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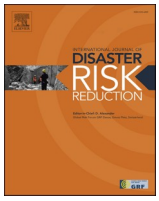

"Shots fired! We have many people down!": Common recommendations for managing high-casualty active shooter events in the USA

Aaron Duron

ALERRT, School of Criminal Justice and Criminology, Texas State University, 601 University Drive, San Marcos, TX, 78666, USA

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ABSTRACT

Active shooter events are disasters that continue to impact communities and people in the United States. Responses to active shooter events by first responder organizations have improved since the Columbine event; however, problems still exist in these responses. Using systems theory and the qualitative method known as thematic analysis, the purpose of the current study was to examine the recommendations provided in after-action reports of high-casualty active shooter events to identify improvements that can be made by first responder organizations to provide a more effective response to active shooter events. Three main themes were identified and are discussed.

1. Introduction

On February 14, 2018 at around 2:21 p.m., shots were fired from an AR-15 style rifle at Marjory Stoneman Douglas High School located in Parkland, Florida. The nineteen-year-old shooter killed eleven and wounded thirteen people in less than two minutes as he walked through the first-floor hallway of the building. The attacker continued to move throughout the building while shooting people. In less than four minutes, a total of seventeen people were killed and seventeen people were wounded. The attacker was later arrested by law enforcement officials [1].

Although situations like the shooting described above are difficult to manage, the loss of life may have been exacerbated by the problems encountered by the first responder organizations that responded to the active shooting. Identifying the problems encountered by these organizations and providing recommendations for how to improve the response was one of the tasks assigned to the Marjory Stoneman Douglas High School Safety Commission. This commission created a report analyzing the response to the active shooter event. Some of the problems mentioned in the report included: (1) the response of the Broward Sheriff's Office (BSO) was hindered by sporadic functioning of radios, (2) due to the absence of a policy requiring them to wear the vests regularly, some BSO deputies took time to put on ballistic vests even though they were hearing active gunfire, (3) law enforcement officers were confused as to what rooms were cleared in the building, (4) mass confusion was present about the role of the staging area and the location of the command post due to ineffective radio communications, (5) the poor sharing of resources between the Broward County Public School and law enforcement officials delayed victim prehospital care, (6) the lack of continued active shooter training led to a poor response by BSO deputies, and (7) the law enforcement and fire department command posts were not unified [2].

A poor response to disasters, such as an active shooter event, potentially leads to more wounded victims, more deaths, and an increased risk of danger to first responders. The list above illustrates some of the numerous problems encountered by organizations responding to an active shooter event. No response to an active shooting is perfect and every response will inevitably have problems. However, it is possible that similar problems are experienced across active shooter events in general, thus leading to similar recommendations for improved responses in future situations.

To date, little academic research has attempted to systematically identify how different first responder organizations, such as law enforcement agencies, Emergency Medical Services (EMS), and fire departments, can better prepare to have a more effective response during active shooter events. Callaway [3] suggested that one of the problems current emergency and trauma systems face is the identification of best practices that apply to all those who might be involved in the rapid response to events such as an active shooting. Using the qualitative method known as thematic analysis, the current study addresses this problem by identifying themes from the recommendations of after-action reports (AARs) of select active shooter events to identify what organizations can do to better respond to future active shooter events.

E-mail address: a_d185@txstate.edu.

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2. Literature review

2.1. Active shootings in the United States and the response during Columbine

The FBI defines an active shooting as "an individual actively engaged in killing or attempting to kill people in a confined and populated area" [4]; p. 5). According to the Federal Bureau of Investigation (2019, 2020), there have been a total of 305 active shooter incidents between 2000 and 2019. These events led to a total of 981 people killed and 1696 wounded. About 44% of these events took place at areas of commerce (e.g., malls and businesses open to pedestrians) and about 20% of these events occurred at education environments [5,6].

Poor response by police, fire, and EMS can result in more casualties. For example, before the Columbine incident, law enforcement officers were trained to set up a perimeter around the area where an active shooting occurred and wait for Special Weapons and Tactics (SWAT) teams to secure the area [7]. EMS personnel and firefighters would wait outside of this perimeter until the SWAT team declared the area secure. These delays likely lead to an increased probability of death for wounded victims [7,8].

As was evident during the Columbine incident, the poor response by first responder organizations led to the attackers having more time to shoot people and left those injured suffering sometimes for hours before they received any type of medical assistance. For instance, the first law enforcement officer arrived at the school five minutes after the attack started. Eleven students were shot during this time. Similarly, more than half an hour would pass since the start of the incident before the first wounded victims would receive medical assistance by paramedics. The decision to wait for SWAT also led to hours passing before the school was cleared and the last wounded victims were found. Ultimately, 21 people were wounded and 13 people were killed at the end of this event (see Ref. [9] for more information).

2.2. Response tactics after Columbine

After Columbine, the public expected law enforcement officers to respond differently to active shooter events [10]. In response to these expectations, tactics used during active shooter events changed and improvements for responses were proposed. For example, SWAT team members from different law enforcement agencies began providing active shooter training to first responders so that the first officers on scene could quickly enter an attack location to stop the killing instead of waiting for SWAT to arrive [9]. Regarding victim survival, the Hartford Consensus suggested that victims should not die from uncontrolled bleeding [11]. Therefore, a coordinated response between police, fire, and EMS with the objective of quickly controlling hemorrhage in victims is needed [11].

