WHEN MINUTES MATTER: Lifesaving care in mass casualty incidents
This special Bound Tree University guide brings together articles written by experts to help EMS providers, law enforcement officers and laypeople better prepare for mass casualty incidents — especially those involving severe bleeding.

Because the consequence of uncontrolled bleeding is loss of limb or life, those first minutes are so critical. The training and tools to control bleeding need to be easily accessible and available to all emergency responders, as well as laypeople.

For an EMS provider, mass gatherings and public events can be some of the most challenging venues in which to work safely. EMS workers need to understand how to keep themselves as well as the public safe, all while properly treating the injured. Learn more about factors that affect crowd control, how to preplan properly and how to use incident command systems.

Law enforcement officers are often the first on scene. Coupled with the right tools, officers have the potential to decrease the time it takes for patients to receive lifesaving care. Police officers regularly use AEDs and naloxone to save lives. Now they are using tourniquets to care for life-threatening bleeding from gunshot wounds, shootings and accidents. Read about the role of law enforcement officers as medical first responders.

Prior to a trained medical responder arriving on scene, programs that help laypeople identify and control severe bleeding can make a difference in patient outcomes. Learn how public access hemorrhage control programs apply the successes and principles from public access AEDs to make tourniquets available to laypeople, often times in the same cabinet as an AED.

When minutes matter, the preparation of you and your community can make a difference.

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EDITOR’S NOTE

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EMS systems are called upon to perform a variety of functions in protecting community health. Providing standby medical coverage for large gatherings such as sporting events and fairs is a specialized task that requires significant preparation to fulfill reliably and efficiently. However, with proper planning and communication among stakeholders, EMS providers can provide effective coverage that can scale rapidly in case a mass casualty event occurs.

**What is mass gathering and why is it different?**

Perhaps not surprisingly, there is not one single definition as to what constitutes a mass gathering. The National Association of EMS Physicians (NAEMSP) states that a mass gathering is an “organized emergency health services provided for spectators and participants at events in which at least 1,000 persons are gathered at a specific location for a defined period of time.” The World Health Organization defines a mass gathering as “an organized or unplanned event where the number of people attending is sufficient to strain the planning and response resources of the community, state or nation hosting the event.” These two definitions could be combined to define a mass gathering as a large group of people who gather for a specific purpose, at a specific location, where the potential for emergency response is significant and would overwhelm the daily operating resources of the local EMS system.

More practically speaking, examples of mass gatherings include events such as:

- Festivals, parades and fairs.
- Sporting events at the college and professional level.
- Major political and social events.
- Air shows, auto races, music concerts and religious gatherings.
- Running, biking and triathlon races.

In these examples, the incident population could range from hundreds to tens of thousands of people or more. This can result in a large number of people crowding into a small physical area. Panic stampedes at major religious, holidays and sporting events have occurred numerous times over the years, as well as support structures that fail under the weight of spectators. Mass gatherings, like the 2013 Boston Marathon, can also be targets for terrorists.
Factors that can affect crowd safety

1. Weather
There are several factors that can uniquely affect the dynamics and subsequent EMS response to a mass gathering. Weather can have a serious impact on a crowd that is unprepared for it. Heat and humidity can result in rapid dehydration and subsequent heat exhaustion, especially for pediatric and geriatric patients. Rain, snow and cold can produce hypothermic conditions, as well as hazardous footing that can result in fall-related injuries. Keep in mind weather can impact participants, like marathon runners, and the spectators that spend hours outdoors cheering on the runners.

2. Age
Attendee age and prevalent medical conditions can raise the potential for a large number of patients. Older patients have fewer physiologic coping mechanisms and are less likely to endure long periods of standing, elevated temperatures and other environmental conditions.

3. Drugs and alcohol
The focus of the festival can bring unique confounding conditions. Readily available alcohol and recreational drugs raises the possibility of overdose, trauma and violence. While event organizers attempt to provide safe operating conditions for both spectators and participants, events such as air shows and auto races have the potential for crashes that affect the overall population.

4. Location
Where the event is located adds yet another complication. A fair or festival may have limited access and exit points in order to restrict entry to the public, but can also create chokepoints for incoming response resources.

On the other hand, a parade, marathon or bicycle race may stretch across an entire city, spreading onsite resources very thin and potentially making it difficult to pinpoint a precise incident location.

5. Timing
The length of the event presents its own challenges. While most gatherings might last less than a day, a multi-day or even multi-week event can present significant logistical issues for participants, from available drinking water and food supplies to sanitary and trash services. Prolonged events also create a logistical challenge for EMS leaders to provide rest and refreshment opportunities for providers, shift changes and equipment restocking.

