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Research Article

Active Shooter Survivability of Persons with Mental Health Services Training

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Abstract

Background: Eight Medical Reserve Corps' (MRC) Units from Darke, Shelby, Miami, Champaign, Clark, Preble, Montgomery, and Greene counties in Ohio conducted Mental Health First Aid (MHFA) and Active Shooter (AS) training for MRC volunteers. The purpose of the training was to improve regional Mental Health (MH) emergency response capacity.

Methods: MHFA training was provided by certified trainers. AS training was provided by law enforcement officers. Volunteers were randomly assigned to three conditions: Contact (C) with assailant, Barricade (B), Survive (S) in 3 different orders: Group 1 exposed in CBS order, Group 2 BSC, Group 3 SCB. Survival during the AS scenarios were keyed to responses to a disgruntled person, run-hide-fight, and perimeter safety.

Results: Willingness of volunteers to provide MHFA was not changed by AS training (p=0.679). There was no difference in MH knowledge of (p=0.823) or attitude (p=0.138) among volunteers with previous MH training. Among those without MH training, participation in the AS scenarios increased their ability to provide MH services from awareness to novice level (p=0.019). Volunteers who had prior training in MHFA had higher AS survival rates than those with other MH trainings (86.1% versus 70.3%, p=0.024). Survival from an AS event was higher among volunteers who had prior MH training than those without (89.8% versus 75.5, p=0.004).

Conclusions: When the 'staged' AS training introduced realism (guns firing, injured and dead moulage victims, escaping to survive while holding hands up to move past armed police) survival increased compared to others with less direct exposure. There was a dose-linear response in survival rates with 'early-on realistic exposure' resulting in greater survival. Realistic and dramatic AS training increased survival and among novice volunteers, ability to provide MH services. Individuals with pastMH trainings did not demonstrate improved MH knowledge, their AS survival increased.

Introduction

After the San Bernardino County mass shooting terrorist attack at the Health Department on December 2, 2015, there was an increase in local preparedness activity related to mass shootings [1]. Our 8-county area conducted prior preparedness activities including integration of public health response with hospitals and law enforcement, community mass care, mental health triage, medical allocations to persons with special needs, and mass prophylaxis [2-6]. As part of a 2015-2016 Challenge Award from the National Association of County and City Health Officials, public health agencies from the 8-county area (Darke, Shelby, Miami, Champaign, Clark, Preble, Montgomery, and Greene counties) conducted Mental Health First Aid and Active Shooter workshop for Medical Reserve Corps (MRC) volunteers (see acknowledgements). The sequential preparedness activities will be discussed to attempt to show the research as an incremental improvement in the region's preparedness activities, as well as to present novel findings of the impact of mental health training on active shooter response.

Even before the bioterrorism attacks of 2001, there had been concern about the capacity of local public health to protect the public from a terrorist attack. Strategies to get lifesaving services to those exposed were among the critical-bioterrorism-preparedness issues identified after the post 9/11 anthrax attacks [2]. Remediation of long-term effects by providing prophylaxis, integration

of the response through establishing partnerships, and enhanced preparedness through training beyond awareness levels are concepts applicable to a wide range of disaster medicine and public health preparedness.

In a vaccination campaign to prevent pandemic influenza, agency level capacities and deployment of resources are vital to saving lives [7]. There are many stakeholder agencies integrated in a public health system including law enforcement, hospital, emergency medical services, public safety, and public health. The type and managerial-cultural-style specific to the agency are significant independent predictors of lives saved [8]. What response agencies do, as well as their structure, partnerships, and strategies are key to a successful public health response to disasters.

What has previously worked to prepare the community for disasters has helped in the following ways: A mental health-screening tool to screen survivors of natural disasters for PTSD and depression was efficient and easy to use [9]; The willing volunteers' training, medical knowledge, and preparedness significantly increased the odds (>18:1) of correctly routing survivors to the right service [4]; Public health workers and Medical Reserve Corps (MRC) volunteers were 15% more effective at correctly triaging survivors to mental health services when past trauma was considered as a risk factor [5].