Fabbri [11] describes a series of actions that first responders should take to save lives during active shooter events known as THREAT. The order of the actions is: (1) threat suppression, (2) hemorrhage control, (3) rapid extrication to safety, (4) assessment by medical providers, and (5) transport to definitive care. Essentially, first responders who are responding to an active shooter event should first neutralize the threat to prevent further injuries. Life-threatening hemorrhage should be controlled for victims who can be treated at the scene. Victims should then be moved to a safe location where they can be triaged and evaluated for transport to definitive care (usually a trauma center).

Following the recommendations set by the Hartford Consensus and Fabbri [11]; Advanced Law Enforcement Rapid Response Training (ALERRT) teaches law enforcement officers to quickly engage and neutralize the attacker, provide medical assistance to the wounded, and ensure that the wounded are quickly transported to definitive care [7]. Additionally, many fire and EMS organizations have developed joint rescue tactics where a combined team of law enforcement and fire/EMS personnel work to provide care to the wounded as quickly as possible [12]; Kue & Kearney, 2014).

2.3. Research objective

While advancements have been made in improving the response to active shooter events, problems with these responses still exist. For example, Keating (2017) suggests that current responses to active shooter events are ineffective with problems being due to the complication of victim prehospital care methods. Delays for victim prehospital care are also caused by the lack of a unified command structure among responding organizations [13]. Additionally, few EMS organizations have plans in place addressing the integration of EMS with law enforcement officers during a response to an active shooter event [10]. Given the existence of issues with current active shooter responses, this paper aimed to identify improvements that can be made by first responder organizations to provide a more rapid and effective response to an active shooter event. Systems theory was used as the framework for an effective response to an active shooter event. The application of the theory will be discussed next.

3. Methodology

3.1. Theoretical framework for disaster management

Systems theory, or general system theory, has been used in many different academic disciplines to explore a variety of topics such as family violence and organizational leadership [14–16]. Systems theory is not a unified theory. Rather, it is a way of conceptualizing the structure of systems by examining the relationships between the system of interest components and other systems [16,17]. Most systems tend to interact with other systems and the environment. These are known as open systems [16]. If subsystems exist in the system that contribute to maintaining the functioning of the overall system, then the system is referred to as dynamic open system [16]. Systems also vary in complexity. Generally, social systems are made up of different subsystems that interact with the external environment [16].

Systems theory has also been used to assess disaster management [18]. The Federal Emergency Management Agency (FEMA) defines a disaster as "an occurrence of a severity and magnitude that normally results in deaths, injuries, and property damage and that cannot be managed through the routine procedures and resources of government," [19]; p. 2). Disasters can also be man-made [19]. Active shooter events can be considered a type of man-made disaster. Therefore, systems theory should be applicable to the response to active shooter events (see Fig. 1).

Systems have been defined as being a "collection of various structural and nonstructural elements that are connected and organized in such a way as to achieve some specific objective though the control and distribution of material resources, energy, and information" [17]; p. 72). I view the combination of first responder organizations that respond to an active shooter event as a complex and dynamic open system (the first

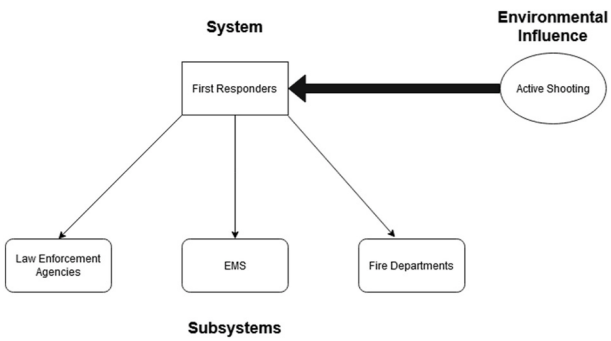

Fig. 1. Systems theory applied to first responders and active shooting.

responder system). The first responder system is open in that it interacts with its environment and other systems (e.g., school system). The first responder system is dynamic in that it is made up of subsystems (e.g., law enforcement agencies, EMS, and fire departments) that all work together to maintain the system's effectiveness, which can be considered saving lives. Taken together, when an active shooter event occurs (an environmental factor), the event exerts an influence on the first responder system and all of its subsystems (each separate type of organization). This leads to the goal of the system becoming the response to the active shooter event (stopping the threat, providing prehospital medical assistance to victims, and transporting the wounded to definitive care).

Therefore, the overall functioning of the system is dependent on the efficiency and collaboration of the subsystems. In other words, if all the first responder organizations are working collaboratively and efficiently, the goal of providing an effective response to the active shooter event should be met. However, if the first responder organizations fail to work together, the overall response to the active shooter event will be hindered and more lives may be lost.

Using this theoretical framework as its basis, the current study was designed to examine the common recommendations found in official after-action reports (AARs). A focus was placed on the five active shooter events that had the highest numbers of victims shot or killed. These events were chosen because they are arguably the most difficult events for first responders to manage, and, therefore, are the ones most likely to reveal problems with the first responder system.