6. Potential for violence
The potential for intentional violence at high-profile mass gatherings have added yet another layer of complexity to incident planning. The 2013 Boston Marathon bombing demonstrated how critical surge capacity was in managing the critically injured and transporting them in appropriate order.

Early planning is critical
Given the complexity of a mass-gathering event, the EMS response may be as simple as a few medical units being stationed at the site, supplementing other medical resources, or as sophisticated as a mini-EMS system, with its own station, dispatching and freestanding emergency department. Each configuration requires forethought and careful planning.

It’s very likely that any planned event will require some type of approval from the local or regional authorities in order to operate. Public safety providers, such as EMS, should have a set of requirements that the sponsoring agency must meet before an event is approved.

During the planning phase make sure to not overlook the importance of reimbursement for EMS-related expenses. Will participant fees and ticket sales pay for EMS providers, disposable supplies and other costs?

An incident plan is mandatory. Given the parameters described earlier, each facet must be thought out carefully, with appropriate agencies, personnel, equipment and other resources allocated. The Federal Emergency Management Agency has a series of templates and guidance that local agencies can use to plan and organize an EMS response.

Get everyone involved
It’s critical that all stakeholder agencies are involved at one level or another during the planning and subsequent notification process. EMS, law enforcement and fire services are responsible for providing public safety; coordination among these agencies must ensure a clear line of reporting and a comprehensive communication system.

Often medical facilities are staffed at the larger events, either through a contracted clinic or hospital medical provider, EMS or a combination of both. Roles and responsibilities for all health care providers must be clearly defined so overlap of function is minimized and no gaps in coverage are created.
While most event-related illnesses and injuries are minor, hospitals must be made aware of the potential of a surge in patient load in case of disaster. Arrangements for offsite transport via ground ambulance and/or air medical services should detail staging areas, pickup points and access/egress locations.

Public health authorities are responsible for sanitation concerns surrounding toileting and cooking. While not obvious, reducing water and food-borne illnesses can minimize the potential for outbreaks within the event population.

Other services might include utility services, towing companies for keeping safety lanes open, and neighboring public safety agencies for mutual aid if needed.

**Command and control**

While small sized gatherings may require a simple command structure, medium- and large-scale events require the use of incident command system. All personnel should be well versed in standardized emergency management systems and be prepared to assume any role if a disaster strikes. During normal operations, SEMS can be used to maintain a cohesive line of communication among providers.

**Personal preparation for personnel**

Staffing a large scale event is significant. EMS providers should make sure they follow a few basic tips in order to remain alert and prepared to respond:

- Sleep well the night before and stay rested during the event.
- Use sunblock and bug repellent if appropriate to the venue. Stay hydrated by drinking water and avoiding beverages containing caffeine.
- Eat healthy and avoid overeating.
- Dress in layers in order to stay warm during overnight and early morning hours, and to stay cool during the daytime.
- Avoid injury by stretching and walking regularly during the event.

For a long duration event, staff schedules should allow for adequate rest periods and “off duty” time so that personnel can perform at their best while on duty.

With careful, thoughtful planning and resource allocation, EMS systems can be well prepared to manage mass gatherings effectively and without fanfare. If done well, participants will likely never know about the safety net that exists to protect them during what is usually a joyful fun event.

*References available online.*
For many medical and trauma emergencies, law enforcement personnel are the true first responders, arriving on scene before EMS providers. Although the law enforcement skill set is highly specialized to safeguard lives and property, and protect individuals in the communities they serve, many cops have not received extensive training in emergency medical care.

The utilization of law enforcement officers as first responders during medical emergencies has the potential to decrease the time it takes for a patient to receive lifesaving care. Patients who experience a sudden cardiac arrest, an opiate overdose, or significant trauma may benefit greatly from programs that equip and prepare law enforcement for immediate medical intervention.

Sudden cardiac arrest: AED deployment in law enforcement vehicles

The first three links in the American Heart Association’s Chain of Survival are early access to the emergency response system, early CPR, and early defibrillation. Each year, over 350,000 Americans experience an out of hospital cardiac arrest and only 41 percent of those patients receive bystander CPR. Equipping law enforcement vehicles with automated external defibrillators and ensuring that officers are trained in CPR and AED use allows lifesaving interventions to be delivered as quickly as possible.

Training in AED use can be completed in a matter of hours with a high degree of success, and many areas in the U.S. have already equipped law enforcement with AEDs. Studies suggest that deployment of AEDs in law enforcement vehicles significantly decreases the time from the initial 911 call to the delivery of the first defibrillation attempt, and increases survival to hospital discharge rates.

