVIOUS TRAINING AND EXERCISES

According to a public safety review of security at LAX, the LAWAPD actively engaged in tactical training and preparations for active shooter and terrorist events prior to November 1, 2013. LAWAPD calls its training program “MACTAC,” which stands for Multi-Assault Counter Terrorism Action Capabilities. A part of MACTAC protocol involves officers becoming versed in military-style urban assault tactics known as close quarters combat (CQC). In CQC, law enforcement and military operators proactively seek out and engage violent perpetrators, as opposed to taking a defensive posture by waiting outside a secure perimeter. Based on the response times and decisive outcome of this active shooter event, with Paul Ciancia incapacitated with minutes of initiating his assault, it appears the tactical response, which was consistent with MACTAC training, was appropriate and effective.⁴³⁷

In 2012, LAPD hosted the Joint Counterterrorism Awareness Workshop Series (JCTAWS) training session for local, state, and federal public safety agencies in the Los Angeles area participated. JCTAWS are a product of the National Counterterrorism Center (NCTC), the DHS, and the FBI. JCTAWS entails tabletop exercises designed to foster collaboration between federal, state, and local law enforcement entities during complex mass casualty events. There is no indication that the 2012 JCTAWS held in involved active shooter scenarios at LAX, or had any impact on the combined emergency response on during the LAX active shooter event.⁴³⁸

LAFD did not participate in any agency-specific or police integrated training for active shooter events prior to November 2013. According to the Joint Public Safety Review of the LAX shooting conducted by LAWAPD, LAPD, and LAFD, emergency medical service preparations for large-scale emergency medical event at LAX were

⁴³⁶ Ibid.

⁴³⁷ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 14.

⁴³⁸ Ibid., 19.

lacking.⁴³⁹ There was no prior training to enter the LAX terminals during an active shooter event for EMS personnel. This lack of training and preparation adversely affected the ability of paramedics to aid the wounded at LAX. Paramedics possessing the skills and abilities to treat gunshot wounds were held on standby outside the LAX terminals while police searched for additional shooters.

The Joint Public Safety Review also found that there were deficiencies in police and fire department communications during the LAX shooting. A unified command between all fire, police, and EMS personnel was not fully established until 10:14 a.m., which was almost one hour after the first shots were fired inside Terminal 3.⁴⁴⁰ This lack of police and fire department integration hindered emergency rescue efforts. The most seriously wounded victims, Gerardo Hernandez and Brian Ludmer, were not triaged by LAFD paramedics until 9:46 a.m., which was approximately 28 minutes after they were shot. LAFD EMS did not enter Terminal 3 to treat victims of the shooting as it was against existing departmental protocols.

F. ANALYSIS OF EMERGENCY MEDICAL RESPONSE

The emergency medical response to the LAX active shooter incident was hampered by the absence of TECC rescue task forces. The police response was swift; the assailant incapacitated and taken into custody by within seven minutes of opening fire inside the terminal. The first Los Angeles Fire Department ambulance was on scene within 12 minutes of the first shots being fired, and others following in short order. A total of seven individuals were triaged by LAFD paramedics, six of whom were transported to hospitals. One victim, TSA officer Gerardo Hernandez, most likely died before receiving medical treatment; however, no other person died in the LAX active shooter incident. The initial security sweep of Terminal 3 was completed 42 minutes after the event began but only law enforcement personnel were allowed in this area during, and for a prolonged period after the sweeps were completed.⁴⁴¹ It took police over five hours

⁴³⁹ Ibid., 18–19.

⁴⁴⁰ Ibid., 19.

⁴⁴¹ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 68.

to clear all nine LAX terminals and parking facilities.⁴⁴² LAFD paramedics did not enter the terminals during the police security sweeps.

Gerardo Hernandez was the most seriously injured of all of the victims and likely died within minutes of being struck. Due to the extensive nature of his wounds, it is doubtful that he could have been saved. A review of the coroner's report from Hernandez's autopsy indicates that his injuries, which included perforations of his aorta, liver, and a kidney, were not survivable.⁴⁴³ Another victim, Brian Ludmer, suffered a potentially life threatening wound after he was shot in the upper left leg. Subsequent to being struck, Ludmer made his way to a closet to avoid being injured further by the gunman.⁴⁴⁴ The bullet caused extensive vascular damage and bleeding, so Ludmer affixed an improvised tourniquet made from a sweatshirt to his own leg⁴⁴⁵—a technique he learned as a Boy Scout.⁴⁴⁶ Realizing he was in urgent need of medical attention, Ludmer yelled for help. Two police officers pulled him from the closet, placed him in a wheelchair and transported him outside Terminal 2 where LAFD EMS personnel were standing by.⁴⁴⁷

At the time of the LAX shooting the LAFD's standard operating procedure for an active shooter event was to stay outside the secure perimeter until it was declared safe by police.⁴⁴⁸ Such was the procedure that was jointly recognized by LAFD, LAWAPD, and LAPD on November 1, 2013. LAFD, LAPD, and LAWAPD did not have a TECC rescue task force program in place at the time of the shootings. The non-existence of TECC rescue task forces resulted in delayed medical treatment of victims at the scene and a lag in evacuating them to hospitals. In recognition that the emergency medical response to

⁴⁴² Ibid., 69.

⁴⁴³ County of Los Angeles, Department of Coroner, *Case Report and Autopsy Report*, 6–18.

⁴⁴⁴ Richard A. Serrano, Joseph Tanfani, and Kate Mather, "LAX Shooting: Gunman's Rifle May Have Been Ready to Fire in His Bag," November 4, 2013, *Los Angeles Times*, <http://www.latimes.com/local/lanow/la-me-ln-lax-shooting-gunman-rifle-20131104-story.html>

⁴⁴⁵ Darscha Philips, and Melissa McBride, "LAX Shooting: Teacher Hid in LAX Closet w/Gunshot Wound," *ABC Local News*, November 4, 2013, http://abclocal.go.com/story?section=news/local/los_angeles&id=9313205

⁴⁴⁶ Serrano, Tanfani, and Mather, "LAX Shooting: Gunman's Rifle May Have Been Ready to Fire in His Bag."

⁴⁴⁷ Philips and McBride, "LAX Shooting: Teacher Hid in LAX Closet w/Gunshot Wound."