3.2. Data

All events from the FBI active shooter database were examined (see Ref. [20]. The events were organized from those resulting in the greatest to the least number of victims. The top five highest casualty events were identified (see Appendix 1 for more information about each active shooter event). Following the selection of events, after-action reports (i.e., documents that summarize critical information regarding the overall performance of the handling of an emergency event) were identified. A total of seven after-action reports were found regarding these five events. Two of these events (Route 91 and Pulse Nightclub) had two after-action reports. The remaining events only had a single published after-action report. All of the after-action reports were included in the analyses [21–27]. Table 1 shows the event that each after-action report was created for along with the in-text abbreviation of each after-action report.

Following their identification, each after-action report was read to determine the total number of recommendations provided. A total of 602 recommendations were identified. Each recommendation was used as a data point during the analysis. Because it is difficult to determine a sufficient sample size a priori in this study since knowing how many data points will be needed to create an understanding of unknown concepts is illogical and problematic, all recommendations were included in the analysis to ensure no potentially important ideas were excluded [28,29]. An explanation of the analysis used in this paper is described next.

Table 1
After-action reports and corresponding in-text abbreviations.

After-Action Report Name	Event Report Describes	Abbreviation
After-Action Review of the Orlando Fire Department Response	Orlando/Pulse Nightclub	Pulse One
Rescue, Response, and Resilience: A Critical Incident Review	Orlando/Pulse Nightclub	Pulse Two
1 October After-Action Review	Route 91/Las Vegas	Vegas One
1 October After-Action Report	Route 91/Las Vegas	Vegas Two
Aurora Century 16 Theater Shooting: After-Action Report	Century 16 Theater	Aurora
Mass Shootings at Virginia Tech	Virginia Tech	Virginia
Protecting the Force: Lessons Learned	Fort Hood	Fort Hood

3.3. Analysis

A qualitative approach was used to analyze the data. Specifically, the six-phase thematic analysis method developed by Braun & Clarke [30] was used to address the research objective of the current study and guide the development of the thematic map (see Fig. 2). Themes were organized hierarchically into three levels. The first level are the codes, which are basic elements that identify a feature of the data. The second level are the subthemes, which can be considered the components that make up a theme. The third level are the main themes, which can be considered more abstract but important concepts about the data.

The R package RQDA was used to develop codes and themes from the after-action reports [31–33]. The process began with copying each individual recommendation from all the after-action reports and pasting the recommendations into text files that "RQDA" could read. Only text that was presented as a "recommendation" in each after-action report was imported into the program (see Appendix 2 for an example). A file was made for all recommendations given in each after-action report. Essentially, one can think of each file as a stand-alone text-based file of recommendations corresponding to each individual after-action report.

The recommendations in each file were then reexamined. During this time, semantic coding was used to create codes based on ideas that were constantly mentioned in the recommendations. Following the recommendation of Byrne [34]; codes were created for recommendations if they were thought to be of some relevance to addressing the research objective. Examples of some codes included: pre-incident planning, protective equipment, pathfinder vehicles, communications systems, radio procedures, command post, commanders, awareness training, tactical emergency medical training, victim advocates, victim services, and casualty collection points. This process was repeated for all the files.

Fig. 3 shows examples of recommendations (plain text) and their associated codes (highlighted text) as seen in RQDA. For instance, one of the recommendations found in the Pulse Two after-action report shown in Fig. 3 was: "some OPD personnel expressed concern for the limited attention and recognition command staff gave to those who responded to the Pulse attack." In this case, the identified codes included: OPD, recognition, command staff, and Pulse attack.

After the coding process was complete, themes were developed. It is important to note that the salience of a theme is not dependent on the number of codes used to create a theme [34]. Instead, the focus should be the incorporation of patterns of codes that help provide useful answers to the research questions of a study [35]. In accordance with this perspective, the process of theme creation began with a reexamination of the codes to determine which codes shared an overarching common feature relating to improvements that first responder organizations can make to provide a more effective response to an active shooter event. This led to the final creation of three themes: (1) advanced planning for an active shooter event, (2) training for first responders, and (3) prehospital care. Subthemes were identified for the first and second theme. Table 2 presents the identified themes, a description of each theme, and a description of each subtheme.

4. Results

While Table 2 presents an overview of the identified themes found in the after-action reports, Braun and Clarke [30] suggest that a proper thematic analysis should provide evidence to demonstrate to readers that the analysis conducted was valid. To achieve this goal, the following paragraphs provide data extracts to illustrate the prevalence of each identified theme.

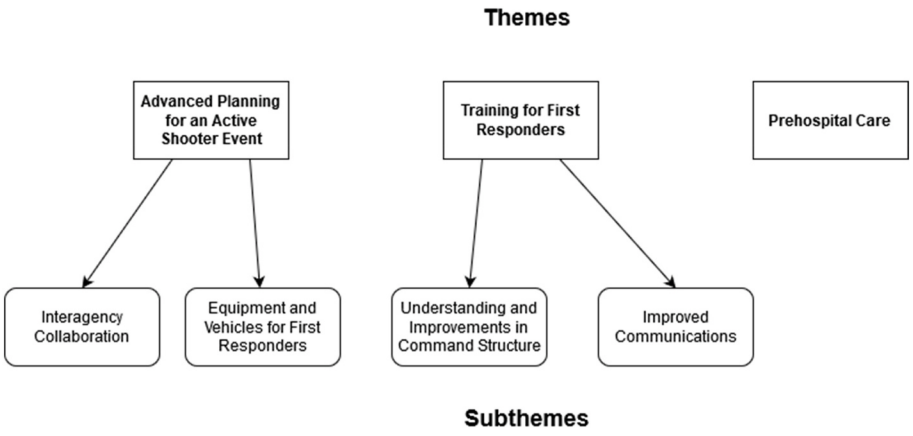

Fig. 2. Thematic map of recommendations from after-action reports.