Even in a fairly routine response, victims' needs, although medically stable initially, can become physically fragile quickly, due to the ongoing disaster effects causing loss of medicines and services normally available to them [10]. This is especially true for persons with chronic conditions including mental health service needs [5]. Not only can the disaster cause a secondary event among survivors, volunteer responders must be carefully evaluated for psychiatric conditions after responding to a disaster since they are more vulnerable than professional responders [11]. Memories of an active shooter event can trigger psychological symptoms weeks to years after experiencing a disaster [12-13]. Individuals who live in areas where terrorist attacks occur have had a higher prevalence of post-traumatic stress disorder, PSTD [14]. PTSD was higher in New York City two months after 9/11 compared to other US Residents.

Mental health screening and treatment is not necessarily a priority to disaster victims, though it was identified as a need by disaster service providers [15]. Many of the service providers recognized the need for evacuees to receive psychological services. Despite this need, it appeared to many service providers that evacuees underutilized therapeutic services. One participant suggested that this underutilization might be due to stressors within the post hurricane environment and the prioritizing of current needs by the survivors. Communities should include mental health screening in their disaster plans. Even communities with plans in place may not address the mental health needs of all constituents [16]. While a majority of residents were found to have received an early and proactive outreach and targeted responses from specialized mental health services, an important minority had not been reached as planned. Community mass care plans should incorporate evidence based triage tools to improve the triage efficiency of individuals with chronic healthcare needs [5]. A chronic care triage process as part of community mass care management that considers the availability of personal care assistance and service methodology will enhance the allocation of functional needs support services and increase compliance with Americans with Disabilities Act requirements.

Increasing communication with family, friends and neighbors helps people cope with PTSD [17]. Individuals engaging in interpersonal communication to help themselves cope with the Joplin Tornado disaster resulted in those with the most severe symptoms engaged in the most frequent coping behavior. This pattern of coping behavior should ultimately improved mental health. Social interactions between victims of mass casualties and their families and friends promote well-being compared to seeing professional counselors [18]. Face-to-face interaction significantly improved well-being; however, interacting with friends and family members through e-mail, text messaging, or other forms of social media was unrelated to well-being.

Response to the Gulf Oil spill had not only an impact on the ecosystem but also caused PTSD in groups of children living in the community [19]. There appeared to be a cumulative interactive effect such that those with high preexisting PTSD symptoms, high previous hurricane exposure, and high oil spill-related stress having the most elevated post-oil spill PTSD symptoms. This finding demonstrates the synergistic and disproportionate consequences of cumulative stress and trauma on youth with preexisting difficulties. Physiological changes occur in the brain after a traumatic event [20]. Alterations in brain function are seen shortly after major traumatic experiences, highlighting the need for early evaluation and intervention for the trauma survivor. Mental health disorders increase in communities after a mass disaster [21]. Exposure to the Canterbury earthquakes was associated with a small to moderate increase in the risk for common mental health problems.

Social support and resources after a mass shooting event can provide improvements for individuals experiencing chronic depression and anxiety [22]. Some participants showed substantial improvements in depression and anxiety. These individuals had elevated levels of depression and anxiety before the shooting and experienced a marked reduction soon after. A short intervention pre-event or immediately following trauma exposure could prospectively mitigate the development of post-traumatic stress syndrome after an active shooter traumatic exposure [23]. Training increased mental health capacity in a rural community [24]. Training improved ability and confidence of rural support workers to provide mental health first aid for members of their communities.

Training improved the confidence, ability and comfort aiding individuals during active shooter events [25]. Attitudes and perceptions regarding EMS active shooter incident response appear to change among providers after participation in a focused active shooter response-training program. Training using the Fast-Mental Health Triage Tool improved the skills of MRC volunteers [3]. The incorporation of a temporal component should be evaluated for potential inclusion in existing mental health triage systems. Mental health first aid training aided high school students in their ability to interact and assist individuals with mental health illnesses [25]. Training for high school age students is an effective program that improved community capacity to provide mental health first aid.

Within the increasing incidence of active shooter events, MRC units should prepare volunteers through critical training [26]. An overwhelming majority of MRC units provide critical training to their volunteers prior to an emergency deployment. To further strengthen the overall MRC capacities, it is important for MRC units to have a training plan tailored to their community needs and features.