⁴⁴⁸ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 20.

the LAX shooting exposed systemic deficiencies, the LAFD implemented a rescue task force program within weeks of the incident. To date, the LAFD has trained all of its fire captains and is in the process of training and equipping the entire department.⁴⁴⁹ After unveiling the new program via Los Angeles Fire Department Training Bulletin Number 135, Interim Fire Chief James G. Featherstone released a memorandum in which he refers to the department as one of the United States' "trailblazers" in tactical emergency program standardization. This statement emphasizes the point that only a few jurisdictions in the nation have implemented RTF programs.⁴⁵⁰ If a similar situation to the LAX shooting occurs, medical responders will not necessarily wait until the scene is declared safe by police but instead will enter *with* police so they can administer medical treatment to injured victims, and evacuate them to a hospital as soon as possible.⁴⁵¹

LAX is similar to the Aurora mass shooting because it highlights the need for TECC rescue task forces at active shooter incidents. LAFD paramedics responding to active shooting events will now have plans in place to enter *warm zones* at mass casualty event sites accompanied by a dedicated police force protection unit. Warm zones are areas where police have conducted initial sweeps for perpetrators, or where the shooter is may still be present but has been incapacitated.

It took a catalyst such as the 2013 LAX shooting to demonstrate the necessity for LAFD to establish a TECC rescue task force program. The fact that LAFD did not have a rescue task force program in place before the November 2013 active shooter event is not unusual, as most jurisdictions in the U.S. do not have such task forces. LAFD is now among the few departments in the nation that have a formal rescue task program. This thesis will recommended that more jurisdictions take a proactive approach and institute TECC rescue task forces programs before a mass casualty events take place. Having the rescue task forces in place ahead of time will save lives. The next chapter will provide summaries and detailed analyses of the three case studies on mass casualty events that are encompassed in this thesis.

⁴⁴⁹ Featherstone, *Los Angeles International Airport Shooting Incident*.

⁴⁵⁰ Ibid.

⁴⁵¹ Ibid.

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VIII. ANALYSIS

A. INTRODUCTION

The case studies in the previous chapters reviewed and assessed the abilities of particular public safety agencies to provide emergency medical services to victims in three mass casualty incidents. The case studies also evaluated hospital trauma responses during these mass events. The case studies on the Aurora, Boston, and Los Angeles attacks provide insight as to how different police and fire departments provide tactical emergency medical services in mass situations and illustrate the need for TECC rescue task force programs. The Israeli case study examines how hospitals in that country manage casualties occurring in terrorist attacks. Lessons can be learned in terms of what practices and procedures worked well and which were detrimental to rescue efforts. All of the case studies show that active shooter and other terrorist-type events created several logistical and force protection problems for public safety professionals. First responders at these incidents had to contend with multiple casualties as well as the continued threat posed by assailants, while hospitals had to manage numerous casualties simultaneously.

The purpose of the current chapter is to provide summaries and in-depth analyses of public safety agency actions in Aurora, Boston, and Los Angeles after mass casualty incidents. This chapter will examine responses through the lenses of tactical emergency casualty care and the Israeli trauma model. Both of these paradigms are critical components in the provision of emergency medical services at mass casualty events.

B. BOSTON MARATHON BOMBINGS-SUMMARY AND ANALYSIS

The bombings at the Boston Marathon in April 2013 constituted the largest terrorist attack on U.S. soil since the September 11 hijackings. The response by police, fire, and EMS personnel in Boston was near instantaneous. Within seconds of dual blasts, law enforcement officers, firefighters, and paramedics were at the sides of the injured administering first aid. EMS applied tourniquets while police and bystanders used belts and pieces of clothing to stanch arterial bleeding in numerous extremity wounds. The practice of using combat application tourniquets to treat casualties has been highly

developed and refined by U.S. military medical practitioners of tactical combat casualty care in Iraq and Afghanistan over the course of the past decade. Knowledge in treating combat casualties had been transferred from the military to the civilian domain as was evident in Boston. We learn from the public safety response to the Boston Marathon bombings that training for disasters works. Boston is an area in which local, state, and federal public safety agencies regularly participate in joint training exercises, and this greatly has bolstered the emergency medical response to the bombings. Many had actually participated in a tabletop exercise just a few weeks before the 2013 Boston Marathon, and one of the scenarios posited was an improvised explosive device on the day of the race.⁴⁵² This likely helped first responders visualize how emergency medical personnel and assets would deploy if a bomb were detonated at the marathon.

As a result of lessons learned from the U.S. military's TCCC programs, Boston EMS paramedics carry tourniquets, which they used extensively to treat victims of the marathon bombings. Tourniquet use to control hemorrhages is one of the basic tenets of both TCCC and TECC. Also, many of the race's participants and bystanders were active or former U.S. military veterans who had been trained in TCCC protocols, and many of these people used their skills to assist with rescue efforts.⁴⁵³ Using lessons learned from the U.S. military in Iraq and Afghanistan, EMS personnel in Boston recognized the urgency to address bleeding using tourniquets and get victims to hospitals posthaste. After initial treatment was administered, there was a concerted effort among fire, police and EMS personnel to rush victims of the bombings to trauma centers in Boston. The bombing sites were cleared of the most seriously wounded victims within 22 minutes.⁴⁵⁴

Hospital personnel in Boston also participated in extensive training exercises and drills in preparation for mass casualty events prior to the 2013 Boston Marathon. In addition, medical professionals at Boston Hospital learned how to treat large numbers of

⁴⁵² Department of Homeland Security, *Lessons Learned: Boston Marathon Bombings: The Positive Effect of Planning and Preparation on Response*, July 10, 2013, accessed May 31, 2014, <https://www.llis.dhs.gov/sites/default/files/Boston%20Marathon%20Bombings%20Positive%20Effects%20of%20Planning.pdf>

⁴⁵³ Tim Rohan, "War Zone at Mile 26: 'So Many People without Legs,'" *The New York Times*, April 15, 2013, http://www.nytimes.com/2013/04/16/us/witnesses-describe-scene-of-carnage-after-blasts-at-boston-marathon.html?pagewanted=2&_r=5&hp

⁴⁵⁴ Leonard et al., "Why Was Boston Strong?" 8.

trauma casualties from their counterparts in Israel. In the years prior to the marathon bombings, hospitals conducted training and drills designed to ready themselves for IED and other types of mass casualty events. Furthermore, hospital staffs in Boston trained using Israeli trauma methodologies, such as clearing their emergency departments of non-critical patients and designating “micro-sites” consisting of multi-disciplinary teams of surgeons and medical support staff for each patient. This meant that they were in a position to provide definitive medical care once the victims arrived at emergency departments. The emergency medical responses to the Boston Marathon bombings and related events serve as exemplars of for other jurisdictions in the U.S.