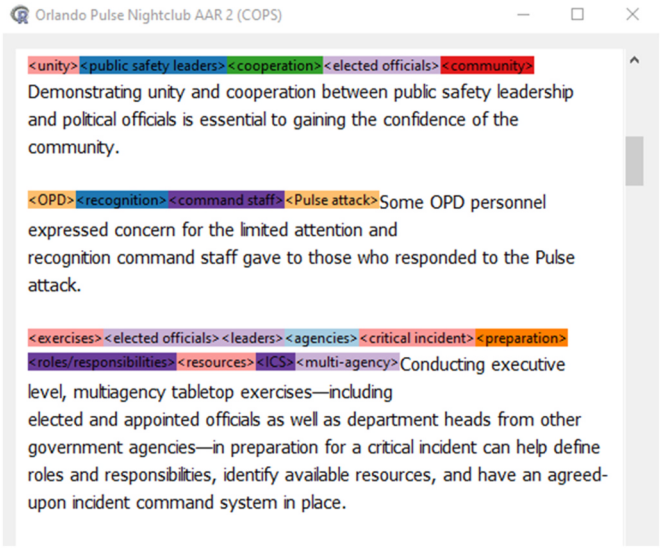

Fig. 3. Example of recommendations and associated codes.

4.1. Identified themes

4.1.1. Theme one: advanced planning for an active shooter event

All after-action reports included recommendations relating to improved planning before an active shooter event or mass casualty event occurs. Although the ideas behind the plans slightly differed depending on where the event took place, many of the recommendations suggested that all relevant first responder organizations (e.g., law enforcement agencies, fire departments, and EMS) and other stakeholders should be included in the planning process. It appears that many of the problems that were encountered during these active shooter events stemmed from the fact that the different agencies did not know how to respond to the event as one cohesive unit since plans, if any, were made by each individual agency.

The development of plans and policies aimed at responding to a mass casualty event, such as an active shooter event, is needed. "Establish policy requiring internal synchronizing of installation programs, plans, and response for emergency management" (Fort Hood). "Create policy, procedures, and protocols for a comprehensive mass-casualty incident plan" (Vegas One). One recommendation suggested that "building diagrams, internal contact telephone numbers, mutual aid staging locations, and communications procedures" (Aurora) should be included in plans. Other recommendations were more specific in terms of what plans should be made. For example, it was suggested that the development of "clear communications plans" was needed in order to "assign common radio channels" (Vegas Two).

A review of current plans and policies was also suggested. "Review plans and procedures related to the location of and need for various assignments based on the incident" (Vegas Two). "Develop a plan for annual review (audit) of all policies and procedures" (Vegas One). Another recommendation emphasized that existing policies should have "clear and concise definitions, assignments, and role descriptions for responding personnel" (Vegas One).

4.1.1.1. Subtheme One: Interagency Collaboration. Responding to an active shooter event requires the involvement of all first responder

Table 2
Description of identified themes and subthemes in after-action reports.

Theme and Subtheme[a]	Description
Advanced Planning for an Active Shooter Event	Improved planning should be conducted before an active shooter event occurs All relevant first responder organizations and other stakeholders should be included in planning process
Interagency Collaboration	All first responder organizations should work together effectively Training and constant communication will help foster collaboration
Equipment and Vehicles for First Responders	Equipment that is needed to manage an active shooter event needs to be provided to first responders Vehicles should be available and outfitted to be used in an active shooter event
Training for First Responders	Active shooter training is needed for first responders in general More specialized training and joint training with agencies is needed
Understanding and Improvements in Command Structure	Clarity is needed for first responders regarding the incident command structure for an active shooter event
Improved Communications	Improved communication, including radio communication, is needed within and between first responder agencies
Prehospital Care	First responders need to work cohesively to aid victims immediately after the threat is neutralized and in the long-term Medical equipment (e.g., tourniquets) should be used to treat wounded victims as soon as possible Transportation of wounded victims to hospitals should be a priority Assist victims in more innovative ways to prevent loss of life

[a] Themes are presented in bold and subthemes are presented without bold formatting.

agencies. "Emergency management by its very nature involves support to and cooperation from all city departments in order to be effective" (Aurora). All after-action reports suggested that an effective response to an active shooter event requires collaboration between different first responder agencies. "Mutual trust and respect between agency leaders and command personnel within and across agencies, along with trust among line-level personnel working toward a unified goal, are overarching components for reducing competing interests and ensuring a collaborative response" (Pulse Two). Another recommendation suggested that there was a need for "[improved] communication and collaboration with inter-state operations" (Vegas Two).