Training may improve confidence and capacity but not necessarily knowledge [27]. Training improved MRC volunteers' confidence and capability to provide psychological first aid. Mental health first aid training improved the ability of MRC volunteers to effectively assist individuals with mental health problems related to disasters [28]. Training improved mental health literacy and abilities to identify and assist those with mental health issues.

Disaster response organizations should plan mass treatment or preventing strategies taking into consideration extra time required by some special needs individuals and children [29]. Planning to provide assistance for those individuals who may require additional help before, during, and after an emergency is needed. Specifically, public health planners should be aware of how to provide assistance to people with disabilities and to develop or augment existing response plans for these populations [2]. The Bioterrorism Preparedness and Response Survey found issues related to the local health department's ability in a public health emergency response.

Training using the CDC's Radiological Terrorism Toolkits for Public Health Officials and Emergency Services Clinicians improved community mass care triage skills of MRC and Public Health employees [4]. Alleviating stressors of daily living after disasters should be a priority of public health policy to reduce PTSD [30]. Experiences during and immediately following Hurricane Ike were the primary determinants of PTSD. Training increasing confidence and inclination to assist those with mental health illnesses [31]. Training contributes to increased confidence and inclination to act when meeting people with mental health. Mental health first aid training improved the ability of MRC volunteers to effectively assist individuals with mental health problems related to disasters [32]. Training improved mental health literacy and abilities to identify and assist those with metal health. Training improved the confidence, ability and comfort aiding individuals with mental health issues [33]. Trainees are better informed regarding assessing suicide risk, listening nonjudgmentally, encourage professional referral, and encourage self-help strategies. Training for mental health and providing support decrease PTSD in the responder and survivor respectively.

In summary, terrorism related preparedness activities have increased from 2000 through 2017 [1-7]. Critical issues to get life saving services after terrorist attacks included medical prophylaxis, integrated response among agencies, and training beyond awareness level [2]. Later, specific findings included agency level capacity, deployment of resources, organizational structure and culture. Community mass care including getting those affected and resources to the right place [4-11]. Preparedness efforts became more refined to respond to mental health effects of terrorism including early and efficient triage even of those currently healthy but exposed to psychological trauma. Efforts associated with response and preparedness efforts to those with chronic illness before and after the disaster event were continued to be refined [12-21]. Efforts to understand the preparedness needs related to active shooter were focused on with training improving the ability to provide comfort and other assistance by EMS and volunteers [22-33]. This current study will present new findings of the impact of Mental Health First Aid training on active shooter response.

Methods

Two trainings were conducted: Mental Health First Aid and Active Shooter. The target audience was Medical Reserve Corps volunteers. Baseline and post-testing were conducted around three active shooter scenarios. Mental Health First Aid training was provided using standardized curriculum. Other prior active shooter and mental health trainings were noted. Analysis of variance was used to measure training effectiveness. All volunteers who attended the active shooter scenarios were exposed to three conditions in varying orders: Contact (C) with assailant, Barricade (B), Survive (S) (shootings, escape past dead and injured, past armed police who ordered hands up). Volunteers were randomly assigned to 3 groups: Group 1 exposed in CBS order, Group 2 BSC, Group 3, SCB. Mental Health First Aid training was provided by approved trainers. Active Shooter training was provided by law enforcement officers where the volunteers were in the role of persons experiencing an active shooter event. Statistical tests included independent t tests, analysis of covariance and univariate modeling on level of ability. Evaluations included training history, perceptions on ability to provide mental health services after an active shooter incident, knowledge of mental health, attitudes about mental health, and willingness to provide mental health services after an active shooter event. Survival of volunteers during an active shooter scenario (based on responses to active shooter including response to disgruntled person, run-hide-fight, and perimeter safety); past mental health training categories of 'no prior mental health training', 'other mental health training' and 'mental health first aid'; and univariate modeling of order of exposure groups.