The emergency response to the Boston Marathon bombings highlights the need for TECC rescue task force programs. Although Boston did not have a formal TECC rescue task force program in place prior to the bombings, the emergency response between police and fire personnel was fully integrated in TECC-fashion, making it optimal for treatment of mass casualties. It was fortuitous that police, firefighters, and EMS personnel were already at the Boston Marathon finish line when the bombs went off, and they easily refocused their attention on wounded spectators. Once victims were triaged, they were rapidly evacuated to trauma centers, where physicians were able to perform definitive life-saving medical interventions. Police effectively controlled civilian and vehicular traffic at and around the scene of the bombings, which helped facilitate ingress and egress of ambulances. When the fleet of available ambulances was exhausted, police cars were to transport many of the injured to hospitals.

For future mass casualty events, first responders will need to consider how they will mitigate a combined attack in which IED detonations are followed by active shooting assaults. In Israel, Afghanistan, and Iraq, first responders have been the targets of secondary attacks. In order to guard against this, public safety agencies must consider this possibility and have plans in place to mitigate the targeting of first responders. The best way to treat casualties while guarding against additional attacks is a rescue task force. Since the bombings, Boston EMS has initiated a training and operational TECC program based on Arlington County’s RTF. For future mass casualty events, Boston EMS

paramedics will enter *warm zones* with a dedicated police force protection unit.⁴⁵⁵ The establishment of RTFs enhances the abilities of public safety agencies to provide medical treatment in hostile environments.

C. AURORA'S CENTURY THEATER SHOOTING-SUMMARY AND ANALYSIS

At the time of the Century Theater shooting, Aurora public safety agencies did not have a TECC rescue task force program in place. This put first responders at a disadvantage, as the overall response was not fully integrated. The Aurora Fire Department's primary concern during the event was to treat wounded at the theater and then transport them to area hospitals as soon as possible. Fire officials followed the departmental procedures by placing firefighters and paramedics on standby outside the theater while waiting for the scene to be declared safe by police.⁴⁵⁶ This protocol proved detrimental to the rescue efforts when it failed to address the crisis unfolding inside the theater; there were at least 10 people gravely wounded inside the theater, and EMS personnel did not get inside the auditorium for 36 minutes after the first 911 calls were received.⁴⁵⁷ During this crucial period, the only individual present with advanced life support training skills was an Aurora Police Department SWAT team medic.⁴⁵⁸

Simultaneous with the security sweep for the suspect, police officers, firefighters, and EMS personnel collaborated to treat the scores of victims, most of whom had made their way to various locations outside the theater. Some of the most seriously wounded victims inside theater nine were unable to move. As the event unfolded, it became apparent that ambulances could not navigate through the theater's parking lots and access roads because of congestion created by parked vehicles—including many police cars—and the large numbers of moviegoers that flooded outside in the wake of the shooting. This created a perilous situation for victims who were bleeding profusely from gunshot

⁴⁵⁵ Cue and Kearney, "Transitioning To Warm Zone Operations," 24.

⁴⁵⁶ Chuck Murphy, and Karen E. Crummy, "Some of the Most Injured in Aurora Massacre Waited for Help," *The Denver Post*, July 24, 2012, http://www.denverpost.com/breakingnews/ci_21149531/some-most-injured-aurora-massacre-waited-help

⁴⁵⁷ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 162.

⁴⁵⁸ Crummy, and Ilescas, "Aurora Theatre Shooting Report Shows Delays."

wounds and in desperate need of medical aid. Police and fire commanders subsequently made the decision to deviate from protocol by loading 19 victims into police cars and rushing them to area hospitals, a decision that unquestionably saved lives.

Police and fire officials also had the obligation to ensure that the personnel under their command were not placed in any unnecessarily perilous situations. Incident commanders followed existing protocols and placed fire and EMS personnel on standby a safe distance from the building. While police and fire officials arrived on scene quickly, they had difficulty grasping the magnitude of the event. They were initially surprised by the omnipresence of panicked spectators moving about frantically outside the theater and by the high volume of casualties they encountered. This led to confusion and resulted in a communications breakdown over how many people needed medical assistance and where they were located.⁴⁵⁹ One of the Aurora Fire Department's incident commanders initially thought there were a total of only 20 casualties at the site,⁴⁶⁰ when in fact there were more than four times that many.⁴⁶¹ Police officers deploying at the scene parked their vehicles in a manner that prevented ambulances and fire trucks from navigating through the theater's parking lot and access roads, which added to the turmoil. As a consequence, many of the emergency responders were unable to reach their intended destinations.

Police also had difficulty containing the 1,200 people who amassed outside the theater. Consequently, police officers and EMS personnel deluged by multitudes of terror-stricken survivors of the shooting, which hindered the triage and evacuation processes. The congestion outside the theater made it impossible for ambulances to reach all of the victims in need of medical assistance.⁴⁶² As a result, police cars and privately owned vehicles transported the majority of those wounded to area hospitals. While speed of movement from the point of injury to the hospital is important in traumatic events, it is also important that patients receive medical treatment on scene and while in transport, and EMS personnel can best achieve this in ambulances. In Aurora, those who were

⁴⁵⁹ Murphy, and Crummy, "Some of the Most Injured in Aurora Massacre Waited."

⁴⁶⁰ Ibid.

⁴⁶¹ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 42.

⁴⁶² Murphy, and Crummy, "Some of the Most Injured in Aurora Massacre Waited."

transported in police cars arrived at the hospital quickly but received little if any treatment while they were in transit.⁴⁶³

Hospitals in Aurora were well prepared to treat victims of this mass casualty event. Aurora hospitals regularly participated in drills, training, and exercises in the months and years leading up to the event. Each hospital had a robust disaster plan in place, and just as importantly, each hospital had skilled and dedicated physicians, nurses, and technicians on hand. Attending physicians coordinated medical teams and treatment plans for each patient. Furthermore, hospital employees, such as custodians and housekeeping staff who do not typically assist in medical situations, were called into action. Aurora hospitals management of Century Theater shooting victims very closely mirrored the Israeli hospital model for dealing with mass casualty events. In a similar manner to the Israeli accordion approach, the two attending physicians inside the University of Colorado Hospital (UCH) emergency department acted as surgeons in charge (SIC). They conducted initial assessments of each patient and determined who was in greatest need of medical intervention. Some of the victims were near death when they arrived at UCH and needed immediate surgery. The attending physicians prescribed the treatment plan for each patient and then continually monitored each one's status. At various junctures, they summoned specialists from various disciplines to attend to patients based on injury patterns. UCH would ultimately treat 23 victims of the shooting, which was the highest number of any hospital. One of these victims arrived without any vital signs and hospital staff were unable to resuscitate. However, the other 22 victims brought to UCH survived, in large part to the speed in which they were transported from the theater to the emergency department and the expert medical attention they received after arriving at the hospital.