One of the shared recommendations found in six after-action reports involved agencies training and constantly communicating with one another before an attack occurs in order to promote collaboration. "Strengthen working relationships with partnering agencies through regular communication and frequent joint training across ranks of personnel" (Vegas One). "Continue to maintain relationships with local public safety agencies and conduct joint training" (Vegas Two). "Create relationships with and include hospital and medical personnel in regional mass casualty or terrorist training" (Pulse Two). Improving the collaboration between first responder agencies will ultimately lead to a better overall response to an active shooter event. "Response to and management of critical incidents are greatly enhanced when pre-existing relationships exist between leaders and supervisors from all potential first responder agencies" (Pulse Two).

Although they were slightly different given the location of the event, recommendations made for the Fort Hood event involved collaboration among agencies that may be involved in the response to or prevention of an active shooter event on a military base. For example, one recommendation suggested that there should be coordination with the "FBI Behavioral Science Unit's Military Violence unit to identify behavioral indicators that are specific to DoD personnel" (Fort Hood). Another recommendation suggested that coordination with the Department of State and Office of Personnel Management should be conducted in order to establish "more rigorous standards and procedures for investigating Foreign National DoD personnel" (Fort Hood).

4.1.1.2. Subtheme Two: Equipment and Vehicles for First Responders. While first responders carry equipment useful for day-to-day events, it appears that more specialized equipment may be needed when responding to an active shooter event. One of the mutual recommendations provided in five after-action reports included first responders having equipment immediately available that would improve an effective response to an attack. For example, it was suggested that "agencies should ensure that adequate personal protective equipment (PPE) is issued to and used by first responders" (Pulse One). Similarly, after active policies are established by local agencies, "mass purchases of any protective or countermeasure equipment [should] be performed" (Aurora).

Some recommendations explicitly stated what types of equipment should be ready for use by first responders. One recommendation suggested that "officers assigned to patrol should have a tactical medical kit (like IFAKs)" (Aurora). A different recommendation suggested that officers should be allowed to "carry rifles and other needed gear depending on the event, as well as tactical vests" (Vegas Two) in order to ensure that the officers would be ready to deal with an active shooter event should one occur. Other equipment included providing "ear buds in the ICP to lower background noise if multiple radios are in use" (Vegas Two).

Recommendations also focused on having necessary equipment installed in vehicles that first responders would use during an active shooter event. In order to allow fire and law enforcement responders to communicate when driving to the scene, one recommendation suggested that first responders should consider "installing both police and fire radios in police and fire command vehicles" (Aurora). Another recommendation suggested that "the tactical response vehicle (TRV) should be outfitted to function as a communication and surveillance vehicle … should the SWAT TOC (Tactical Operations Center) be out of commission" (Vegas Two). Other recommendations dealt more directly with the vehicles themselves, such as the recommendation to have "an incident safety officer … oversee decontamination protocols for decontamination of all responding personnel and their vehicles" (Pulse Two).

4.1.2. Theme two: training for first responders

Building on the theme of advanced planning for an active shooter event, one of the ideas that was discussed in all after-action reports was training for first responders. Some of the recommendations were vague with simple suggestions that first responders need to train for active shooter events. One recommendation was the need for "campus police [to] train for active shooters (as did the Virginia Tech Police Department)" (Virginia). Another recommendation suggested that "improved counterterrorism training is necessary to strengthen both community and officer safety" (Pulse Two). A separate recommendation suggested to include "civilian law enforcement best practices … into training certifications for civilian police and security guards" (Fort Hood).

While many first responders have received active shooter training (see Ref. [7], recommendations included the need for first responders to increase their training in specific areas. One of these areas was assisting victims. An interesting recommendation suggested training "several more fire or police personnel as SWAT paramedics" (Aurora). The idea here would be that first responders who were trained to be SWAT paramedics could enter into buildings or areas where an active shooter event took place that was not entirely cleared by law enforcement officers for a more expedient response to assisting wounded victims. A similar recommendation was made where "Tactical Emergency Casualty Care (TECC) training for officers" (Vegas Two) should be considered.

Training should also emphasize how the incident command structure (ICS) works. One recommendation asserted "ICS planning, training, and implementation must involve all public safety first responders and medical facilities" (Pulse Two). Another recommendation suggested that agencies need to "conduct ICS training and TTXs to reinforce the standard practice that the first unit to an incident scene requiring multiple units establishes command and a staging area" (Vegas Two).

While training generally occurs within each first responder organization, it may be difficult for first responders from different organizations to effectively work together if they have rarely done so before an attack occurs. Therefore, there is a need for training to be conducted with multiple first responder organizations at the same time. A main benefit of joint trainings is that different first responder organizations become more familiar with their roles when it comes to responding to an active shooter event. "Conducting executive level, multiagency tabletop exercises-including elected and appointed officials as well as department heads from other government agencies-in preparation for a critical incident-can help define roles and responsibilities, identify available resources, and have an agreed-upon incident command system in place" (Pulse One). There should also be a continuation to "pursue and promote joint planning, training, and exercise initiatives that foster relationships and mutual understanding of roles and responsibilities across public safety agencies" (Vegas Two).

