SPECIAL ISSUE ARTICLE

COUNTERING MASS VIOLENCE IN THE UNITED STATES

Rapid response to mass shootings

A review and recommendations

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Research Summary: We conducted a scoping review of
literature indexed in the National Library of Medicine's
journal citation database, MEDLINE, and Scopus to iden-
tify articles in which the rapid response of hospital staff,
emergency medical services personnel, the police, and the
public to mass shootings is covered. Sixty-five articles were
included, and critical themes related to reducing the harm
from a mass shooting were summarized.

Policy Implications: According to our findings, when mass
shootings occur in the United States, several evidence-
informed steps can be taken from the moment the first bul-
let is fired until the last injured individual is transported
to the hospital to promote a rapid response that can reduce
death and disability. Ten recommendations are made rang-
ing from recognition of the need for rapid response and
bystander training to triage and transport training of police
and avoidance of over-response.

KEYWORDS
firearms, mass casualty incidents, mass shootings, rapid response, review

On October 17, 2017, just after 10 PM, the highest causality mass shooting event in U.S. history
occurred at a music concert in Las Vegas, Nevada. From a 32nd floor window of the building across
from the concert venue, a single individual shot more than 1,000 bullets into the crowd on the ground
below. After performing retrospective evaluation, the devastating human toll of this shooting was con-
firmed; more than 800 people were injured, more than 500 required medical care, and 58 people died
(Lake, 2018). Arguably, the response to this mass shooting was also one of the most profound tests of

the capacity of the local hospital system, emergency medical services (EMS) system, and law enforcement in and around Las Vegas in rapidly responding to a civilian act of mass violence.

In a case study published by the Nevada Hospital Association, the author reviewed the many lessons learned in the aftermath of the shooting. The socially and medically complex nature of these kinds of human-made disasters was highlighted. For example, people at the scene of the Las Vegas shooting behaved differently than they might have in the aftermath of other high causality events, such as a multiple-vehicle road traffic crash (Lake, 2018). In Las Vegas, many victims fled the scene of the shooting and sought medical care on their own, bypassing EMS and established protocols for choosing appropriate medical facilities and notifying hospitals of impending arrivals (Lake, 2018). Many victims and noninjured bystanders also used smartphones and mapping applications to find health-care facilities. Given the sheer volume of victims, both trauma centers and smaller community hospitals received patients with major injuries and little notice (Lake, 2018). As a result, these hospitals experienced unplanned strains on their resources and staff capacities (Lake, 2018).

The Las Vegas mass casualty shooting may have been unusual in its magnitude, but its need for a rapid multisector, mass casualty, and mutual aid response is not unique. Both medical and law enforcement responses are necessary and interdependent when contending with mass casualty incidents and reducing the risks of death. The findings from research spanning two decades on the use of law enforcement personnel as a coordinated part of the medical response to shootings have demonstrated benefits in terms of rapid access to medical care and mortality reductions (Band et al., 2014; Branas, Sing, & Davidson, 1995; Wandling, Nathens, Shapiro, & Haut, 2016). In addition, based on the results of national research funded by the Centers for Disease Control and Prevention more than a decade ago, rapid access to accredited trauma center hospitals in the United States has been shown to reduce the risk of death significantly for people who are severely injured (MacKenzie et al., 2006). The findings from further national research on the mass casualty response capabilities of 25 major U.S. cities showed that longer wait and transport times needed to distribute high numbers of severely injured patients to trauma centers after fast-onset mass casualty incidents resulted in predictable increases in mortality. This research was funded by the National Institutes of Health and conducted in conjunction with Office of the Assistant Secretary for Preparedness and Response at the U.S. Department of Health and Human Services, and its findings highlight the need for a coordinated systems-based approach to mass casualty incidents that includes multiple public sectors—hospital, EMS, and law enforcement—and appropriate execution of multijurisdictional mutual aid agreements (Carr, Walsh, Williams, Pryor, & Branas, 2016).

Mass shootings are a category of mass causality incidents for which there is no single definition or set of criteria. The Congressional Research Service designates mass shootings as incidents in which four or more people are killed with a firearm, in one event, and at close proximity. By comparison, the Federal Bureau of Investigation's (FBI's) operationalizing of a mass shooting differs in that its definition requires an "active shooter" (an individual attempting to kill people in a populated area). Nongovernmental and media organizations also track mass shooting events over time. In these databases, mass shootings are identified as any incident that occurs in a public place, with a firearm, where three or more people are killed, and where the motive seems to be indiscriminate (Follman, Aronsen, & Pan, 2019).

By many of these definitions, mass shootings have been increasing in frequency and lethality in the United States (Center for Victims of Crime in partnership with the Office for Victims of Crime, 2018). Mass shootings garner extensive public attention and often become the center of policy debates around firearm ownership and prevention efforts (Shultz, Thoresen, & Galea, 2017). It is important to note, however, that many U.S. cities contend with multievent and multivictim firearm injury scenarios on a near everyday basis, most of which do not make the news. In an article published in 2019, the

authors found that firearm-injured patient clusters, where four victims of firearm violence arrived to Philadelphia hospitals at the same time from an event that occurred in temporal and spatial proximity, are common (Beard et al., 2019).

Whether they warrant their own set of dedicated policy and practice interventions, or simply are a more extreme example of the burden of "everyday" firearm injury and mortality in contemporary U.S. society, the occurrence of mass shootings highlights critical gaps and challenges in current emergency and trauma systems and subsequently offers opportunities to improve efforts and streamline existing systems. Some of these gaps include the lack of consolidated data on nonfatal firearm injuries and interventions that occur in the pre-hospital arena, understanding of the capacity of and outcomes from publicly oriented mass trauma response campaigns, and identification of common principles and best practices applicable to all who might participate in a rapid response from victims and bystanders to the clinicians at specialized accredited trauma care hospitals (Callaway, 2018).

