



28 |

**Initial management of
mass-casualty incidents
due to firearms:**

Improving survival

by Lenworth M. Jacobs, MD, MPH, FACS;
Karyl J. Burns, RN, PhD;
Norman McSwain, MD, FACS;
and Wayne Carver, MD

Whereas much attention has focused on the weapons used and the mental health of the shooter, other issues, including the provision of timely care to the victims, have been somewhat overlooked.

HIGHLIGHTS

- Defines mass casualty incidents due to firearms as a public health problem.
- Discusses the phases of mass-casualty events and the factors influencing injury.
- Describes aspects of mass-casualty firearm events that require careful examination, such as medical scene management and tactical emergency medical support.
- Authors suggest that TEMS teams be used more frequently to deliver emergency care at the scene of the shooting.
- Introduces readers to the Joint Committee to Create a National Policy to Enhance Survivability From Mass Casualty Shooting Events. The ACS played an active role in creating this committee and in the development of a report the panel has released.

Since 1996, more than 60 mass-casualty shootings have occurred in the U.S, and 18 have transpired in other countries.¹ As these statistics demonstrate, gun violence is a public health problem. As such, analysis and policymaking are required to reduce the suffering and burdens that are a direct result of these events. This article discusses several aspects of mass-casualty firearm events that require careful examination, such as medical scene management and tactical emergency medical support.

Initial response

Whereas much attention has focused on the weapons used and the mental health of the shooter, other issues, including the provision of timely care to the victims, have been somewhat overlooked. One aspect of mass-casualty firearm events that has been examined inadequately is the initial response and immediate management of the scene. A key feature of medical scene management is the immediate assessment, resuscitation, and transportation of the survivors to a trauma center. Enhanced methods of scene management and patient care are needed to improve survivability. The Haddon Matrix, a conceptual model of injury prevention, can guide the analyses and evaluations required to develop and implement policies and procedures to maximize survivability.^{2,3}

The Haddon Matrix, which William Haddon, Jr., MD, developed in the mid-1960s, applies epidemiological principles to injury prevention.^{2,3} Initially, it was a two-dimensional model of phases (pre-event, event, post-event) and factors related to injury, namely the interacting components that contribute to an injury, including the host, the agent or vehicle, the physical environment, and the social environment.⁴

Carol W. Runyan, PhD, proposed a third dimension in 1998 to direct decision making.⁴ This third dimension accounts for psychosocial and economic aspects of injury that decision makers may use to select and implement the most appropriate strategies for injury prevention. The application of the Haddon Matrix presented in this article considers factors of the event phase of mass-casualty firearm situations and highlights the need for a decision-making process to implement strategies for increased survival.

Event-phase factors related to the agent of injury include the weapon, the shooter, the ability of law enforcement to neutralize the shooter, and the survivability of the victims. One area that needs more extensive consideration during the event phase is the ability of emergency medical services (EMS) personnel to expeditiously assess

The first priority needs to be assessment and care of the victims. As noted in the Prehospital Trauma Life Support program—patients are the most important people at the scene of an emergency.

and attend to survivors. Knowledge of the weapon and ammunition used and the type of injuries sustained may enhance their assessment.

Knowledge of the type of weapon and ammunition used in the shooting will help EMS to anticipate the nature and extent of injuries and to begin formulating a response. As with much of trauma, injury due to firearms is related to kinetic energy, or the force that is produced and strikes the victim. In addition, three characteristics of the frontal surface area of a bullet determine capacity to cause damage or cavitation: the profile, tumble, and fragmentation.³ The profile refers to the bullet's ability to increase its size on impact, tumble pertains to the bullet's ability to change its angle once inside the body, and fragmentation describes its capacity to break into pieces. All three factors increase the lethality of the bullet. Victims shot with a single, low-energy bullet that does not change size on impact, does not tumble to increase its impact, and does not break into fragments are more likely to survive.³

Determining the anatomy of the injuries is another assessment that needs to occur rapidly. Direct injuries to the heart or central nervous system are rarely survivable. An analysis of the Sandy Hook Elementary School shootings in Newtown, CT, in December 2012, by two of this article's authors—Dr. Carver, Connecticut's Chief Medical Examiner, and Dr. Jacobs, the Chair of the State of Connecticut Committee on Trauma, who was deputized to participate in the review—revealed injuries in 26 victims that were immediately lethal. However, two women at the event sustained injury to an extremity and survived.⁵ Survival from an extremity injury is not unusual. Injuries to the extremities or torso may be survivable if treated in time (minutes are critical at this stage), but may lead to hemorrhagic death if treatment is delayed.