4.1.2.1. Subtheme One: Understanding and Improvements in Command Structure. It is expected that the response to an active shooter event will be a confusing and chaotic experience, especially when it comes to knowing who is in charge. One of the common recommendations found in all after-action reports was the need for first responders to understand how to follow an incident command structure or a unified command structure when a response to an active shooter event or mass casualty event is needed in order to provide a more coordinated response. "At least one mutual aid command officer advised that due to the presence of many high-ranking Aurora police commanders, he had difficulty in

determining who was in charge and to whom he should report. This problem was compounded by lack of a designated staging area and staging officer. The Incident Commander should announce his status and location on all pertinent radio talk groups (channels) or have the information rebroadcast by the Communications Center" (Aurora). One recommendation suggested that there should be a "review [of the] force protection command and control relationships to ensure they are clear" (Fort Hood).

4.1.2.2. Subtheme Two: Improved Communication. Clear communication among first responders is crucial to provide an effective response to an active shooter event. However, it appears that communication was a challenge for many of the first responder organizations. One of the shared recommendations found in six after-action reports was the need for improved communication among first responder organizations. An example of how communication could be improved is provided in a recommendation suggesting that "command-level personnel should ensure appropriate interagency communications, planning, and execution [in order] to ensure the safety of law enforcement personnel during tactical operations" (Pulse Two). Another recommendation recognized that different organizations use different jargon; this makes it difficult for the organizations to understand each other. In order to establish communication between first responders that can be understood by all, there should be a reinforcement of "plain language, not police/fire codes, as a form of communication during these training opportunities" (Vegas One).

Other recommendations dealt with radio communication between first responders. Many communication issues seemed to arise because different agencies operated on different radio frequencies. Highlighted in one recommendation was the idea that a better overall response can be achieved through more unified radio communications between organizations. "Interoperability and the ability to patch together responding agency radios facilitated the sharing of information which greatly enhances response coordination when necessary" (Pulse Two). When it is difficult to have some type of unified radio system for first responder organizations, critical information should still be communicated to different organizations using different radio channels.

4.1.3. Theme three: prehospital care

While stopping the shooter is important, a primary goal of first responders is to prevent the death of wounded victims. One of the common recommendations provided in four after-action reports was the need to purvey prehospital medical assistance to victims that were wounded during an attack. Given that active shooter events are extremely chaotic, "responders and their leaders will be required to quickly make creative decisions with little to no reliable information under constantly changing … circumstances. These decisions could mean life or death for victims" (Pulse Two). In an effort to increase victim survival, "public safety agencies should consider, train, and exercise how they will deploy emergency medical responders in active shooter or other hostile events to ensure victim extraction, triage, and treatment" (Pulse Two).

Similar to the coordination of first responder organizations in planning for an active shooter event, coordination among first responders who are engaging the threat and interacting with victims immediately after the threat is neutralized should be established to quickly help victims. "The first officers on scene of an active shooting incident should organize contact teams to engage, contain, apprehend, or neutralize the gunman and rescue victims" (Pulse Two). "Law enforcement personnel should be prepared to improvise to save critically injured persons" (Pulse Two). Another recommendation suggested using rescue task forces to quickly provide aid to wounded victims or moving victims to EMS personnel away from the scene. "Several recommendations have been offered by various national and regional agencies regarding how aggressive EMS providers should be in entering and providing triage in a warm zone. Choices include … law enforcement teams to escort and protect EMS providers in the warm zone … or having law enforcement quickly remove patients to a triage unit in the cold zone" (Aurora).

First responders can prevent the dying of many wounded victims by providing prehospital medical assistance. However, all wounded victims need to receive more definitive care at hospitals or similar facilities. To facilitate this, victims should be transported to hospitals as soon as possible. It was suggested that responders should "continue to make medical transports a priority" (Vegas Two). Other recommendations suggested that proper ingress and egress routes should be maintained to and from the location of the event to ensure that victims are transported to hospitals as quickly as possible. "[An] Incident Safety Officer … should pay particular attention to the access or egress of emergency vehicles" (Aurora). "[It] may be appropriate to rapidly move all patients away from the incident. Choices include direct transportation to hospitals or to awaiting ambulances in the staging area" (Aurora). "Responders and responding agencies should continually plan and evaluate ingress and egress routes during critical incidents to ensure that routes are clear for ambulances and other emergency vehicles" (Pulse Two).

It may also be necessary to transport victims in emergency vehicles other than ambulances. "In situations where immediate transport of patients is warranted, use of police or other emergency vehicles is appropriate when ambulances are not immediately available. This is especially true for patients suffering from penetrating wounds" (Aurora). It is also important to keep track of first responders during transportation of victims. Therefore, there should be "clarification on the communications plan and policy for units leaving the scene to transport patients to the hospital and subsequently returning to the scene" (Vegas Two).

Depending on the extent of the attack, numerous wounded victims may be found in different locations. It then becomes necessary to help and triage victims quickly. Therefore, first responders should use equipment to facilitate the prehospital medical assistance of wounded victims. For example, first responders should "consider using reflective tape to mark victims" (Vegas Two). Tourniquets should also be used to "control severe hemorrhage, and [should be] employed when dressings and direct pressure have failed" (Aurora). Medical equipment should also be available for law enforcement personnel. "Law enforcement agencies should equip and train officers in the use of personal tactical emergency medical kits that include tourniquets, "quick clot" occlusive dressings, and Israeli bandages" (Pulse Two). "Continue to provide supervisors and officers … with robust MCI/medical kits, including sufficient numbers of tourniquets and pressure bandages" (Vegas Two).