Aurora's hospitals ensured that there was adequate numbers of staff in the emergency department to perform triage on Century Theater shooting victims.⁴⁶⁴ Hospital supervisors convened approximately 30 minutes after the first victims arrived

⁴⁶³ Michael Muskal, and Jenny Dean, "Cop Transporting Movie Shooting Victims Says Blood Sloshed in Car," *Los Angeles Times*, January 7, 2013, <http://articles.latimes.com/2013/jan/07/nation/la-na-nn-police-james-holmes-theater-shooting-20130107>

⁴⁶⁴ TriData Division System Planning Corporation, *Aurora Century 16 Theater Shooting*, 70, 72.

activated their disaster plan. As part of this plan, an incident command center was established at UCH so that information could be received and disseminated more efficiently during the crisis.⁴⁶⁵ Additional surgeons and other essential staff members were contacted at their homes, and some reported to the hospital's emergency department within 20 minutes of being notified of the shooting event.⁴⁶⁶ There was a particular need for trauma surgeons, neurosurgeons, vascular surgeons, radiologists, and orthopedic specialists to deal with penetrating wounds suffered by the victims.⁴⁶⁷ Even housekeepers and custodial staff were called in to assist. The emergency department at UCH filled with over 100 staff members, all of who were focused on patient care.⁴⁶⁸ Four operating rooms were prepared and staffed for surgery within 30 minutes of notification of the incident, and an additional five were established over the course of the next hour.⁴⁶⁹ Making practical use of all available space, a storage room in the emergency department was converted into a triage area.⁴⁷⁰ Understanding that survivors of the shooting were hemorrhaging profusely, doctors and nurses prepared transfusion systems and requested blood products from the hospital's blood bank.⁴⁷¹ Because of the high numbers of casualties from the shooting, it became necessary to augment the existing supply from a local blood center, and a total of 185 units of blood products were delivered to the UCH.⁴⁷² By requesting additional blood, the UCH staff demonstrated foresight, realizing that the many victims of the Century Theater shooting would need infusions of blood once they arrived at the emergency department. Personnel assigned to the incident

⁴⁶⁵ Smith, "Rapid Response to 23 Victims," 1.

⁴⁶⁶ Sanders, Conroy, and Conroy, "When Disaster Strikes."

⁴⁶⁷ Erica Goode, "The Night The E.R. Staff Can Never Forget," *The New York Times*, August 16, 2012, http://www.nytimes.com/2012/08/17/us/colorado-mass-shooting-tested-an-er-staff.html?pagewanted=all&_r=0

⁴⁶⁸ Ibid.

⁴⁶⁹ Sanders, Conroy, and Conroy, "When Disaster Strikes."

⁴⁷⁰ Goode, "The Night The E.R. Staff Can Never Forget."

⁴⁷¹ Neff, "A Night in the ED," 1.

⁴⁷² Smith, "Rapid Response to 23 Victims," 1.

command center also directed extra supplies delivered to the emergency department, such as code carts, medical tubing, and portable code carts.⁴⁷³

When responding to a mass casualty event, it is important for first responders to maintain situational awareness and have plans in place for cumulative deployment of personnel and resources as they arrive on scene. Police officers and firefighters responding to these events need to know exactly where to go and what tasks need to be carried out at active shooter and mass casualty incidents. Police need to stop assailants from wounding additional victims and provide force protection to EMS personnel. EMS technicians need to have unimpeded access to the wounded. The best way to deliver emergency medical services at active shooting events, such as the Century Theater incident, is with a TECC rescue task force.

D. LAX SHOOTING-SUMMARY AND ANALYSIS

The police reaction to the LAX shooting was prompt and was the greatest strength of the overall public safety effort. Law enforcement officers assigned to the airport had trained specifically for an active shooter situation. When confronted with an assailant armed with an assault rifle, police officers were able to incapacitate him within a relatively brief time. They also had to conduct security sweeps of nine passenger terminals and adjacent parking facilities. Police contributed to the emergency medical effort by moving victims from inside Terminal 3 to the triage area staged outside of Terminal 2. The emergency medical response to the shooting proved to be problematic, though the initial EMS deployment was rapid. LAFD EMS personnel followed established protocols by assembling in a safe area at curbside arrival outside Terminal 2 while waiting for the “all clear” pronouncement from police inside the terminal. However, this strict adherence to procedures was a problem at the LAX shooting incident. The police security sweep of Terminal 3 took approximately two hours to complete, and it took a total of five hours to clear the entire LAX complex. These times are not out of the ordinary for active shooting events. In such situations, police must methodically check for additional threats. In this case, the assailant was apprehended at

⁴⁷³ Ibid., 3.

9:25 a.m., approximately seven minutes after he fired the first shots. By this time, or shortly thereafter, LAFD paramedics could have entered Terminal 3 to initiate medical treatment and evacuate victims for definitive medical care.

The EMS response to the LAX incident is typical for active shooting events in the U.S.: firefighters remained on standby for an inordinate period while casualties laid waiting for medical attention. At LAX, once the shooter was taken into custody by law enforcement, Terminal 3 of LAX had become a warm zone. This is the type of situation for which the TECC rescue model is designed. Under the rescue task force model, LAFD would enter the active shooter site with a dedicated force protection unit comprised of police officers. The police officers assigned to the RTFs' sole function would be to maintain the integrity and safety of the task force. If the scene remains stable, the paramedics move quickly to the wounded administer exigent lifesaving procedures and then evacuate wounded to hospitals. If conditions deteriorate into a hazardous situation, the force protection unit can resolve by neutralizing any threats or by withdrawing with the paramedics to a safe area. Neither LAFD command staff nor firefighters can be faulted for following established training and protocols. At the time of the LAX shooting, the LAFD's standard operating procedure for an active shooter event was to stay outside the secure perimeter until the scene was declared safe by police.⁴⁷⁴ Such was the procedure that was jointly recognized by LAFD, LAWAPD, and LAPD. This status quo response resulted in delayed medical treatment of victims at the scene and a lag in evacuating them to hospitals.