With these gaps in mind, the purpose of this review is to describe the scope of publication and major findings of literature and make recommendations pertaining to the processes and impact of rapid response by health systems, EMS, and law enforcement in the aftermath of mass shooting events. To our knowledge, we are the first to evaluate research and reports dedicated to the current evidence on rapid response optimization and mortality prevention and to include multisectoral prehospital and in-hospital efforts. The conclusions drawn from this review may help guide future research, improve practice, and support new policies.

1 | METHOD

We conducted a scoping review (Colquhoun et al., 2014) of literature indexed by the National Library of Medicine's journal citation database, MEDLINE, in which all biomedical and life science journal articles published since 1946 have been captured, through the PubMed interface, which in addition to Medline includes other biomedical, criminological, and social science content from 1996 onward. We also searched Scopus, in which all PubMed content is catalogued but additionally includes literature from social science and criminology journals. We conducted both searches from the beginning of each database through September 2019. With so few articles published on mass shootings, the search terms were set to be sufficiently sensitive to capture all literature on response to mass shootings. These included "mass shooting" OR "mass killing" OR "mass homicide" OR "mass murder" OR "active shooter" OR "school shooting" OR "mass casualty incident" and "shooting" OR "mass casualty incident" and "firearms" OR "mass casualty incident" and "homicide". "Response" was included as an additional required search term for Scopus as a result of the large number of articles produced via the previous search terms. Articles were uploaded to Rayyan (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016), a platform for sorting and identifying appropriate and relevant articles for a scoping review.

Once the articles we identified were added to the database, the titles and abstracts of each were reviewed for fit with our inclusion criteria. To meet inclusion eligibility, an article must have been published in English and must have direct relevance to medical, EMS, police, school, or civilian responses to mass shooting events in the United States. We excluded articles in which the relationship to rapid response was missing or indirect, for example, case studies in which mass shootings were described but not how the medical system, police, or citizenry reacted to reduce harm after the event; descriptive statistical analyses on the incidence of mass shootings in relation to legal, demographic, and historical trends; protocols specific to dealing with an active shooter in the hospital; and psychological studies of mass shooting perpetrators and victim responses. After the title and abstract review, any article in
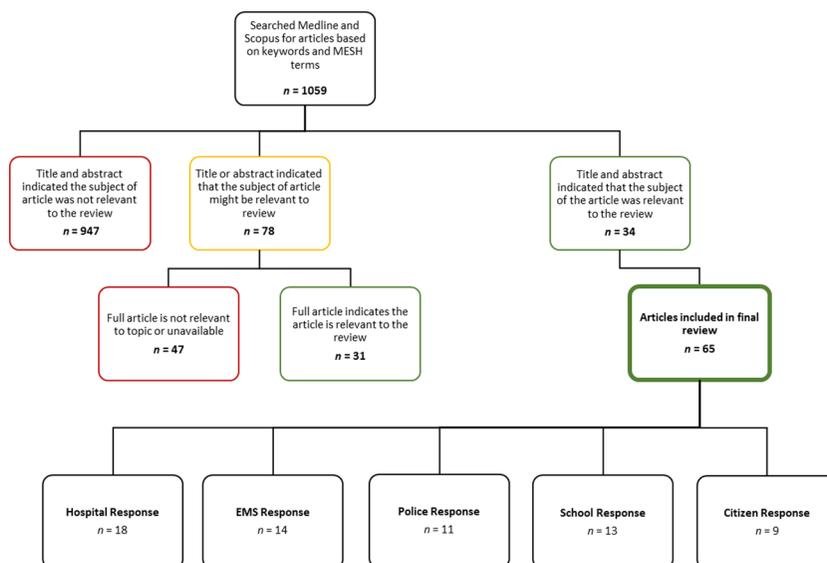
FIGURE 1 Literature search and selection process [Color figure can be viewed at wileyonlinelibrary.com]

which a match with inclusion and exclusion criteria remained unclear was evaluated on the basis of review of the article's full text. All articles selected for final review were read in full and then collated into distinct overarching themes, agreed to by the three authors.

2 | RESULTS

In total, 1,129 articles were identified from which 34 were determined eligible for inclusion based on title and abstract review alone, and an additional 78 articles required full text review to determine inclusion eligibility. Of those 78, 31 were eligible, yielding a total of 65 articles that were ultimately sorted, evaluated, and summarized in this present review. A flowchart outlining the search and selection process is illustrated in Figure 1.

Of the 65 articles included in this review, most ($n = 36$) were a mixture of commentary, case reports, summaries of lessons learned, and suggestions for management of future mass shooting events. Eight articles were descriptive epidemiologic studies, nine included the results of a survey, and seven involved a simulation, either computer (agent-based models) or through reenactments. Four articles were evaluations of educational programs, and one article was a presentation of the outcome of a randomized control trial. The articles included in this scoping review can be identified by a (*) in the Reference section.

The earliest article included in our review was published in 1999. The number of articles published per year on mass shootings, as well as the number published specifically on "rapid" response to mass shootings, is graphed in Figure 2.

Clear themes emerged among the articles, which are also illustrated in Figure 1. Most ($n = 19$) were focused on hospital training and response, followed by articles focused primarily on EMS training and protocols ($n = 14$) and police response ($n = 11$). Thirteen articles were focused on rapid school response and notification, whereas the rest were on citizen response ($n = 9$).
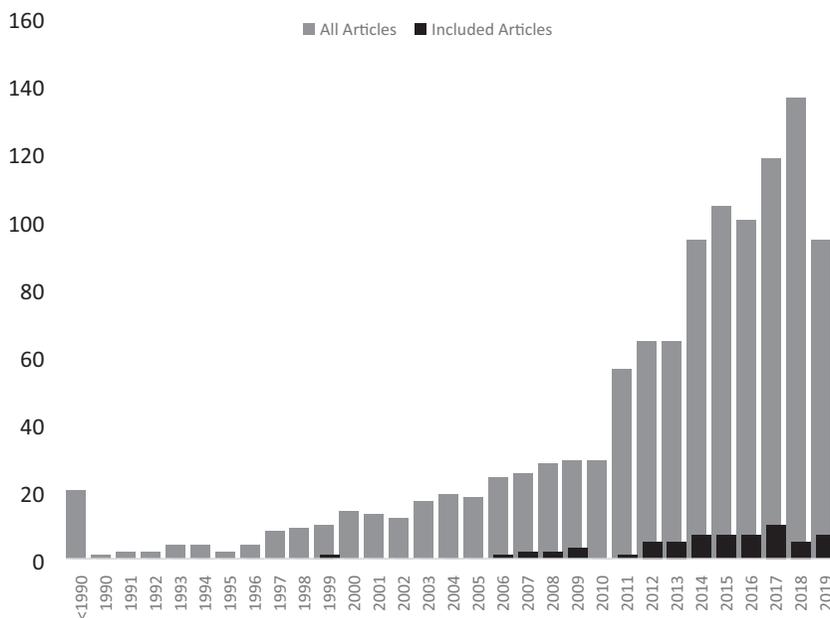
FIGURE 2 Number of articles published per year on mass shootings and rapid response to mass shootings available on pubmed and scopus