5. Discussion

Based on the recommendations provided by the after-action reports, three main themes were identified. The first main theme of advanced planning for an active shooter event was comprised of two subthemes (interagency collaboration/equipment and vehicles for first responders). The second main theme of training for first responders was comprised of two subthemes (understanding and improvements in command structure/improved communications). The third main theme identified was prehospital care.

As suggested by Braun and Clarke [36]; the identified themes all build upon one another to tell an overall story about the recommendations provided in the after-action reports. In order to have a more coordinated and effective response to an active shooter event, law enforcement agencies, fire departments, and EMS should first have plans in place that are aimed at managing and responding to an active shooter event. These plans should discuss the roles and responsibilities that each individual organization will have during these situations. By having these roles and responsibilities established before an event occurs, each organization should have a better understanding of what they each need to do to provide a collective response to these types of events. These are ideas are supported by systems theory. When the subsystems (i.e., first responder organizations) establish plans for the response and

management of an active shooter event, the system's effectiveness should be increased since less time and resources are spent trying to identify the tasks of each subsystem.

In addition, collaboration between first responder organizations should be established through interagency training and communication. The establishment of good working relationships between first responders should lead to neutralizing the threat faster and quicker prehospital medical assistance for wounded victims. The need for integration, coordination, and planning among first responder organizations before and during active shooter event responses has been supported by various researchers [7,12,13,37,43].

Any equipment and vehicle needs should also be addressed in these plans. Especially when it comes to a large-scale event (e.g., Route 91 Music Festival) where many people could be injured should an active shooter event occur, life-saving equipment like individual first aid kits (IFAKs) and equipment that is needed to neutralize an active shooter (e.g. rifles for law enforcement officers) should be discussed. Modifications to vehicles and having vehicles ready for responders to use during active shooter events should also be included in plans. Ensuring that first responders have the necessary equipment, such as rifles and tourniquets, to have effective responses to active shooter events has been supported by other researchers [13,38].

Because of their infrequent use, trainings should be provided to first responders to ensure they know how to operate equipment that will be utilized during active shooter events, such as how to correctly use IFAKs and apply tourniquets to wounded individuals. Additionally, training for active shooter events is needed by many first responder organizations. However, what appears to be more important is joint training and interagency training for responding to active shooter events. This finding is consistent with the suggestions of other researchers [7,37]; "Mass Casualty Trauma," 2019). A more effective response by agencies would probably occur if first responders consistently trained together. They would become more familiar with how each organization operates and identify potential problems with a joint-response during trainings rather than discovering the problems during actual attacks.

Trainings should also provide communication methods that facilitate the effective communication between first responder organizations. Many problems arise when first responders do not know how to communicate with each other or are confused by the terminology that is used by different first responder organizations. Jacobs [13] supports this idea with the suggestion that the lack of common language among various first responder organizations delays victim assistance. Instead, plain language or an agreed upon set of terms should be used by first responders during an active shooter event to allow all first responders to clearly understand what is being asked of them. This becomes especially important when ad hoc teams of law enforcement officers are being established to engage the shooter. Clear communication between all three organizations is also important in order to expedite the assistance provided to wounded victims. It should be noted that establishing an agreed upon set of terms for all first responder organizations in the United States is highly unlikely given the large number of organizations. However, a good starting point would be to have an agreed upon set of terms that are used by first responder organizations in a local city or county.

Communication is also extremely important for incident commanders during active shooter events. Although there may be different commanders directing the response of first responder organizations (e.g., police commander for law enforcement response and fire commander for fire response), there needs to be clear and constant communication between these organization commanders to ensure a coordinated and complimentary response to an active shooter event. First responders also need to recognize how the incident command or unified command structure works during critical incidents. Topics such as staging and chain of command should be understood by all first responders. Various researchers have suggested that improvements need to be made to incident command and unified command by first responder organizations in order to improve the response to an active shooter event [7,13,37].

As systems theory would suggest, when the subsystems all train together, the overall system's goal of providing an effective response to an active shooter event should be achieved quickly and more efficiently. This is because all subsystems should be more familiar with how to work with each other. Similarly, the use of clear and constant communication between subsystems should reduce possible confusion that each subsystem may have regarding their changing roles during the progression of an active shooter event. All subsystems should also be able to identify which of the three subsystems is in command of the overall system's response to the event. This identification of command should allow all subsystems to quickly determine which subsystem they should be receiving their tasks from. When this identification is done, a more efficient and coordinated response should be delivered by the overall system.