The volunteers were randomly allocated into three different groups (Contact, Barricade, Survivor). Group One had initial Contact with the irate person but otherwise did not experience the active shooter event directly. Group Two had to Barricade themselves in to protect themselves from an active shooter. Group Three were Survivors, amidst shots being fired, that had to evacuate past dead and injured victims, and had to hold their hands up as they past the security perimeter. The experience was sequential from, just contact with the first group, to the second group hearing shots and barricading themselves in, and the third group hearing shots, seeing injured and dead victims, and evacuating to survive. Participation in the mental health training was not a mandatory requirement for participation in the active shooter training. The goal was to see if volunteers respond better to active shooter events while controlling for their past active shooter and mental health trainings.

The volunteers were surveyed for knowledge of mental health services and ability to respond to an active shooter event. The active shooter research construct was that any behavior along four areas that were inconsistent with surviving an active shooter event was considered a failure. These four areas included responding to a disgruntled worker, opting to fight if backed into a corner, evacuating when alerted and after hearing shots from the far side of the building, and providing mental health services in a safe area. The response to the disgruntled, recently divorced worker who had also purchased multiple weapons was coded as a success if the volunteer initially listened, documented, and/or reported suspicious behavior rather than immediately evacuating, counseling, or calling the police. Independent t tests were conducted by stratifying on prior mental health or active shooter trainings on percentage of volunteers who would survive compared to baseline after participating in the active shooter scenario.

Analysis of covariance (ANCOVA) was conducted on the effect

of mental health training on the MRC volunteer's ability to survive an active shooter event. A requirement of this analysis is that there is independence between the factor, the phase of baseline and post-event, and covariate, prior mental health training. There should be no significant interaction between the covariate and factor. Interaction was tested for and there was no significant interaction for prior mental health trainings and survival by phase (baseline or post-event) or by condition. The condition variable expands the scenarios into the three groups of Contact, Barrier, and Survivor but keeps the baseline variable the same. These results show homogeneity of the coefficient for the covariate (prior mental health training) across the levels of factor (phase or condition) remain the same.

The goal was to train volunteers in both Mental Health First Aid and in Active Shooter response. Public Health Dayton-Montgomery County received the award in December 2015. Urgency was added to our training efforts when the deadliest mass shooting in US occurred on June 12, 2016 at the Orlando night club in Florida [6]. Another shooting occurred at San Bernardino on April 10, 2017 further supporting the need for communities to prepare for active shooter events. The objectives included exploring the effect of mental health services on MRC volunteers' response to an active shooter incident and describe the evaluation of the effect of mental health training or no training on Medical Reserve Corps volunteers' competency to contribute to a mental health response after an active shooter incident.

Results

Willingness of volunteers to provide Mental Health First Aid (MHFA) during an active shooter effect was not changed by participating in an active shooter scenario (F=0.579, p=0.679). There was no difference in knowledge of (F=0.380, p=0.823) or attitude (F=1.784, p=0.138) about mental health among volunteers and their training in MHFA or psychological first aid. Among those without prior mental health training, participation in active shooter training increased their ability to provide mental health services from awareness to novice level (p=0.019). Volunteers who had prior training in MHFA had higher active shooter survival rates than those with other mental health trainings (86.1% versus 70.3%, p=0.024). Survival from an active shooter event was higher among volunteers who had any prior mental health trainings than those who had not (89.8% versus 75.5, p=0.004). When the 'staged' active shooter training introduced realism such as gun firings with blanks, injured and dead moulage victims, and having to escape to safety while holding their hands up to move past the police perimeter, survival of the trainees increased compared to other trainees that had less direct exposure to active shooter aspects. Further, there was a linear dose-response observed in survival rates, with early exposure resulting in greater survival than those who had gradual exposure to realistic active shooter event. There was a change in survival after the volunteers went through the active shooter scenarios. The standard deviation in survival decreased. After controlling for prior mental health trainings, the effect of participating in the active shooter scenarios increased survivability by 14.6% (p=0.004). In summary of the results: Active shooter training that provides a realistic and dramatic impression increased survival in a linear dose response and the ability among volunteer participants to deliver mental health services after an active shooter event. Unintended stress induced side effects may increase among some trainees with this type of training. While persons with past mental health trainings did not demonstrate improved mental health knowledge, those with mental health training had increased survival in an active shooter event.