The LAX shooting in November 2013⁴⁷⁵ accentuates the need to have a TECC rescue task force response at mass casualty events. A rescue task force response gives EMS personnel the ability to access, treat, and evacuate wounded under the protection of a police force protection unit. Recognizing that the emergency medical response to the LAX shooting exposed systemic deficiencies, the LAFD implemented a rescue task force program within weeks of the incident. LAFD paramedics responding to active shooting events now have plans in place to enter *warm zones* at mass casualty event sites

⁴⁷⁴ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 20.

⁴⁷⁵ A separate active shooter event took place at LAX on July 4, 2002.

accompanied by a dedicated police force protection unit. The LAX active shooter incident is similar to the Aurora mass shooting because it highlights the need for better police and fire department coordination and integration at mass casualty events. Also, these events show the need for paramedics to be able to access and treat the wounded without delay.

E. CONCLUSION

Analyses of the case studies discussed in this chapter illustrate how some police and fire departments in jurisdictions across the U.S. prepared for and responded to active shooter and other types of terrorist events and demonstrates the need for TECC rescue task force programs. In the Aurora and Los Angeles active shooter events, the most significant problems encountered involved delays in providing emergency medical treatment to the wounded on scene. Neither Aurora nor Los Angeles public safety agencies had TECC rescue task force programs in place prior to the active shooter incidents detailed in this thesis. During the time that these shootings transpired, both jurisdictions had policies in place that precluded firefighters from entering the scene of an active shooting. Also, in both the Aurora and LAX incidents, the perpetrators were taken into custody within minutes of police arriving on scene, and therefore, no longer posed any type of threat. However, firefighters had difficulty rendering medical assistance because they remained on standby instead of working as part of an integrated rescue task force with police. The Aurora police and fire departments have since instituted a high-risk extraction protocol (HREP) since the Century City incident,⁴⁷⁶ and the Los Angeles Fire Department has remedied the response deficiencies exposed during the LAX shooting by adopting the rescue task force model pioneered by the Arlington County (Virginia) Fire Department.⁴⁷⁷

⁴⁷⁶ Megan Verlee, "Outgoing Aurora Police Chief Reflects on his Time at the Department," *Colorado Public Radio*, May 31, 2014, <http://www.cpr.org/news/story/outgoing-aurora-police-chief-reflects-his-time-department>.

⁴⁷⁷ Robert J. Lopez, and Ben Welsh, "L.A. Fire Department Dramatically Overhauls Response To Shootings," *Los Angeles Times*, December 22, 2013, <http://articles.latimes.com/2013/dec/22/local/la-me-ems-response-20131223>

In the Boston and Aurora mass casualty incidents, area hospitals were required to take extraordinary measures to treat high volumes of trauma patients. Prior to their respective events, hospitals in both of these locations had conducted training drills and exercises in preparation for mass casualty events. Additionally, hospitals personnel in Boston learned from Israeli trauma specialists. While the research in this thesis does not indicate where Aurora hospitals learned how to handle large numbers of trauma patients, their response was very similar to the Israeli archetype.

For future mass casualty incidents, police, fire, and EMS professionals will need to be prepared to manage greater numbers of injured than were encountered in Aurora, Boston, and Los Angeles. Based on availability of human targets, the casualty counts in each of these events could have been much higher. For example, at the incident in Aurora, the assailant, James Holmes, shot 70 people, and there were approximately 400 people in the theater, and another 800 moviegoers were in adjacent theaters. Holmes' assault rifle was reported to have jammed during the rampage, which likely resulted in far fewer people being wounded; he had hundreds of unspent rounds of ammunition in his possession when the police took him into custody.⁴⁷⁸ Similarly, the perpetrator of the LAX 2013 shooting had hundreds of rounds on his person and access to hundreds of victims in LAX's Terminal 3.⁴⁷⁹ And the Boston marathon bombers timed the explosive devices to detonate at point when the race's finish line would be the most crowded.⁴⁸⁰ If the bombs had been more powerful, many more people would have been seriously injured.

The next and final chapter will offer conclusions and recommendations for the implementation of tactical emergency casualty care (TECC) rescue task force programs and Israeli-trauma center protocols in jurisdictions across the United States. Tactical emergency medical programs and hospital preparedness initiatives are essential to ensure

⁴⁷⁸ Candiotti, "Colorado Shooter's Rifle Jammed during Rampage."

⁴⁷⁹ Los Angeles World Airports, *Active Shooter Incident and Resulting Airport Disruption*, 60.

⁴⁸⁰ Chris Kirk, "Did the Boston Marathon Bomber Time the Explosions to Guarantee the Most Possible Casualties?," *Slate*, April 16, 2013, http://www.slate.com/blogs/the_slatest/2013/04/16/boston_bombs_timing_were_the_marathon_attacks_timed_to_maximize_casualties.html

that communities in all parts of the U.S. are ready to respond to active shooter and terrorist attacks.

IX. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The previous chapter provided analyses of the three case studies of mass casualty incidents detailed in this thesis: Aurora's Century Theater mass shooting, the Boston Marathon bombings, and the Los Angeles International Airport active shooter event. This chapter will present the findings, conclusions, and recommendations of this thesis.

A. FINDINGS

This thesis sought to answer the research question: why are tactical emergency casualty care rescue (TECC) task force (RTF) and Israeli hospital trauma programs the best approaches to addressing the current gaps and weaknesses in trauma management in the United States in the context of terrorist attacks and/or active shooter incidents?

To find answers to these questions and in an effort to develop a model for other jurisdictions to consider, specific case studies were undertaken to examine how public safety agencies in three communities across the U.S. responded to mass casualty events. Additionally, a case study on the Israeli trauma system was conducted to explain how physicians in that country manage mass casualty situations, and what it is necessary for hospitals in the U.S. to emulate the Israeli approach. The contentions of this thesis are that civilian TECC rescue task force programs, based on U.S. military's prototypical TCCC system for treating combat casualties in the field and Israel's model for managing mass casualties at the hospital, are necessary to save the lives of people injured in acts of mass violence. Active shooter events are on the rise in the United States and require an integrated law enforcement and EMS response with TECC rescue task forces. These task forces involve highly trained firefighters and EMS personnel working in tandem with police force protection units to administer on-scene medical aid and rapidly evacuate victims to hospitals. Active shooter incidents and terrorist attacks also necessitate hospitals that are capable of managing large numbers of trauma patients simultaneously.