2.1 | Hospital response

2.1.1 | Clinician perceptions of preparedness

A rapid response to mass shooting events may hinge on the preparation and capacity of physicians and other clinicians at nearby hospitals where victims are first treated. In an article published in 2008, the authors examined the predictors of perceptions toward mass casualty emergency response preparedness among pediatric surgeons (Chokshi, Behar, Nager, Dorey, & Upperman, 2008). They found that three quarters of the surgeons surveyed felt that they would were "definitely" responsible to participate in a mass casualty emergency; however, only a quarter believed they were "definitely" prepared to do so. Preparedness was predicted by whether the surgeon attended national conferences and/or if he or she had previous disaster response experience. The same proportion (74%) of surgeons in this study who believed that they were unprepared for a mass casualty emergency also endorsed the need for more training. The findings highlight the potential disconnect between what medical professionals, including nurses and other clinicians in hospitals, might perceive as their required role in rapid response to mass shooting events and what they have been trained and practiced to do in order to feel confident in their ability to respond well and save lives.

2.1.2 | Planning and drills

In the disaster planning literature, scholars have more broadly suggested that one way to help medical professionals feel more confident responding to a crisis may be through the implementation of frequent and realistic planning and training drills (Gowing, Walker, Elmer, & Cummings, 2017). Although some type of disaster planning was mentioned in many articles, in six articles, the authors detailed the impact of planning for a mass shooting event through training drills that include administrative, clinical, and security personnel (Albert & Bullard, 2016; Cheatham, 2016; "Dealing with school shootings, violence: how Jonesboro and Denver hospitals met this new challenge to emergency preparedness.," 1999;

Glasofer & Laskowski-Jones, 2018; "Mass shooting in Colorado: practice drills, disaster preparations key to successful emergency response.," 2012; Sofer, 2018). For example, in two articles, the authors describe the relationship between comprehensive training drills and the capacity of nearby hospitals to respond to the Pulse nightclub mass shooting in Orlando, Florida, in June 2016. The nearest hospital to the scene of the shooting was only a few blocks away and received dozens of patients in rapid succession. The administrators from this hospital credit the success of the hospital's rapid response to recently conducted training exercises (Albert & Bullard, 2016). The Orlando Regional Medical Center, the hospital to receive the majority of the victims, had undergone an active shooter drill only 3 months before the shooting. During the drill, substantial efforts were made to provide as much as realism as possible in which included the participation of 15 hospitals, 50 agencies, and 500 volunteers (Glasofer & Laskowski-Jones, 2018). Although it is not possible to know the number of lives saved as a result of this training exercise, the hospital credits the drill with helping to identify and rectify processes in need of improvement. They also stated that the drills likely increased the confidence of medical staff to act quickly when responding to an actual mass shooting event (Glasofer & Laskowski-Jones, 2018).

The importance of drills was not limited to retrospective evaluation of the Pulse nightclub shootings. Sofer (2018), as part of the Emergency Nurse's Association, outlined the importance of mass shooting drills that included training for the mobilization of significantly increased surgical services and additional security and safety measures to contend with the potential for secondary violence. Sofer credited the rigorous disaster planning of the University Medical Center of Southern Nevada (UMC-SN) for its ability to handle the large influx of patients after the mass shooting in Las Vegas in 2017.

2.1.3 | Communication

Scholars have suggested that two distinct aspects of communication are crucial for responding quickly to mass shooting events. The first is signaling to hospitals near to an event that they will be receiving an influx of patients. The type of injuries most common in the aftermath of a shooting event are likely to cause rapid and life-threatening hemorrhage, and the faster victims receive resuscitative measures and definitive care in the hospital, the more likely they are to survive (Alarhayem et al., 2016). Therefore, the sooner the hospital can receive notice of a mass casualty event, the sooner hospital staff can mobilize surgeons and other staff to respond to the medical needs of multiple patient admissions at the same time or in rapid succession. Often communication of a mass shooting event occurs when the first patient arrives to the hospital or via a phone call from first responders *en route*. For example, after the mass shooting in Aurora, Colorado, in July 2012, the primary receiving hospital heard that there was a shooting at a movie theater via emergency dispatch radio. Hospital staff did not know the extent of the shooting's impact, initially disregarded it as "street" violence, and therefore did not activate the hospital's disaster plan until the first patient arrived (Johnson, 2012).

An emergent strategy may decrease the time from a shooting event to when a hospital receives notice to prepare by including signaling from social media platforms like Twitter. In a study released in 2017, the authors examined five multiple casualty events, including the 2012 Sandy Hook and 2014 Marysville school shootings. They found that a threshold can be identified based on the number of tweets about a given event that can signal that a mass casualty incidence has occurred. They also found that this signal, for all of the events studied, preceded the first patient arriving to the hospital (Callcut, Moore, Wakam, Hubbard, & Cohen, 2017).