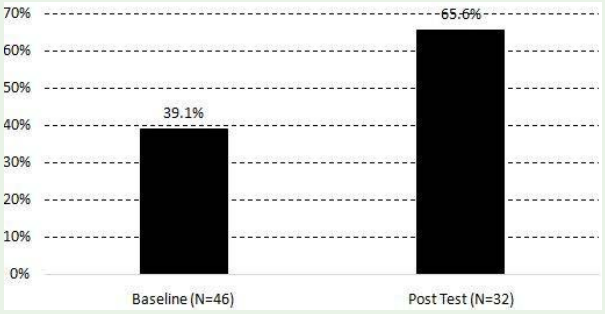

Figure 1: Effect of Active shooter workshop on survival (p=0.021). Independent t tests, equal variances are not assumed.

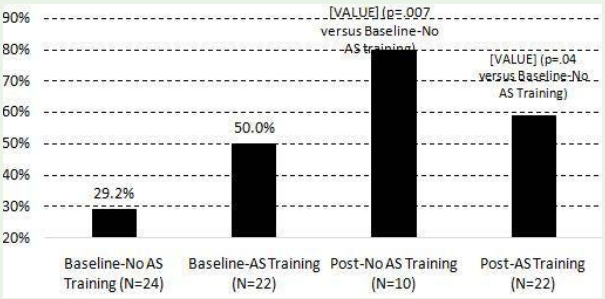

Figure 2: Effect of Active shooter (AS) workshop on survival.
One way analysis of variance (p=0.035) comparing prior AS training on survival.

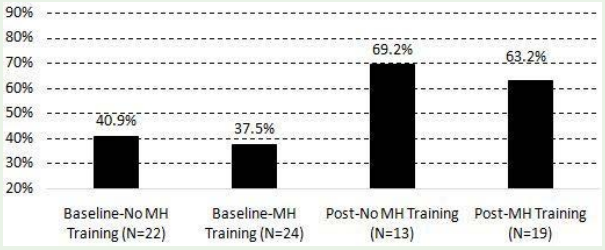

Figure 3: Effect of Active shooter (AS) workshop on survival.
Analysis of variance (p=0.144) comparing prior Mental Health (MH) training on survival.

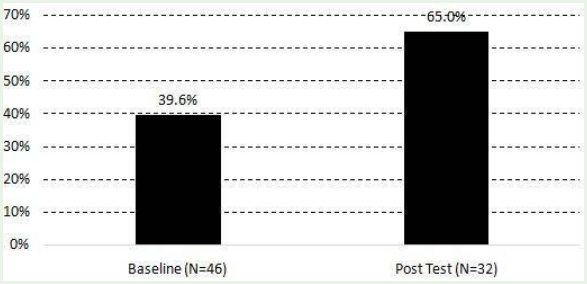

Figure 4: Effect of Active shooter (AS) workshop on survival.
Analysis of covariance estimate of marginal means of survival control for prior AS training (p=0.031).

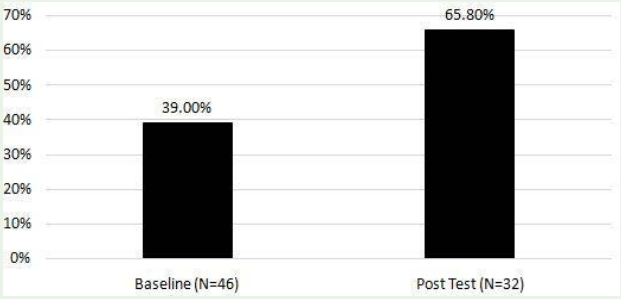

Figure 5: Effect of Active shooter (AS) workshop on survival.
Analysis of covariance estimate of marginal means of survival control for prior Mental Health training (p=0.021).