Chapter II consisted of a literature review, which showed that lessons learned from the U.S. military and the Israeli hospital system are slowly making their way to the civilian domain in the United States. Over the course of the past two decades, the U.S.

military has developed a dynamic new emergency medical program known as tactical combat casualty care. There is compelling data to support military researchers' contentions that TCCC in saves lives at unprecedented rates on battlefields. TCCC addresses the need to get medical attention to wounded combatants at the point of injury and to rapidly evacuate them to definitive care. In TCCC, medics prioritize the leading causes of preventable death on the battlefield: bleeding, collapsed lungs, and airway obstructions. Once a patient is stabilized in the field, they must rapidly evacuate to a hospital. This is achieved with specially trained medics working in conjunction with a force protection unit designed to keep the medics safe and assist with casualty evacuation. The literature on TCCC also validates the use of modern tourniquets to treat extremity hemorrhaging. Tourniquet use essentially buys time for first responders to get individuals suffering from extremity hemorrhages to the hospital for definitive, life-saving treatment.

The research undertaken for this thesis found that hospitals in Israel are adept in the care of mass casualties stemming from the large number of suicide attacks on its civilian population. Trauma physicians in Israel developed a unique system—known as the *accordion approach*—for trauma care of large numbers of people injured in bombings.⁴⁸¹ Data analyzed for this thesis indicates Israeli trauma centers have lower case fatality rates than trauma centers in the U.S. Israeli emergency medicine is predicated on training and drills, standard operating procedures, and surge capacities for mass casualty incidents. From the accordion approach, Israeli hospitals have advanced a flexible *all hazards approach* to mass casualty events.⁴⁸² This means that they train and prepare for any type of disaster—whether it is a terrorist attack or natural disaster—which might result in large numbers of injuries. Israeli medical experts have found that the processes that work well for suicide bombings are also suitable for other types of medical emergencies in which multitudes of people are injured.

Chapter III provided a historical perspective of the creation and development of tactical combat casualty care after the Battle of Mogadishu in 1993, and the beginnings of

⁴⁸¹ Almog et al., "Suicide Bombing Attacks," 301.

⁴⁸² Adini, and Peleg, "On Constant Alert: Lessons to be Learned," 2179.

domestic tactical emergency casualty care programs, such as TECC rescue task forces, in the U.S. The need for such programs at active shooter events was first made apparent by the Columbine High School massacre in 1999. Chapter IV chronicled the evolution of the Israeli trauma model, which is focused on treating victims of suicide bombings and other mass casualty incidents with multi-disciplinary teams of trauma specialists working under the guidance of senior doctors.

The case studies discussed in Chapters V, VI, VII, and VIII covered recent mass casualty events that took place in U.S. cities. Each identified critical areas of strengths and weaknesses of public safety agency responses to these events. In Boston, the public safety and hospital responses to the marathon bombings were estimable because first responders and medical professionals were on scene at the race's finish line when the bombs exploded, and they went to work immediately to treat the injured. Many first responders had training in TCCC techniques, such as tourniquet application, and they made extraordinary efforts to transport victims of the bombings to hospitals rapidly. Staffs at Boston hospitals were ready to provide medical care to large numbers of severely injured patients because they had trained under the tutelage of physicians in Israel, whom in turn, had acquired knowledge in treating traumatic casualties in the wake of suicide bombings over the past two decades.

In Aurora, public safety resources were initially overwhelmed by the high number of casualties, concerns about the possibility of additional assailants and the specter of hidden improvised explosive devices at the scene. Aurora public safety agencies did not have a TECC rescue task force program in place at the time of the Century Theater shooting, and this hindered the treatment of victims at the scene. When it became apparent that EMS personnel could not reach many of the wounded, public safety officials deviated from existing protocols and rushed casualties to area hospitals in police cars. While this decision saved lives, it was not optimal because victims did not receive medical treatment during transport. It took a combined effort of police officers, firefighters, paramedics, and even civilians to get victims to definitive care, but the overall response, in terms of on-site triage and evacuation, was successful. However, had there been additional casualties or had the hospitals been a greater distance away from the

point of injury than they were in Aurora, the loss of life could have been far greater because of the absence of TECC rescue task forces.

Hospitals in Aurora were well prepared to handle multiple casualties from the event because they trained and drilled in for mass casualty incidents in the years leading up to the shooting, and the exemplary performance of doctors, nurses, and other staff members at area medical facilities was a major factor in victim survivability. At LAX, the police response was swift, but the emergency medical response lagged because existing protocols required EMS personnel to remain on standby outside the secure perimeter, and they were consequently unable to access those persons who were seriously wounded inside the terminal complex.

These case studies illustrate the urgent need for integrated police and emergency medical service responses to mass casualty events. Optimal care of wounded in such episodes can only take place if law enforcement, emergency medical service, and hospital personnel work in synchronicity. The best way to achieve successful outcomes at mass casualty incidents is the establishment of TECC rescue task force programs and Israeli-style hospital trauma protocols. Victims sustaining injuries due to gunfire and explosive fragmentation require immediate treatment on scene, which primarily addresses bleeding, followed by rapid transport to the hospital. Hospitals with personnel trained in advanced trauma care protocols are needed to treat numerous victims of active shooter incidents, terrorist attacks, and other types of hazards. The nation of Israel has developed the prototypical system for the management of large numbers of mass casualties, and the procedures employed by Israeli trauma physicians can be replicated in the U.S.

The Century Theater shooting shows us why TECC rescue task forces, used in conjunction with skilled hospital trauma care, is essential to saving the lives of those injured in active shooter situations. If the response is not unified, victims will go without medical attention and run the risk of dying from penetrating trauma injuries, such as gunshot wounds and explosive fragmentation. Police and fire department incident commanders must coordinate vehicular and personnel deployment so that crowds can be controlled, and ingress and egress access areas remain clear of obstacles. Since the Century Theater shootings, public safety departments in Aurora have established high-

risk extraction protocols (HREP) in order to facilitate the medical treatment and evacuation of wounded people from active shooter sites.

From Boston, we know that TCCC methods, such as tourniquet applications and other hemorrhage control techniques, are effective. Additionally, scenario-based training can prepare first responders and hospital personnel for mass casualty events. We also see the value of an integrated police, firefighter, and EMS response to disasters. We may also observe how lessons learned from TCCC play a role in the civilian realm in the U.S. EMS personnel in Boston now carry tourniquets, and many of the first responders in Boston, have military experience, which ostensibly included TCCC training.⁴⁸³ Leaving nothing to chance since the marathon bombings, Boston has initiated a program modeled after the Arlington County Fire Department's rescue task force. The successful emergency medical response to the marathon bombings involved another critical component-expert hospital trauma care. Staff members at hospitals, such as Massachusetts General, had consulted with Israeli trauma surgeons on a regular basis in the years prior to the bombings, and consequently they had embraced many Israeli practices, such as clearing of space in emergency rooms, bringing in extra physicians and other medical personnel, and having a seasoned trauma doctor examine each casualty as they arrived. A designated medical team was also assigned to each patient to ensure comprehensive care and continual triage.