The second major form of communication is the need for a receiving hospital to process and disseminate information about victims quickly to their family members, law enforcement, and the media. Soon after a mass shooting event, hospitals typically need to manage and respond to a staggering number of phone calls and requests for information from family members and friends that are worried about

the status of loved ones who might have been in close proximity to the event. For example, after the Aurora shooting, the hospital was forced to implement a hotline to handle the hundreds of phone calls received from the public. This hotline was set up *ad hoc* the night of the shooting, but in a retrospective evaluation, the authors noted that the absence of and need to plan and develop such a hotline was known prior to the event (Koehler, Scott, & Davis, 2014). In addition, on the basis of lessons learned in the initial hospital's response, a "telephone tree" was established in the pharmacy department and managed by second-year pharmacy residents to streamline communication about the mass shooting to medical professionals (Shakowski, Page, Fish, & Stolpman, 2014).

The relationship between a hospital's capacity to manage external communication and media reporting surrounding an event can also impact early medical response. For example, after the 2009 Fort Hood shooting, the news networks covering the incident broadcasted the main receiving trauma center's telephone number (Wild et al., 2012). This led to an influx of more than 1,300 phone calls, which complicated communication within the hospital. As a result, two individuals were inappropriately transferred from the trauma center to a regional hospital without a trauma center designation (Wild et al., 2012). The pressure of the number of incoming telephone calls was attributed to errors in triage designations.

2.1.4 | The "second wave" effect

In studies of trends of patient arrivals after a mass shooting, scholars have identified what is referred to as a "second wave" effect. For example, immediately after the mass shooting in Aurora, one of the first patients to arrive to the University of Colorado Hospital was a young woman with her infant, transported in a private vehicle by her boyfriend. She only had a few wounds and none that were life-threatening. It was much later when those who were most hurt arrived (Johnson, 2012). This phenomenon, in which the less injured arrive significantly before the patients in need of critical care, has not been unique to the Aurora shooting. There was a similar second wave effect after the Pulse nightclub mass shooting: the first wave arrived at the hospital at 2 AM, whereas the second wave did not arrive until 3 hours later when the police were able to infiltrate the club and kill the gunman as the most severely injured were not able to escape until this point (Albert & Bullard, 2016). A second-wave effect also occurred after the Virginia Tech shooting in 2007 in Blacksburg, Virginia (Armstrong & Frykberg, 2007). Appreciating the potential for this trend may be a vital component of how hospitals prepare and predict patient needs after a mass shooting event by specifically resisting judgment about the severity and causality rate of an incident on the basis of the first patients to arrive.

2.2 | EMS response

2.2.1 | Triage

One of the most important duties of first responders to an event with mass casualties is properly triaging patients for treatment and/or transport. In ten articles identified in this review, researchers evaluated the importance of prehospital processes to improve EMS triage after mass shooting events. For mass casualty incidents, like a mass shooting, triage must be done quickly and accurately with a proper command structure to diminish confusion among responders (Kelley, 2008). One option is to use what is known as "intuitive triage," in which an experienced first responder relies on his or her general impression of the severity of an injury and sense of required urgency for response. In a recent analysis using a simulated disaster, Hart, Nammour, Mangolds, and Broach (2018) found that intuitive triage was not only faster but also was statistically no different than more traditional triaging methods, such as Simple Triage and rapid treatment (START), which is an algorithmic approach to assign hierarchical severity and urgency labels to victims using multiple points of observed and measured physiologic criteria.

Relatedly, in an article published in 2009, Talving, DuBose, Barmparas, Inaba, and Demetriades described various forms of penetrating trauma injuries that might be caused by a shooting event and classified them by likelihood of survival if a patient reaches definitive medical care; a process that could potentially improve the effectiveness of mass-shooting specific triage. For example, penetrating head injuries associated with specific physiologic responses, such as respiratory arrest, fixed and dilated pupils, and extreme hypertension might be designated as "unsalvageable," whereas other penetrating head injuries might be more amenable to medical intervention. For each major injury type, the authors provided an algorithm to help guide EMS first responders during these mass causality emergencies. Generally, algorithms for sorting victims are helpful in reducing errors during triage and therefore in reducing mortality, as was observed during the 2009 Fort Hood mass shooting (Strommen, Waterman, Mitchell, & Grogan, 2015).

Even with clear algorithms, it can be difficult to triage victims in the chaotic and often hazardous environment that surrounds mass shooting events. For example, during the Fort Hood shooting, many patients were undertriaged (those whose injuries were classified less life threatening than they truly were). This was likely a result of the lack of a security for EMS first responders (Wild et al., 2012). Errors during triage were also prevalent after the Virginia Tech shooting. Although only one individual was undertriaged, 69% of victims were overtriaged (determined to need more attention and resources than injuries warranted) at the scene (Armstrong & Frykberg, 2007). Both of these forms of misclassification can threaten an effective rapid response. Although overtriage might seem to be a problem that medical professions are willing to bear, it can be harmful in its depletion of limited resources and time in mass causality events. Researchers have suggested that although triage errors are bound to occur in chaotic scenes, like a mass shooting, implementation of several levels of triage can help minimize errors and optimize rapid response (Talving, DuBose, Barmparas, Inaba, & Demetriades, 2009).

Implementation of in-person simulations, integrating simulation content generated via the Delphi Method by subject matter experts (Cicero et al., 2014), may improve the EMS providers' knowledge and skill level for appropriately triaging patients at the scene of a mass shooting (Cicero et al., 2012). In an effort to understand integrated responses by law enforcement officers and the EMS better, simulations of active shooter incidents were performed. Through these "real-life" trainings, errors in triage were spotted and first responders received immediate feedback and hands-on practice on what to do if the simulated event occurred in the future (Bachman et al., 2019).

Another way of improving EMS triage practices includes the use of virtual simulations. A video-game intervention, titled "60 Seconds to Survival," was shown to have some success in improving triaging knowledge of EMS providers (Cicero et al., 2017). In this game, players have to triage 12 victims in three scenarios, one which includes a school shooting. They are then provided in-game feedback of their performance. In this randomized control trial, the intervention group, those who played the game, had a significant improvement from their baseline score, whereas the control group did not. Thus, the video-game intervention could have value in improving triage among EMS providers (Cicero et al., 2017).