Implementing a law enforcement AED program is not without challenges. The effectiveness of equipping law enforcement with AEDs may be directly related to the number of first responding fire department vehicles that also have an AED.

An early study in an urban area of Ohio saw no significant changes in out of hospital cardiac arrest survival after equipping law enforcement with defibrillators, however in the test area all fire department vehicles were also equipped with AEDs. Response times for law enforcement and fire resources were similar in the study area, meaning that an AED usually arrived on scene early regardless of law enforcement response. This suggests that AED programs for law enforcement may have the most impact in areas where response times for EMS are notably longer than for law enforcement.
A study of widespread deployment of AEDs to law enforcement in Miami-Dade County in the late 1990s revealed the importance of officer support and comprehensive education prior to initiating an AED program. The study found that the average response time for police to a cardiac arrest event was just over six minutes, while response time for all other events was significantly faster at just over four minutes. The study suggests possible factors for the delay as lack of comfort with AED use, and concern over liability.

Another study in a Pittsburgh suburb showed similar results. Although law enforcement consistently arrived on scene before EMS resources, defibrillation was only used in 69 percent of cardiac arrest situations. Factors contributing to the inconsistent AED use included the expected imminent arrival of EMS personnel, failure to bring the AED to the patient, and excessively lengthy patient assessments.

These studies indicate that best practices for AED use by law enforcement include comprehensive education of officers prior to AED deployment. Comfort level of individual personnel with the use of an AED, and commitment to program implementation directly relate to rates of survival for cardiac arrest patients. Officers must be knowledgeable about the impact their AED can have, and be ready to respond to cardiac arrest situations appropriately.

AEDs may be most effective when deployed in areas where law enforcement response times are shorter than those of EMS, however given the effectiveness of early defibrillation on cardiac arrest patients it may be true that deploying more AEDs into a given community is a net plus, regardless of agency response times.

**Opiate overdose: Naloxone administration by police**

More than 220 law enforcement agencies in at least 24 states currently equip officers with naloxone for emergency administration to opiate overdose patients. Overdose deaths are not isolated to intravenous drug users. The availability of potent opiate-based analgesics makes opiate overdose a concern for patients in virtually all demographics. Death from prescription drug overdose has increased steadily in recent years, and overdoses in heroin users doubled between 2010 and 2012.

Opioid abuse and overdose causes significant respiratory depression. Death from opiate use occurs subsequent to hypoxia, and can occur very rapidly in some cases. The medication naloxone displaces opioids from the receptors in the brain, effectively reversing respiratory depression. Naloxone has been used for decades to reverse opiate induced respiratory depression, can be administered easily via an intranasal atomizer, and has no potential for abuse. The effectiveness of naloxone has prompted the development of community programs that provide naloxone and training in its administration to individuals who use drugs or know someone at risk of overdose.

Given the effectiveness of naloxone, and its successful use by otherwise untrained laypersons, it would seem that equipping law enforcement officers with the medication would provide significant benefit.

One such program, in Quincy, Mass., had great success after supplying officers with intranasal naloxone kits. Officers responded to 191 suspected overdose incidents, and successfully reversed 182 opiate overdoses. That same program identified an unexpected benefit, in that drug users’ perception of law enforcement became more positive once it was understood that lifesaving medication was available.

There are several barriers to successfully supplying law enforcement with naloxone. First, naloxone is a prescription medication and must be administered with some medical oversight. In Michigan and Pennsylvania, law enforcement operates under EMS protocols for naloxone administration and is therefore under the oversight of the EMS agency medical director. The other 22 states, at the time of this writing, that allow law enforcement administration of naloxone have statutes or regulation authorizing its use. Although these precedents are in place for regulation and oversight, organizing and implementing such statutory changes takes time and may hinder other states adoption of naloxone administration by law enforcement.

Legal liability may also be of concern for law enforcement agencies considering naloxone use, however these concerns would be unfounded. There are no records of any lawsuit relating to naloxone use through community programs or law enforcement administration. The use of naloxone for opiate overdose reversal is well established, and the risks of administration are very low. It would seem that concern over liability relating to naloxone use has little merit and would not be reason to delay implementing a law enforcement naloxone program.
The cost of naloxone is relatively low, approximately $60-$80 per two-dose package, but costs may be rising to match the increased demand for the drug. The administration of the drug in its intranasal form is simple and easy.