The emergency medical response to the LAX active shooter event was not optimal, but it is archetypical for most communities in the United States. Prior to the November 2013 active shooter incident, there was no TECC rescue task force in Los Angeles. Los Angeles Fire Department firefighters followed established protocols and went into a standby mode outside of LAX's terminal buildings while police cleared the scene inside. Unfortunately, this resulted in a significant delay in getting medical treatment to the wounded. LAFD paramedics did not enter the passenger terminals at LAX to treat the wounded, and they had to depend on police officers had to move victims from the interior of the terminal to the LAFD triage area outside. Once casualties were

⁴⁸³ Leonard et al., "Why Was Boston Strong?" 8.

brought to the LAFD triage area, they were administered first aid and eventually transported to the hospital. Just weeks after the LAX shooting, the Los Angeles Fire Department officially changed its response protocol for an active shooter incident by instituting a rescue task force program. LAFD firefighter paramedics now train for and are prepared to enter *warm zones* with a police escort at active shooting scenes. This represents a paradigm change for the department, and it is a positive development that will undoubtedly pay dividends in saved lives during future mass casualty situations.

B. CONCLUSIONS

The typical jurisdiction in the United States is not ready for an active shooter event or a terrorist attack resulting in mass casualties. The nation as a whole is unprepared to get medical assistance to the wounded in these events. This is because most public safety jurisdictions do not have TECC rescue task force programs in place that would enable EMS personnel to enter the scenes of mass casualty events assimilated with law enforcement. Due to this systemic deficiency, the nation is particularly vulnerable, and lives will be unnecessarily lost due to the inability to get medical attention to the wounded during high threat situations.

It is difficult to predict where and when mass casualty incidents will occur, which makes planning, preparation, and visualization for them difficult. Unfortunately, active shooter incidents are taking place across the U.S. with increasing degrees of regularity and lethality. The Boston Marathon bombing is also a likely harbinger of future terrorist attacks from homegrown terrorists using improvised explosive devices in crowded areas. Therefore, it is necessary that public safety officials demonstrate foresight and make the necessary changes that will affect the paradigm change of having special trained and equipped paramedics make entry into warm zones at mass casualty events.

Public safety jurisdictions lacking specialized rescue task force units or tactical emergency casualty care programs are leaving themselves susceptible to disaster. Active shooter incidents and terrorist attacks require an integrated police, firefighter, and EMS response, and TECC programs must be in place before an event occurs. This means that

law enforcement and emergency medical service personnel must train together and have explicit plans in place for response to high threat, mass casualty situations.

Another vital component of mass casualty care is having hospital systems in place that are prepared and capable of handling multiple trauma patients simultaneously. Hospital staffs in Boston learned about the treatment of mass casualties—and in particular how to respond to improvised explosive devices—from their counterparts in Israel. They trained and drilled for an event in which Boston hospital emergency departments would be inundated with trauma patients. Hospitals in Boston were able to manage hundreds of casualties seamlessly because they understood Israeli concepts such as surge capacity and having an experienced trauma physician triage and then manage each victim's curative plan.

C. RECOMMENDATIONS

In *Thinking in Systems*, Donatella Meadows posits that there are leverage points that can be used to change systems.⁴⁸⁴ The shift from the status quo to a national standard for tactical emergency casualty care programs necessitates a paradigm change. Leverage points, as defined by Meadows, are needed to bring such a paradigm change about. A national standard is necessary to ensure that emergency medical services are quickly and efficiently rendered at active shooter incidents and other terrorist events.

The most sensible approach to deliver these emergency medical services is the TECC rescue task force model pioneered by the Arlington County Fire Department in Virginia. Establishment and implementation of TECC rescue task forces require funding for equipment and joint tactical training. Police officers assigned to these task forces provide force protection to EMS personnel as they enter *warm zones* to administer first aid. Additionally, fire and EMS departments need to equip their personnel to participate in rescue task forces. Basic equipment for firefighter paramedics assigned to rescue task forces include combat application tourniquets (C.A.T.s), hemostatic bandages, thoracic needles, and nasopharyngeal airways, and first responders need this gear to address hemorrhaging and breathing impediments. Just as importantly, firefighters and EMS

⁴⁸⁴ Meadows, "Thinking in Systems: A Primer," 145–146.

personnel assigned to rescue task forces will need to have access to specialized personnel protection equipment—specifically level III body armor and helmets—because they will be entering high threat areas and run the risk of being exposed to gunfire. Level III body armor is designed to stop projectiles fired from assault rifles, which have been frequently used in active shooter attacks, including those that transpired at Century Theater in Aurora and LAX.

Congress, DHS, and FEMA must identify funding mechanisms that will meet the needs for TECC rescue task force training and equipment. FEMA’s Assistance to Firefighters Grant (AFG) program would be a logical source for rescue task force funding. In terms financing for firefighting activities in the United States, there is a complex relationship between the federal government and local governments. Up until the 1990s, firefighting and EMS departments were generally funded by state and municipal governments. This changed after members of the firefighting community requested federal augmentation of local fire departments to compensate for budget insufficiencies and increased responsibilities, such as providing emergency medical services that were not previously firefighter functions.⁴⁸⁵ As a result of the recognized need for federal assistance, the Assistance to Firefighters Grant Program (AFG) was established in 2001. Since the AFG program’s inception in 2001 through fiscal year 2013, Congress appropriated over \$6 billion to firefighter assistance.⁴⁸⁶ The AFG program is designed to help fire departments obtain equipment and facilitate training to enhance firefighter safety and bolsters departmental capabilities to provide emergency services during fires and other analogous perils. Fire and EMS departments that establish TECC programs would be worthy recipients for Assistance to Firefighter Grants.

Additional funding for rescue task forces may be obtained through the Homeland Security Grant Programs, such as the State Homeland Security Grant Program (SHSP), which has \$401,346,000 available in fiscal year 2014 and the Urban Areas Security

⁴⁸⁵ Lennard G. Kruger, *Assistance to Firefighters Program: Distribution of Fire Grant Funding* (CRS Report No. RL32341) (Washington, DC: Congressional Research Service, 2013), 1.