Focus on the victims

Typically in mass-casualty shootings, law enforcement's initial focus is on the perpetrator. EMS is unable to attend to victims until the shooter has been

neutralized or law enforcement has declared the site of the event to be safe. This situation may cause significant delay in treating survivable victims. Delay can lead to an increased killed-to-injury ratio in contrast with a lesser killed-to-injury ratio when expeditious assessment and care occur. Again, time is critical.

Greater attention to the needs of the victims is important. The scene is a medical emergency. Law enforcement personnel must focus simultaneously on the shooter and the patients. A safe environment for EMS to quickly assess patients and begin their treatment, resuscitation, and transportation for definitive care is critical. Documenting the event and gathering evidence can occur while patients are being treated. The first priority needs to be assessment and care of the victims. As noted in the Prehospital Trauma Life Support (PHTLS) program—patients are the most important people at the scene of an emergency.³

TEMS teams

Unfortunately, mass-casualty shooting may create scenes that remain unsafe for extended periods of time, increasing the likelihood that victims who are not immediately killed will die from a lack of medical care. In such cases, tactical emergency medical support (TEMS) should be called to the scene.³ TEMS teams are specially trained and equipped to function within the perimeter of a danger zone. They support the special operations of law enforcement by carrying out such responsibilities as injury control, care under fire, special extraction, and tactical rescue. TEMS is designed to provide a system of care that supports the missions of law enforcement while maximizing victims' clinical outcomes and minimizing risk to caregivers. This kind of medical support incorporates the principles of military medicine, which include the tactical combat casualty care (TCCC) guidelines.³ These guidelines provide battlefield medics and corpsmen with strategies for managing trauma in a tactical environment. They are the standard of care for military tactical medicine. The American College of Surgeons (ACS) Committee on Trauma and the National Association of Emergency

Unfortunately, the time has come when intentional civilian mass-casualty incidents require a military-like response. This approach will enhance rapid assessment, treatment, and triage of patients.

Medical Technicians have endorsed these guidelines through the PHTLS program.³

Although military and law enforcement operations are unique, the TCCC guidelines may be used to standardize TEMS protocols.³ These principles are applicable to events that generate mass casualties where a team of responders is tasked to secure the scene and simultaneously access and treat multiple victims. The National Tactical Officers Association has endorsed TEMS and the TCCC guidelines.³ All communities should have rapid access to TEMS, including tactical EMS personnel who are trained for the exigencies of mass-casualty shootings. To achieve the earliest possible care, personnel in schools and other public places should be trained not only in evasive and protective maneuvers but also in first aid for penetrating injuries to themselves and others.

Unfortunately, the time has come when intentional civilian mass-casualty incidents require a military-like response. This approach will enhance rapid assessment, treatment, and triage of patients. Mass-casualty shootings should be viewed as medical scenes where treating patients is a top priority. Although the concepts proposed here would not have saved the 26 Newtown victims, survivability of future mass-casualty shootings will be enhanced if EMS and law enforcement personnel adopt policies and procedures for rapid patient assessment, treatment, and transportation to definitive care.

ACS plays leadership role

The ACS has taken a leadership role in achieving the goal of an integrated response system to rapidly care for patients in these horrific events. Recently, the ACS brought together professionals to form the Joint Committee to Create a National Policy to Enhance Survivability From Mass Casualty Shooting Events. The committee had representation from the ACS Board of Regents, the ACS Committee on Trauma, the PHTLS Program, the Federal Bureau of Investigation, the Major Cities Chiefs Association, the EMS section of the International Association of Fire Chiefs, and the Committee on Tactical Combat Casualty Care. The joint committee met in Hartford, CT, on April 2 and produced a document titled "Improving Survival from Active Shooter Events: The Hartford Consensus," which is published in its entirety on the following pages. The organizations and agencies involved in the development of this document anticipate that it will be useful in promoting local, state, and national policies that will improve survival from mass-casualty shootings. ♦

REFERENCES

1. Pearson Education. Time line of worldwide school and mass shootings. Available at: <http://infoplease.com/ipa/A0777958.html>. Accessed February 15, 2013.
2. Haddon W, Jr. The changing approach to the epidemiology, prevention, and amelioration of trauma: The transition to approaches etiologically rather than descriptively based. *Am J Public Health Nations Health*. 1968;58(8):1431-1438.
3. Salomone JP, Pons PT, eds. *PHTLS, Prehospital Trauma Life Support*. Military 7th ed. St. Louis, MO: Mosby JEMS Elsevier; 2011.
4. Runyan CW. Using the Haddon Matrix: Introducing the third dimension. *Inj Prev*. 1998;4(4):302-307.
5. Ng C, Goldman R. Two adult school shooting survivors will be key witnesses. Yahoo News/Good Morning America. December 17, 2012. Available at: <http://news.yahoo.com/two-adult-school-shooting-survivors-key-witnesses-151437205--abc-news-topstories.html>. Accessed February 14, 2013.