2.2.2 | Rapid transport

Rapid transport of victims to hospitals is important for reducing the likelihood of mortality (Blackwell & Kaufman, 2002; Crandall et al., 2013). Ideally, victims, particularly those with penetrating injuries, should be taken directly to a Level 1 trauma center (those that have the resources and training to provide the highest level of surgical care for trauma patients) by EMS. In some mass causality situations, however, this may not be possible as a first course of action. When, as a result of transport or distance constraints, it is not possible to transport victims to a Level I trauma center, rapid transport may involve

moving victims to the closest trauma and nontrauma hospital emergency departments for stabilization, after which they can be transferred if advanced medical interventions are required. Initial transport of patients to lower acuity and nontrauma center hospitals was noted in the evaluation of the response to the Virginia Tech shootings (Kaplowitz, Reece, Hershey, Gilbert, & Subbarao, 2007).

2.2.3 | The "Warm Zone"

During mass shootings, first responders are entering dangerous situations. For that reason, EMS providers typically wait until the area of a mass shooting is cleared of any threat by law enforcement before they enter to take care of victims. Recently, however, there has been a call for EMS to proceed into the "warm zone," an area that is secured by police officers but not totally cleared, so that they can administer life-saving procedures sooner than they would have if they had waited until an area was designated as "all-clear" (Mechem, Bossert, & Baldini, 2015; Smith & Delaney, 2013). Practically, a warm zone is created through joint policies, communication, and collaboration between the police and EMS, as well as physical measures, such as police car formations that create barriers between where EMS providers are working and a potential or known threat (Molloy, Newlin, & Racht, 2017).

In a recent study, a scenario-based survey was administered to EMS professionals to gauge their willingness to enter the warm zone. In these scenarios, the EMS would be part of a "Rescue Task Force," in which they would enter with the second wave of police officers. Although most responded that they would enter the scene if they were supplied with ballistic gear, two thirds would not enter if they did not have any ballistic gear or a firearm. Individuals with military or other tactical training were more likely to enter without gear than were those without similar training. The responses to this survey reveal that although the EMS will in some cases enter the warm zone, it requires the support of police officers and appropriate defensive gear (Chovaz, Patel, March, Taylor, & Brewer, 2018).

In Philadelphia, Pennsylvania, the fire and police departments collaborated to form a similar structure to the "Rescue Task Force" described earlier. In their "Rapid Assessment Medical Support" program, all municipal paramedics trained with the police to learn how to move into a mass shooting scene properly and to use available protective gear (Mechem et al., 2015). Similar cross department collaboration was emphasized by a 2011 article in which the author stated, "Both EMS and law enforcement need to come together, train together and work together to better respond to these unfortunate accidents" (Morrissey, 2011, p. 48). Nevertheless, care must be given to ensure the EMS not put themselves in areas where they are not secured or without protection from the police.

The literature also describes the emergence of and advocacy for tactical emergency medical support teams, or TEMS, embedded in civilian EMS services and ready for response to mass shooting events. TEMS team members are non-military EMS, medical or nursing personnel trained using military methods for responding during police actions and emergencies involving potential shooters where there is need to be "prepared to deal with limited resources, delayed transport and a higher occurrence of penetrating injuries" (Carhart, 2012).

2.3 | Police response

2.3.1 | Integrated response

The ability for the EMS to enter the "warm zone" is predicated by police tactics that then give EMS security. To be able to accomplish this, as well as successfully stop the perpetrator, an integrated response between all responding police jurisdictions and EMS and fire departments may yield the greatest overall benefit (Griffith, Ablanedo, & Nenneman, 2015; Keating, 2016; Marino, Delaney, Atwater, & Smith, 2015). In one article, Ojasalo, Turunen, and Sihvonen (2009) detailed the setup of

a command center that includes the leadership of all responding police jurisdictions and EMS teams. Here, decisions can be made that are consistent across all responders, and it enables "real-time" updates as well as systematic approaches to identify or search for victims and perpetrators (Monteiro et al., 2014). In another article, Frazzano and Snyder (2014) discussed the need for these kinds of integrated approaches especially in light of future threats of "hybrid targeted violence" (HTV), which includes not only a firearm but also chemical and fire related.

2.3.2 | Training

The primary goal across most police interventions for mass shooting preparation is to train officers to respond to these incidents to save the greatest number of lives possible; however, the approach and content of these trainings vary. The Advanced Law Enforcement Rapid Response Training (ALERRT) Center at Texas State University, which was founded by tactical officers from the San Marcos Police Department and the Hay's County Sheriff's Office, trains officers in tactical techniques, movement formations, and communication strategies (Martaindale & Blair, 2019). They also teach the first arriving officers to form an active shooter response team quickly and encourage officers to begin to provide aid for victims once the shooter(s) are no longer an active threat. This program has trained 130,000 from nearly half of all agencies in the United States. Members of ALERRT also wrote a book titled "Active Shooter Events and Response," in which the authors called for more advanced and "aggressive" tactics to be used by the police during mass shootings (Blair, Nichols, Burns, & Curnutt, 2013).

Police officer training with dedicated focus on hemorrhage control has also been described in the literature. The Tactical Casualty Care for Law Enforcement and First Responders is a training program to help police officers better care for victims for mass shootings before they are cared for by EMS or other medical professional (Pons et al., 2015). Specifically, through this hands-on training, police officers are taught how to create and apply a tourniquet and stop bleeding. If given this training, Pons et al. argued that police officers would feel more comfortable acting as medical first responders in mass shooting events that have limited EMS and transport resources and a large number of casualties.