⁴⁸⁶ *Ibid.*, 4.

Initiative (UASI), which has \$587,000,000 appropriated for fiscal year 2014.⁴⁸⁷ FEMA administers both the AFG and Homeland Security Grant Programs. As funding is made available for rescue task forces, FEMA administrators will need to collaborate with decision makers at the local government level, including elected officials, fire, and EMS chiefs to determine specific training and equipment needs in various jurisdictions. It is incumbent upon Congress, DHS, and FEMA to require local jurisdictions requesting various types of homeland security grants to establish tactical emergency casualty care programs with any designated funding.

As part of increased preparedness across the country, police officers need training in hemorrhage control techniques and should be issued combat application tourniquets and hemostatic agents. Law enforcement will likely be the first public safety professionals to respond to the scene of mass casualty event and may have to render first aid before firefighters and EMS arrive on scene. Police officers are also frequently wounded themselves at active shooter incidents, and they must acquire knowledge on administering self-aid techniques. Police departments across the country should also learn lessons from the Aurora and Boston mass casualty incidents and prepare to transport casualties to hospitals when ambulances are unavailable.

There is a need for hospitals in the United States to emulate the Israeli hospital methodology for treating mass casualties. The Israeli all-hazards approach works well for any type of large-scale trauma event. The provision of comprehensive care during active shooter events, terrorist attacks, and natural large-scale medical emergencies, requires that hospitals conduct training exercises and establish standard operating procedures to handle a high volume of seriously injured or sick people. All available hospital personnel should be assigned specific tasks or be assigned to a pre-designated medical team. An experienced trauma surgeon (modeled after the Israeli surgeon in charge concept) must examine each patient as he or she arrives at the hospital to ensure they are triaged appropriately. This surgeon is then responsible for monitoring each patient's treatment plan and recuperative progress. Israeli physicians have found that under-triage inevitably

⁴⁸⁷ Federal Emergency Management Agency, "FY 2014 Homeland Security Grant Program," accessed October 18, 2014, <http://www.fema.gov/fy-2014-homeland-security-grant-program-hsgp>

occurs at hospitals in the wake of IED attacks, and therefore victims need to be re-examined until all injuries are diagnosed and treated.⁴⁸⁸

Additionally, it is recommended that hospitals in the U.S.—particularly the emergency rooms—be designed similarly to those in Israeli hospitals. It is crucial that emergency departments be designed with simple, easy to navigate layouts. For example, in Israeli hospitals, equipment is mounted on the ceiling (freeing up floor space for medical teams to move about freely) and extra supplies are stockpiled and are clearly marked so they are readily accessible when mass casualties arrive at the hospital. Hospitals in Israel use all available space during mass casualty events, including storage rooms and hallways. This may necessitate the installation of oxygen lines and other medical apparatuses at hospitals in advance of circumstances in which influxes of patients arrive at a pace that is beyond normal operational capacity.

Funding for improvements in hospital capabilities may be available through the U.S. Department of Health and Human Services' Hospital Preparedness Program (HPP), which is designed to assist communities enhance operational capacities during disasters. In fiscal year 2014, a total of \$228,500,000 in Hospital Preparedness Program and Hospital Preparedness Funding was allocated to 50 states, as well several U.S. territories.⁴⁸⁹ HPP funding grants would be the sensible vector to fund equipment and training based on the Israeli model to U.S. hospitals across the nation. While funding is critical, some experts in the emergency medical community argue that disaster preparedness in hospitals can be enhanced by the incorporation of sound emergency medical practices into day-to-day regimens.⁴⁹⁰

Interoperability between the first responder community and hospital staffs is also a vital component in the provision of comprehensive resources to mass casualty events. Hospital personnel need to participate in joint training exercises along with police, fire,

⁴⁸⁸ Almogy et al., "Suicide Bombing Attacks," 300.

⁴⁸⁹ U.S. Department of Health and Human Services, "Hospital Preparedness Program-2014 HPP and PHEP Funding Tables," Office of the Assistant Secretary for Preparedness and Response, accessed October 16, 2014, <http://www.phe.gov/Preparedness/planning/hpp/Documents/hpp-phep-2014funding.pdf>

⁴⁹⁰ Kellerman, and Peleg, "Lessons From Boston."

and EMS professionals. Furthermore, personnel from multiple disciplines will need to practice together for large-scale medical events. Such collaboration is necessary to provide medical care for victims of active shooter, terrorist attacks, and natural disasters.

DHS Office of Health Affairs (OHA) currently facilitates dialogue between state, local and regional first responders. DHS OHA is also working to ensure that lessons learned from tactical combat casualty care are transferred to the civilian realm in the United States. In February of 2014, DHS OHA hosted a two-day stakeholder engagement meeting with police, fire, and EMS first responders from around the nation to discuss ways in which to improve survivability in active shooter and terrorist incidents.⁴⁹¹ DHS OHA should increase these efforts by hosting similar stakeholder engagement meetings on a regional basis across the U.S. In addition, DHS OHA should also guide local and state agencies through the various grant application processes. Moreover, this thesis recommends that DHS OHA collaborate with the American College of Surgeons to establish a national trauma registry based on the Israeli and U.S. military models. A national trauma registry would give medical researchers the ability to collect and analyze data on traumatic events, including active shooter and mass casualty events to look for ways to improve care and increase survivability through enhanced trauma care.

Further research can build on this thesis to identify funding, legislative, and educational mechanisms to ensure that TECC rescue task force and Israeli hospital trauma programs are proactively implemented. As is evident in the case studies of this thesis, the current leverage point for establishment of formal tactical emergency medical programs is a violent event in which mass casualties transpire, such as the active shootings that took place in Aurora and Los Angeles and also the Boston Marathon bombings. Each of these jurisdictions formally embraced TECC concepts by adopting rescue task force programs *after* mass casualty events in each of their respective communities. New, proactive leverage points for the establishment of TECC rescue task

⁴⁹¹ Department of Homeland Security, Office of Health Affairs, “Event Summary: Stakeholder Engagement on Improving Survivability in IED and Active Shooter Incidents,” accessed October 6, 2014, <http://www.naemt.org/Files/LEFRTCC/Improving%20Survivability%20in%20IED%20and%20Active%20Shooter%20Incidents.pdf>, 1–7.

force and Israeli hospital trauma programs must be identified by policy makers and public safety leaders.

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