Law enforcement use of naloxone continues to grow. The prevalence of overdose deaths make the deployment of naloxone to law enforcement justified, as does the time sensitive nature of an opiate overdose emergency. First responding officers carrying naloxone have the ability to provide a life-saving reversal of respiratory depression prior to EMS arrival, allowing the patient to receive more definitive care in a timely manner.

Tourniquets and hemostatic dressings: Police treatment of severe bleeding

In recent years the U.S. has seen an increase in the number of large scale incidents involving penetrating trauma or blast injuries. Active-shooter incidents present an environment that resembles combat, with multiple patients located in a hot-zone environment that may not be safe for EMS personnel. The provision of tourniquets to law enforcement officers can allow for the rapid triage and treatment of individuals, including other officers, at risk of death from severe hemorrhage.

In the early 1990s the United States military began developing and implementing tactical combat casualty care, or TCCC. A significant component of TCCC is the control of severe bleeding during a traumatic event. Exsanguinating hemorrhage is the leading cause of death from injuries sustained during combat, and the proper application of tourniquets and hemostatic dressings has been shown to increase survivability of penetrating trauma and blast injuries in the military setting.

The benefit of tourniquet use among EMS providers is well recognized, as is the controlled use of hemostatic dressings in the prehospital environment. Military personnel use tourniquets and hemostatic dressings on a daily basis, yet the use of these lifesaving devices in the civilian setting has not yet been widely adopted.

The events of the Boston Marathon bombing highlight the potential benefit of equipping law enforcement with tourniquets. During that incident, it was identified that the rapid application of a tourniquet resulted in multiple individuals surviving who might otherwise have died from exsanguinating hemorrhage.

News reports from recent active-shooter incidents describe patients bleeding heavily, suggesting that tourniquets and hemostatic dressings may have been useful in those cases.

Commercially manufactured tourniquets and hemostatic dressings are simple to use, relatively inexpensive, lightweight, and require minimal training to be used effectively. Providing these lifesaving devices to law enforcement allows officers to protect the victims of violent crimes quickly and effectively.

Law enforcement officers are often the first public service providers to arrive at the scene of an emergency. The research in support of AEDs, naloxone and bleeding control methods supports the training of officers to provide immediate and life saving care for patients experiencing cardiac arrest, overdose and traumatic injury.

References available online.
PUBLIC ACCESS HEMORRHAGE CONTROL DEVICES

By Kenny Navarro

It is increasingly clear that rapid hemorrhage control contributes to better outcomes in critically injured trauma patients. The American College of Surgeons Committee on Trauma (ACS-COT) has stated that bleeding must be controlled by prehospital providers as quickly as possible. Recent products to control external bleeding have been introduced into the EMS market by various manufacturers.

However, in cases of severe bleeding, it’s possible that trained professionals may not arrive in time to stop it before the patient exsanguinates. The question becomes whether untrained laypersons could be the first part of the chain of survival, providing basic first aid before EMS arrives. Fortunately, there is precedence in this area of first response.

Layperson defibrillation
In the early 1980s the first FDA-approved automated external defibrillator became available in the United States. Soon, researchers demonstrated these devices in the hands of trained EMS personnel and even trained non-medical personnel posed little risk and were effective at saving lives. In fact, AEDs are so simple to use, sixth graders with no previous AED instruction were able to meet similar performance goals as trained emergency medical responders.

Today, AEDs have become part of the landscape in many areas of the country. In 2000, under the direction of President Clinton, the Department of Health and Human Services began preparing guidelines for establishing public access defibrillation programs in federal facilities. In 2006, the American Heart Association recommended that States enact legislation in support of the public’s access to defibrillators. To date, this legislation includes protection from liability when bystanders use the devices in good faith, and legislation to require certain business, schools and public gathering areas to implement PAD programs.

The argument for public access hemorrhage control
Hemorrhage is the second leading cause of death for patients injured in the prehospital environment, accounting for 30-40 percent of all mortality. Many of the patients who hemorrhage do so after suffering vascular injuries in one or more extremities.

The annual incidence of extremity vascular injuries in the U.S. ranges from a low of 12.4 injuries at a rural trauma center in Missouri to a high of 55 lower extremity injuries at a high-volume urban trauma center in Houston. In a study of isolated penetrating injuries to the extremities, 57 percent of the patients who died had injuries that might have been amenable to tourniquet application.
Current state of EMS care
A panel of experts in prehospital trauma care convened by the American College of Surgeons recently recommended the prehospital personnel, from emergency medical responders to paramedics incorporate the early application of tourniquets into clinical practice for controlling extremity hemorrhage when direct pressure is ineffective or not practical. The panel further recommends tourniquets selected for use at a local level be a commercially produced windlass, pneumatic or ratcheting type device with demonstrated efficacy at arterial flow occlusion.