2.3.3 | Hospital transport by police

Although it is usually standard that a patient is transported from the scene of a shooting to the hospital via an ambulance, this might not be possible or effective when there are many casualties and resources are sparse. Dr. Zane, the head of the University of Colorado Hospital Department of Emergency Medicine, credited rapid transport to the hospital by police as being the factor that saved the most number of lives after the Aurora mass shooting (Johnson, 2012). In fact, most patients in Aurora were transported by police car or private vehicle to definitive hospital care (Shakowski et al., 2014). Most recently, the NYPD rapidly transported victims of the 2019 Brownsville mass shooting in Brooklyn, New York, via police car after 12 people were injured by gunshot. The officers were credited by the receiving hospital as doing "an amazing job in terms of saving lives in that moment" (Barton, 2019, para. 2).

Rapid transport by police may be an ideal component of mass shooting response when ambulances are unavailable. This approach has a strong basis in published literature. Known informally as "scoop and run," it is a standard prehospital transport strategy for victims of penetrating injuries, primarily from shootings, in Philadelphia. In the several articles focused on evaluation of police hospital transport in Philadelphia and a few additional municipalities, the authors suggested that it is at least as effective as transport via EMS ambulances. It may, in fact, be life-saving because of the greater presence of police vehicles on patrol and the often faster response times of law enforcement to shooting incidents (Band et al., 2011; Band et al., 2014; Branas et al., 1995; Wandling et al., 2016).

2.3.4 | Advanced techniques

In two articles, emerging technologies were introduced that police may use in the future to help to eliminate or reduce threats during a mass shooting event. Based in crowd and network dynamic theory, computer simulations may be able to predict the best way for police officers to evacuate victims during a mass shooting (Gunn, Luh, Lu, & Hotaling, 2017). For example, computer simulations demonstrated that a "divide-and-conquer" approach in which victims are split into groups, as well as guiding victims from one secured room to the next, offer the most effective way to evacuate victims in the shortest amount of time (Gunn et al., 2017).

An unmanned aircraft system (UAS), or drone, may also have utility in stopping active shooters (Wallace & Loffi, 2017). During the Las Vegas mass shooting, the shooter had barricaded his room, was in an elevated position, and had numerous firearms. The environment was also chaotic during the shooting, and the rush of victims trying to escape made the area difficult for police to navigate and take measures to stop the threat. Authors have since argued that the use of a drone during this situation would have been helpful in more quickly stopping the shooter and that it should be considered as an alternative to reduce harm in future shootings events (Wallace & Loffi, 2017).

2.4 | Educator and school response

2.4.1 | Educator preparedness

Response to mass shootings is increasingly of interest to the general public but in particular to educators and school administrators as more than 200 school shooting incidents, although not all mass shootings, have occurred in primary and secondary schools in the United States (Cox, Rich, Chiu, Muyskens, & Ulmanu, 2018). As such, researchers have studied if and how educators are prepared to respond to a shooting in their school. A survey conducted in 2006 was mailed to 3,670 school superintendents across the United States and chosen at random (Graham, Shirm, Liggin, Aitken, & Dick, 2006). Although most (86%) reported that that their district had a response plan, a third reported that they had never before held a drill for students and staff. Forty three percent had never collaborated with local EMS to discuss what to do in a school shooting scenario, and 22% did not have a plan for children with physical or learning disabilities (Graham et al., 2006). Similarly, the findings from more recent research on principals' perceptions of firearm risks in high schools ($n = 349$) highlighted that less than half of the schools represented in this sample had been trained with regard to how to respond to a school shooting (Price, Khubchandani, Payton, & Thompson, 2016; Thompson, Price, Mrdjenovich, & Khubchandani, 2009). Furthermore, the results of this work confirmed that many principals are unsure about what specific training and programs to implement as there is little evidence guiding existing school gun violence prevention practices (Price et al., 2016). Similarly, on the university level, a survey was conducted using a convenience sample of 28 schools with radiologic programs and found that only 5 schools had detailed plans in place for an active shooter incident (Curtis, 2009).

2.4.2 | Planning and drills

Schools should be perceived as safe places for students (Cornell, 2015). And some scholars have recently focused on the evaluation of action plans and drills that school personnel and students may use to respond to an active shooter. For example, the authors of a 2017 paper suggested that schools develop a Safety Committee that can disseminate protocols and initiate drills mimicking what actions students, teachers, and staff should take if there was ever an active shooter in the school. These authors also suggested that these protocols should cover several aspects of rapid response, including how school staff should communicate with one another and to their students if there is an emergency in the school, and

how to plan for students who have disability conditions (Selekman & Melvin, 2017). [Although not a formal school environment, nursing homes and rehabilitation centers have a similar need as a result of the fragility of older persons and the difficulty that will be faced in facilitating evacuation (Martin & Powell, 2017).] There has also been computer simulated research on what type of "lockdowns" should be implemented in schools. Traditional lockdowns, which typically involve the locking of doors and moving students away from windows, have not been determined to be effective as a more dynamic, multioption response where students evacuate the area, create barricades, and as a last resort actively resist the shooter (Jonson, Moon, & Hendry, 2018).

As schools and families contend with the possibility of mass violence, elected officials have also put forth plans to guide school protocols. Unfortunately, some of these suggested practices are not necessarily grounded in empirical evidence, yet are being used to inform some school safety practices. For example, after the May 2018 mass shooting in a high school in Santa Fe, Texas, Governor Greg Abbott proposed a "School and Firearm Safety Action Plan." The report contained several suggestions for schools, some of which the existing research base findings confirm has some efficacy, such as implementing behavioral threat assessment processes (Astor et al., 2013; Borum, Cornell, & Jimerson, 2010) and increasing the number of mental health professionals in schools, which school administrations universally agree is a reasonable investment. Abbott also called for the increased presence of law enforcement on school campuses, although it is unclear whether law enforcement is a deterrent to violent crime on school campuses (Kubena & Watts, 2019). In this same report, Abbot also called for a push to "harden campus facilities," including the installation of metal detectors, building physical structures around a school's campus in a barricade-like fashion, and using video surveillance to monitor a school's campus (Abbott, 2018). Unfortunately, these practices have not been shown to be effective (Hankin, Hertz, & Simon, 2011).