If first responder organizations complete all these steps, they will be better prepared to assist wounded victims during active shooter events. For example, through joint trainings and clear communication, responding officers can more quickly form entry teams to enter a building or location and stop the shooter. The increased coordination among EMS personnel and firefighters can then lead to them providing prehospital medical assistance to wounded victims more quickly, which can lead to potentially saving more lives. Medical training should also allow law enforcement officers to begin providing prehospital medical assistance to victims (e.g., applying tourniquets) while waiting for support from the other organizations. Good relationships between first responders should also allow for faster triage and transportation of wounded victims to hospitals where they can receive more definitive care. Similarly, when first responder organizations have trained with local hospitals, it is possible that victims will be transported with injury notes already being communicated to hospital officials before victims even get to the hospital.

Overall, when first responder organizations improve their planning and coordination with each other, participate in active shooter training, and employ prehospital care techniques designed for active shooter events, the efficiency and collaboration of the subsystems should be increased. Therefore, the likelihood of the first responder system providing an effective response to an active shooter event should also increase.

6. Limitations

There are a few limitations with the current study that warrant discussion. It should first be recognized that it is very difficult to find all relevant data when it comes to researching events of mass violence. For example, Lopez et al. [39] suggested one of the primary problems that researchers have when examining events similar to active shooter events is the lack of consistent databases that provide facts and details about completed or attempted shootings. The use of varying data sources can lead to inconsistent conclusions in studies, especially since it is difficult to assess the quality of the data. As such, it is possible that the database used in the current study was missing events. If one of these excluded events was a high-casualty active shooter event, the events examined in the current study might have been incorrect. However, a comparison to a constantly updated database of active shooter events maintained by ALERRT suggests that the events examined in the current study were the ones with the highest casualty counts [40].

Additionally, the author is not aware of any database that exists housing all after-action reports from government agencies regarding active shooter events. Therefore, a general search of after-action reports had to be conducted using Google. It is possible that some after-action reports made for active shooter events might exist but were not found. If these after-action reports were made for the high-casualty active shooter events examined in this study, then additional recommendations might have been excluded during the analysis, which might have

impacted the themes found. Future researchers are encouraged to use more rigorous methods when searching for after-action reports to ensure all available data is analyzed if conducting similar studies.

Only five active shooter events that had the highest casualty counts were examined in the current study. These events generally took place in large cities or areas. It is possible that these high-casualty active shooter events differ in terms of the responses that first responder organizations will use in comparison to active shooter events that result in a low number of people killed or wounded. Similarly, the resources that first responder organizations have in these larger cities may differ from the resources that organizations located in smaller cities have. Therefore, the generalizability of the themes found in the study may not be applicable for all active shooter events. Instead, the themes may only apply to responses to active shooter events that occur in large cities and that have a high number of people killed or wounded. However, the themes identified in this study are similar to those found by other researchers examining the responses to active shootings and mass shootings, which suggest that some of these themes may apply to responses to active shooter events generally [41,42]. Future researchers should use an increased number of active shooter events and corresponding after-action reports, extract more recommendations from these documents, and explore whether similar themes are found to those presented in this paper.

7. Conclusion

The aftermath of active shooter events can have detrimental effects on a community, especially for those wounded during the attack and the families of those who died. While some suggestions, such as banning high-capacity gun magazines and placing metal detectors at schools, are aimed at stopping them, it is probably impossible to prevent a future active shooter event from occurring. Therefore, a planned and effective response utilizing the coordination between first responder organizations is needed in order to mitigate the damage caused by an active shooter [41]. With effective planning and increased training among the different first responder organizations, a more rapid and effective response to active shooter events should be provided by first responders, thus leading to less damage created by the shooter as well as increased prehospital medical assistance for victims of the event.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendices.

Appendix 1
High-Casualty Events and Corresponding Number of Victims

High-Casualty Event	Date	City/State	Number of People Killed	Number of People Wounded
Route 91/Las Vegas	October 1, 2017	Las Vegas, Nevada	58	489
Orlando/Pulse Nightclub	June 12, 2016	Orlando, Florida	49	53
Century 16 Theater	July 20, 2012	Aurora, Colorado	12	58
Virginia Tech	April 16, 2007	Blacksburg, Virginia	32	17
Fort Hood	November 5, 2009	Fort Hood, Texas	13	32

Appendix 2
Example of Recommendations Found in Vegas One AAR

	TABLE OF RECOMMENDATIONS	
	Recommendation	Bureau/Division Responsible
Preparedness		
1.	Maintain open communication with key stakeholders in the tourism industry by holding monthly meetings and sending notifications when necessary to the Las Vegas Convention and Visitors Authority, Las Vegas Security Chiefs Association, and community stakeholders. (page 13)	Tourist Safety Division
2.	Support the education of and partnership with the Las Vegas Convention and Visitors Authority and the Las Vegas Security Chiefs Association with awareness training on “See Something, Say Something” as well as “Run, Hide, Fight.” (page 14)	Organizational Development Bureau
3.	Incorporate training, specifically for all commissioned officers within each area command, on the importance and requirements of the Command Post Liaison Identification Card. (page 14)	Organizational Development Bureau
4.	Provide MACTAC response training to hotel and casino industry stakeholders as well as community partners, schools, churches, and those supporting critical infrastructure. (page 15)	Organizational Development Bureau
5.	During large-scale events, designate and assign an LVMPD dispatcher to work the radio channel and dispatch officers working the event. (page 17)	Communications Bureau, Southern Nevada Counter- Terrorism Center, Emergency Management and Support Operations Bureau, Events Planning

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