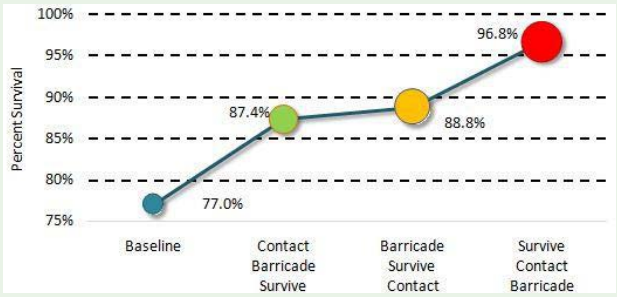

Figure 6: Effectiveness of active shooter workshop on survival by type of active shooter scenario.

Discussion

The current internet based public health surveillance of communicable diseases in Ohio, the Ohio Disease Reporting System (ODRS) began in 2001 [34]. ODRS is Ohio's portion of the National Electronic Disease Surveillance System. Public Health syndromic surveillance systems are for detecting a disease outbreak before the disease itself is detected [35]. Chronic disease surveillance system data has been evaluated for long term trends and potential enhancements [36]. ODH has started to include emergency room injuries and diagnostic codes into their real-time emergency room surveillance system [37]. The use of communicable disease reports varied greatly, the export data has not routinely been used for quality improvement purposes of the disease reporting process itself [38]. In December 2014, Greene County Public Health (GCPH) began a project to improve the response to health outbreaks finding that centralization of command should be implemented at the local level to ensure proper management of outbreak response [39]. Through centralization of command disease reporting times were improved from two to less than one day. There is a clear implication that chronic disease surveillance including mental health is the next logical step in the process of strengthening the public health system. Analogous efforts on how medicines are delivered from the federal stockpile to states in the aftermath of disasters have been ongoing [40]. Consider the paradigm of community mass care regarding radiation effects [4]. Widespread radiation exposure is similar in prevalence to the widespread of exposures to traumatic events during and after a disaster. Early intervention with MHFA helps limit the bad effects of trauma. Does it also limit the good psychological effects from trauma? For instance, the adage "What doesn't kill you makes you stronger." There is also the belief that prior events somehow impart knowledge or skill. However, repeated trauma is known to be psychologically impactful. But is this universal among all survivors? Is there a spectrum of response among survivors who have had repeated trauma? For instance, in the subset of survivors with repeated trauma what is the distribution of quick psychological recovery? It is certainly more likely that there is a skewed distribution of a few survivors who have high resilience and recover quickly with a gradual increase towards longer recovery rather than the notion that all survivors with a history of prior trauma have poor psychological recovery rates. The probability distribution of the psychological impact of traumatic events are unique for specific positive histories of adverse child hood events, and even has a break point of four or higher events for chronic mental health effects persisting to childhood. It is reasonable to assume if the exposure history for adults is categorized into specific levels of past traumatic events within the past year, the probability distributions would be unique with a higher on average latency to recovery with the greater number of past traumatic events. Active shooter training can be simulated to good effect on limiting the effects of psychological trauma. Specifically PFA and MHFA response is improved with simulations and classroom training. Also, the interrater reliability has been shown to be high in fast mental health triage [3]. These three findings taken together suggest validity of a simulation. MHFA training and active shooter simulation should provide a valid research construct to test hypotheses.

There is also the possibility of the healthy survivor effect. Those that do well after trauma are those that have done well, while those that do not do well have a propensity to have a greater amount of information lost to follow up. Baseline testing to control for those can be done for the full spectrum of survivor type in a simulated environment and if exposure assessments are available for those lost to disasters, in real world situations. Given the sensitive nature of an active shooter simulation, the survivor effect determined from a real-world event is much less feasible. The implications for research is that a two-sided test is called for. That is a test for both positive and negative events of the psychological effects from trauma.

Focused active shooter training has been shown to improve the perception of EM response from 41 to 89% and the feelings of being adequately trained from 36 to 87% [41]. Many law enforcement agencies have school resource officers who conduct graduated training in active shooter situations that are developmentally matched to grade levels. Defining roles and updating emergency operation plans will mitigate the risk in schools from active shooter events [42].