Half of the EMS agencies in a California survey already incorporate tourniquet use into clinical practice for the control of severe extremity hemorrhage while the prehospital use of hemostatic gauze was extremely rare. Half of the local regions that allowed EMS personnel to apply tourniquets allowed improvised tourniquets rather than commercially produced devices.

Three commonly cited reasons for failure to implement Tactical Casualty Combat Care recommendations were the differences in injury patterns between combat and civilian casualties, a perception of no proven benefit in the civilian arena and the perception of harm from prehospital application.

However, prehospital application of tourniquets appear safe even when the tourniquet remains in place for one or two hours, with a reported complication rate of about 2 percent. Based on the past and continuing positive experiences from the military, it is likely that more and more EMS systems will implement treatment guidelines for the use of the prehospital tourniquets.

For maximum efficacy, tourniquets must be applied before the patient has developed shock. During Operation Iraqi Freedom, tourniquets applied in the prehospital environment and before the onset of shock were strongly associated with survival in this study, when field personnel applied the tourniquet before the onset of shock, rather than waiting for shock symptoms to develop mortality virtually disappeared (4 percent vs. 96 percent respectively).

Can the public help?
First aid courses often teach bystanders to compress a wound in an effort to control bleeding. Unfortunately, with severe injuries, compression may not be enough. However, an interesting question to consider is whether tourniquets applied before EMS arrival by ordinary citizens without medical training would provide additional morbidity and mortality advantages.

As you can well imagine, definitive evidence in favor of bystander application of tourniquets is sparse. Of the 243 patients injured during the Boston Marathon bombing, 66 had at least one extremity injury. Of those 66, 29 (44 percent) presented with life-threatening limb exsanguination including 15 patients with 17 traumatic amputations of the lower extremities and 10 patients with 14 major vascular lower extremity injuries. Of the 29 patients with life-threatening limb exsanguination, 27 had improvised tourniquets applied in the field with one-third applied by EMS and the remainder applied by non-EMS personnel or by an unknown person.

In a 10-year evaluation of isolated penetrating or blunt extremity injury requiring either arterial revascularization or limb amputation, only 2 percent of patients had a tourniquet applied before arriving at the trauma center and all were improvised tourniquets applied by police officers or bystanders. An additional 2 percent of patients had a tourniquet applied by emergency department staff within one hour of arrival. While a very small number of patients without a tourniquet exsanguinated, no patient with a tourniquet died.

During a seven-year period, researchers at Boston Medical Center identified 11 patients who had an improvised tourniquet applied in the field by EMS. Only one patient died, however, that patient was in cardiac arrest when EMS arrived on the scene. Of the 10 patients who survived, all had complete neurologic function in the affected extremity despite having the tourniquet in place for as long as 167 minutes (mean 75 +/- 38 minutes).

Summary
The military experience has demonstrated that complications associated with tourniquet use are rare, even when the tourniquet is improvised. The limited civilian data supports the safety of the devices. With untrained bystanders as part of the definition of a first responder, the Office of Health Affairs at the Department of Homeland Security recommends the availability of both tourniquets and hemostatic agents in the early management of severe bleeding.

References available online.
LIFE-THREATENING HEMORRHAGING

5,000,000
Approximately 5 million people die every year around the world from accidental & non-accidental trauma, making trauma the leading cause of death in people under the age of 45.¹

3 min
A victim who is bleeding from an artery can die in as little as 3 minutes.²

30-40%
Hemorrhage is the 2nd leading cause of death for patients injured in the prehospital environment, accounting for 30-40% of all mortality.³

28%
About 28% of patients with severe traumatic injury also have dysfunction in the process of coagulation (coagulopathy) when they arrive at the emergency department.⁴

16%
A Canadian study of deaths due to trauma at a Level 1 trauma center found that up to 16% of deaths would have been preventable with earlier recognition of bleeding & more rapid and effective hemorrhage control.⁵

EMS, law enforcement and laypeople utilize these solutions when responding to mass casualty incidents:

HEMOSTATIC GAUZES
BALLISTIC PROTECTION
TRAUMA DRESSINGS
TRIAGE KITS
STOP THE BLEED KITS
RESPONSE KITS


2. 2015 by The National Association of Emergency Medical Technicians https://www.facs.org/~/media/files/quality%20programs/trauma/education/bleeding%20control%20for%20the%20injured%20final.ashx