In response to the Hartford Consensus, an initiative aimed at empowering citizens to participate in hemorrhage control (Jacobs et al., 2013), 26 elementary school educators and administrators were given "short, intensive" instruction on how to apply hemorrhage control properly and their general role as a first responder. Before the training, all teachers reported low confidence in their ability to apply tourniquets and act properly as a first responder. After the training, all teachers reported feeling confident in these acts. The authors reported that this is evidence that the Hartford Consensus can be applied to real-life scenarios and to help train the public on their role as first responders (Ramly et al., 2016), including in a school setting.

2.4.3 | Alert systems and social media

During a mass shooting, it is imperative that students and staff are notified of the event as soon as possible so that they can evacuate or protect themselves. In five articles, all based in university environments, the authors examined the best way to alert students, faculty, and staff to an incident and the role that social media has on both rapidly spreading information. In one article, the researchers argued that social media, as a result of its real-time use and proliferation among college students, could be used as the best way to notify students during a mass shooting, although they cautioned that there needs to be more research in understanding the best way to do so (Haupt, Kapucu, & Morgan, 2017). In contrast, in another article, the authors recommended against the use of social media because of the negative emotions associated with users during these incidents. For example, their survey responses revealed that individuals who used social media as their primary source of information were more likely to be under greater distress as a result of rumor transmission (Jones, Thompson, Schetter, & Silver, 2017). In another article, the authors went further, stating that there should be rules and social media monitoring developed for these scenarios to limit misinformation and rumors (Mazer et al., 2015). Regardless, the

responses to a survey of which communication methods work best during an emergency demonstrated that mobile devices, e-mail notifications, and face-to-face communication were taken the most seriously by students and that mass media, including television and social media, were the least effective (Stephens, Ford, Barrett, & Mahometa, 2014). With this in mind, push notifications on phones (and on computers) could be implemented as a way to inform students, faculty, and staff quickly of a possible active shooter or mass shooting (Egnoto, Svetieva, Vishwanath, & Ortega, 2013).

2.5 | Civilian response

2.5.1 | Hemorrhage control

Five articles included an evaluation of the role of nonmedical and nonpolice actors in hemorrhage control after a shooting event (Jacobs, 2015). Tourniquet use, specifically, has been identified as an underused life-saving technique in the aftermath of a mass shooting that can be implemented by bystanders and other first responders from the general public (Klassen, Marshall, Dai, Mann, & Sztajnkrycer, 2019). One study group reviewed the autopsy records of victims of the Pulse nightclub shooting and found that none of the deceased, including 16 individuals that had potentially survivable wounds, had documented tourniquet application (Smith, Shapiro, & Sarani, 2018).

As noted, in these three articles, the authors described what has become known as the "Hartford Consensus," in which efforts for empowering civilians to participate in hemorrhage control were the primary focus. In 2013, the Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting events was formed by the American College of Surgeons. Along with physicians, the committee included individuals from public safety organizations, and it was later expanded to include the Federal Emergency Management Agency and the National Security Staff of the Office of the President. These meetings produced the initial Hartford Consensus, with its main outcome being the implementation of better hemorrhagic control (Jacobs, 2014). In the committee's second paper, the Hartford Consensus II, they called for better education of the public (individuals at the scene who are uninjured or minimally injured) on what to do to save lives (Jacobs & Burns, 2014). In the Hartford Consensus III, the group expanded these recommendations to include that prior to the arrival of any medical or police first responders, bystanders should perform actions like tourniquet placement to control bleeding and contribute to the reduction of preventable prehospital deaths (Jacobs, 2015). Throughout these recommendations for the public to take an active role during a mass casualty event, the committee advocated that the public not put themselves in danger to perform hemorrhage control, and that any actions they do undertake should be legally protected via Good Samaritan laws.

The recommendation of the national *Stop the Bleed Campaign* that emerged from the Hartford Consensus is that all areas where a large number of individuals will coalesce should have supplies on hand to treat the bleeding of at least 20 victims if a mass shooting were to occur (Goolsby et al., 2019). The American College of Surgeons also started a Bleeding Control training and assessed the successfulness of educating the public on hemorrhagic control. More than 500 employees at Gillette Stadium in Massachusetts participated in the study; after the training, the reported likelihood to help during an emergency increased, as well as the comfort to control hemorrhage. Therefore, it is possible to train a large number of individuals hemorrhage control even if they have little training in first aid (Chaudhary et al., 2019).

2.5.2 | Run, hide, and fight

Three particular actions, "run, hide," and "fight," are suggested by the Department of Homeland Security (DHS) for victims experiencing a mass shooting. The first act to "run" involves evacuating the area

of a shooting quickly and safely. If this is not possible, the second act to "hide" includes locking or barricading doors, silencing cell phones, and moving away from windows or places where one could be hit by a bullet. Finally, if unable to run or hide, the third act is to "fight" the shooter for self-protection. According to DHS, this should only be done as a last resort to incapacitate the active shooter (U.S. Department of Homeland Security, 2008). Although the effectiveness of this action plan in response to simulated or real-time mass shooting events has not been evaluated, one author group looked specifically at the effectiveness of the "fight" portion. Using an agent-based model, they found that if even a small proportion of victims were to attempt to tackle or swarm the active shooter, the total number of individuals shot would be reduced (Briggs & Kennedy, 2017). They noted, however, that this puts those fighting back at greater risk and should only be done as a last resort.

Related to the last resort option, fight, some research has been done on what it would take to stop a mass shooting by a citizen. For example, how many individuals would be killed in a gun-free zone under different conditions was examined in one computer simulation (Kirby, Anklam, & Dietz, 2016). The researchers found that locking the doors was about as effective as having 10% of the individuals be concealed carry holders in reducing the number of deaths. The addition of an armed security guard, however, drastically reduced the number of deaths. Similarly, in another study, the authors looked at how many off-duty police officers would be needed to stop an active shooter in a stadium (Glass, Iyer, Lister-Gruesbeck, Schulz, & Dietz, 2018). They found, through a computer simulation, that in a stadium of 4,000 people, 38 off-duty police officers would be needed; in a stadium of 18,000, greater than 120 officers would be needed to reduce the casualties to three or less. Thus, a large number of trained citizens would be needed to stop a mass shooting in large-scale events, exemplifying the importance of the run-and-hide suggestions given by the Department of Homeland Security.