The number of active shooter events has been steadily increasing over the years. According to a study published by the Federal Bureau of Investigation, the vast majority of these incidents take place in commercial and educational environments [43]. Mass casualty shootings pose significant challenges to emergency medicine physicians and surgeons when survivors present with life-threatening injuries. Following the horrendous event that took place at Sandy Cook Elementary on December 14, 2012, the American College of Surgeons in conjunction with the FBI, the National Security Council and other governmental and medical officials formed the Joint Committee to Create a National Policy to Enhance Survivability from Intentional Mass Casualty and Active Shooter Events [44B]. Thus giving rise to the Hartford Consensus which are the committee's

recommendations on the matter. It consists of four parts, which in summary suggest methods to improve the survival of victims using a multi-agency approach in which all arms of the team are capable of responding in an efficient, synchronized, concise manner at any given moment.

Typical response to an active shooter involves a sequential approach in which law enforcement officers are responsible for disarming the active shooter followed by rescue of victims by first responders [44]. In the consensus they present a strategy based on the acronym THREAT: 1) Threat suppression 2) Hemorrhage control 3) Rapid Extrication to safety 4) Assessment by medical providers 5) Transport to definitive care. This concept stresses continuity of care from the initial interaction with first responders until the final transport of victims to a definitive care provider in a hospital setting where initial transfusion, resuscitation and surgical intervention can take place [45]. According to this consensus, early control of bleeding at the scene of the event is key to increasing the survival of critically injured victims. In the prehospital setting, massive bleeding is the second leading cause of death and is responsible for 30-40 percent of all mortality [46]. They propose that law enforcement officers should undergo hemorrhage control training and implement this into their initial response to an active shooter event where critically injured victims are present. Furthermore, they propose that communities may benefit from this sort of training as well in hopes that minimally injured or uninjured patrons can serve in a rescue capacity as immediate responders [45].

In the mass-casualty shooting that took place at an Orlando nightclub on June 12, 2016, which left over 50 people dead and over 50 injured, paramedics were not allowed to enter the building for an extended period of time because the scene was deemed unsafe. In addition to the Hartford Consensus, the FBI also adopted the ALERRT (Advanced Law Enforcement Rapid Response Training) program as their national standard for special agent tactical instructors [47]. This also holds true for many state and local agencies in response to active shooters. This training equips law enforcement officers, EMS and firefighters with the skills and knowledge to provide care in the immediate setting of an active shooter or mass casualty incident in order to effectively navigate the situation and increase victim survival [48].

The present study suggests the need for mental health first aid training amongst volunteer Medical Reserve Corps as it improves their survival. It is unknown whether this increased survival among these responders translates to increased survivability among victims but further investigation is warranted.

In the emergency room the incoming patients are cleared from all possible dangers to the ER personnel. In the field however, first responders don't know if they are in danger. In the Orlando event the victim's outcomes were impacted due to the delay in helping them. Medical and public health staff, and volunteers require mandatory training that is proven to help. Mental health first aid, in this study was shown to help participants survive the active shooter event. Mental health first aid will also help in self-help by allowing responders and volunteers to handle stress. Stress is caused by underlying fear of the unknown. Arriving on scene the responders may not know but if they have the right training, regardless of the threat.

In summary, our findings found that volunteers who had prior training in Mental Health First Aid had higher Active Shooter survival rates than those with other mental health trainings (86.1% versus 70.3%, p=0.024). Further that survival from an active shooter event was higher among volunteers who had prior mental health training than those without (89.8% versus 75.5, p= 0.004). When the 'staged' AS training introduced realism (guns firing, injured and dead moulage victims, escaping to survive while holding hands up to move past armed police) survival increased compared to others with less direct exposure. There was a dose-linear response in survival rates with 'early-on realistic exposure' resulting in greater survival. Realistic and dramatic active shooter training increased survival and among novice volunteers, ability to provide mental health services. Individuals with past mental health trainings did not demonstrate improved mental health knowledge, however, their active shooter survival increased. Potential implications include providing Mental Health First Aid training to officers and medics expected to be first on an active shooting scene. This would include officers on special weapons units, school resource officers and consideration of providing both mental health and active shooter trainings when either training was indicated.

Limitations

Volunteers were randomly allocated to different groups, the debriefing at the end of each session were done with each group present, decreasing the robustness of exposure. This decreases the difference between groups (increasing a Type II Error) - however, this makes the significant findings of the order of exposure conditions more conservative.

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