3 | DISCUSSION

Based on the findings from our review, when a mass shooting occurs, there are several critical steps that need to be taken, between the moment the first bullet is fired until the last victim is admitted to the hospital, by which a rapid response can potentially reduce death and disability. Therefore, the following ten recommendations are taken from the best available evidence and thinking in facilitating rapid response to mass shootings:

1. Understand that firearm injury is a "surgical disease" and that the faster someone who has been seriously shot gets to a designated trauma center hospital operating room, the better (Carr, Caplan, Pryor, & Branas, 2006).

2. Conduct large-scale trainings of police, educators, and the public in hemorrhage control, taking care not to expose young children to trainings designed for adults. Hemorrhage kits can be kept in areas where crowd sizes are large.

3. When arriving at the scene of a mass shooting, police, EMS and other first responders should form an integrated command center. To the extent possible, transport of seriously injured people to a trauma center hospital should be a first priority by whichever public safety professionals are first to arrive on scene and can safely transport.

4. After being appropriately trained, police should be permitted to triage and transport people who have been seriously injured in a mass shooting to a designated trauma center hospital, *without waiting for EMS personnel*. Jurisdictions should establish direct police-to-hospital transport polices and dedicate equipment and training in support of these policies.

5. Police and EMS professionals should be thoroughly trained in systematic procedures for accurately triaging people in mass shootings. Simulations and virtual trainings can help prepare these public safety professionals for mass shooting events and triage.

6. With proper training, equipment, and support from police, EMS professionals can safely be brought into the "warm zone" near a mass shooting and begin to transport and administer medical support sooner than they otherwise would be able to.

7. Before the first seriously injured people arrive at their emergency departments from a mass shooting, all hospitals should follow the team-based model used at trauma centers and be well prepared in advance to receive these patients. This can be expedited using closed-channel, public safety communication systems that have been tested and prepared in advance, although disaster response coordinators and hospital managers are also encouraged to monitor social media for unplanned patient surges.

8. Hospitals should not only be aware that they are likely to experience additional waves of severely injury patients from a mass shooting, but also be prepared in that these waves of additional people may be more severely injured than the first wave to enter the hospital (Carr et al., 2016).

9. Hotlines can be established to better address concerns from family, friends, and the community and prevent overburdening of local communications systems.

10. Medical and public safety systems should only direct appropriate responders onto the scene of mass shooting and discourage "good Samaritan" response from random members of the public, as well as from non-essential medical and public safety professionals who may be off-duty or coming from far away. Despite often being well-intended, mass casualty over-response is inefficient, creates congestion, and can dangerously impede evacuation and treatment (Carr et al., 2016).

Even though responding to a mass shooting will inevitably be difficult, these steps, if implemented, can help to save lives and decrease burdens on first responders, other medical professionals, educators, and affected families and communities.

In 2016, a systematic review was published specifically on the best prehospital ways to respond to a mass shooting, with focus mostly on the actions of the EMS. The main themes the authors found were consistent with ours, highlighting the value of hemorrhage control, improvements in triage, simulations, and tactical emergency medical support or TEMS (Turner, Lockey, & Rehn, 2016). We, however, have expanded the scope of their review and have looked at all forms of improving rapid respond to mass shootings, including the role of health systems, the education sector, and the general public.

Some limitations to our scoping review must be taken into consideration. First, although we used Pubmed/MEDLINE and Scopus, which include medical, sociology, and criminology journals, there was little gray (non–peer-reviewed) literature in our review that could be informative in considering best practices for rapid response. We did keep search terms as open as possible, however, to ensure that we did not miss any important articles. Nevertheless, this review should be used as a guide for further exploring the literature on rapid response to mass shootings as it may not include specific procedures that are localized to specific law enforcement jurisdictions, hospital networks, or school districts. Another limitation was that most of the articles included in our search were commentaries or reflections, and few were empirical studies. The reason is because of the lack of support for research in the area of gun violence prevention as the result of substantive federal funding limitations (Alcorn, 2017). With that said, many of the included articles contain first-hand responses and real-life experience from individuals who had a role in rapidly responding to a mass shooting, which are valuable in understanding how the medical professionals, the EMS, and the public can better respond to these events.

With this in mind, some notable areas need greater research. For example, the role of social media in identifying people involved in mass shootings and mobilizing first responders is unexplored. Although advocated as the correct procedure for public response to mass shooting, the "run, hide, fight" strategy has yet to be systemically evaluated. Because of the nature of this topic, there is also little empirical evidence beyond simulations, surveys, and case reports from which to build best practices and research-based interventions. As such, we suggest that more research be conducted, including stronger designs like case-control studies, to understand better the best tactics for rapid response to mass shootings in a variety of settings including public spaces, large venues, and schools.

4 | CONCLUSION

Ultimately, to reduce casualties and deaths from mass shootings, the United States must invest in efforts to prevent these tragedies from occurring in the first place. This means investing in initiatives stemming from multiple sectors: For example, implementing stricter firearm laws known to be associated with reductions in mass shootings (Reeping et al., 2019), advancing programming efforts in schools and neighborhoods to address factors that are known to predict violence, increasing access to health care and mental health care across communities, and rethinking law enforcement practices (Leser, Looper-Coats, & Roszak, 2019). As mass shootings continue to persist, however, planned and efficient rapid response, which also includes multiple, coordinated medical and law enforcement sectors, is also a key approach to minimizing the death and disability that an active shooter inflicts. This rapid response should consider all parts of a mass shooting: from when the first bullet is fired until the last patient is transported to the hospital. By using new and coordinated trainings, drills, and technologies, the public, educators, law enforcement, EMS, and medical professionals can feel more confident and better respond to these tragic events.

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