

How Does the Response and Management of Terrorist Attacks by Emergency Medical Services in the UK Compare to Europe and the USA?

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Abstract

Research question

How does the response and management of terrorist attacks by emergency medical services (EMS) in the United Kingdom (UK) compare to Europe and the United States of America (USA)?

Introduction

Terrorist attacks and active shooter events account for a growing number of mass casualty and major incidents in the UK, Europe and the USA. In order to better prepare for future incidents, analysis of prior events is essential.

Methods

Systematic literature searches of papers published between 1/1/2004 and 5/31/2018 were conducted using two key databases: CINAHL Plus and PubMed (indexed from MEDLINE). Key contents of identified papers were abstracted, including EMS response and patient management, with emphasis placed upon identified recommendations and lessons learned.

Results

Four hundred and forty-two records were identified in the preliminary search, with 176 records further screened using the title and abstract. Ten papers were included in the final review, reflecting 13 events from five countries across two continents. Three major themes identified throughout the papers were emergency preparedness, resilience and response

(EPRR), casualty triage, and tactical emergency medical services (TEMS). These themes were present in 90%, 70% and 40% of the papers respectively.

Conclusion

New and innovative EMS response strategies occurred over the study period, in part due to dissemination of lessons learned. Despite advances in response to mass violence events, significant gaps remain, in part due to lack of adoption of recommendations. Recent experience with advanced TEMS providers capable of operating within the inner perimeter suggest that this approach should be further evaluated as part of the response plan for future events.

Keywords

Terrorist attack, terrorism, medical response, emergency medical services, tactical emergency medicine, UK, Europe, USA, bombing, marauding terrorist firearms attack, EPRR, active shooter, mass casualty incident

Background

A “terrorist attack” is the use of violence or threats of violence by terrorists to attempt to publicise their beliefs and achieve their goals, by influencing or exerting pressure upon governments (MI5, 2018). In recent years, terrorism has evolved to use diverse methods of attack, ranging from firearms to bladed weapons to vehicular assaults to improvised explosive devices. Regardless of the mechanism of injury, harm inflicted upon innocent civilians has been substantial (Rozenfeld et al, 2019). Since 2004, more than 24 discrete terrorist mass violence events have been perpetrated in Europe, ranging from the Madrid train bombings to the Manchester Arena attack (USA Today, 2016; BBC News, 2017). UK security services reported thwarting 16 terror plots between March 2017 and February 2018 (Metropolitan Police, 2018).

In addition to terrorist attacks, active shooter incidents can produce similar deadly results. The U.S. Federal Bureau of Investigation defines an active shooter incident as “*an individual actively engaged in killing or attempting to kill people in a populated area*” (FBI, 2018). According to the most recent statistics, 27 active shooter events occurred in 2018, resulting in 85 fatalities and 128 wounded individuals (U.S. Department of Justice, 2018).

Prior studies have highlighted the need to review major incidents, identify common themes, and make recommendations for policy adoption and response agency practice (Moran et al, 2017; Thompson et al, 2014). The purpose of the current

study was to perform a systematic review of recent mass violence events and establish some fundamental areas for improvement.

Methods

This was a structured database review using the online databases CINAHL Plus and PubMed. The inclusion dates 1/1/2004 – 5/31/2018 were selected to capture extensive literature on terrorist attacks and active shooter events. The decision to limit studies to the United Kingdom, Europe, and the USA was taken due to similarities in societal structure and government response. Searches were conducted on 31st May 2018 into both databases using the inclusion criteria listed in Table 1. Exclusion factors and the screening process have been listed in figure 1 and a summary of the literature is reported in Table 2.

1. Type of Event	2. Method of Assault	3. EMS and Learning	Final Search
Terrorist attack	Shooting	Prehospita	1 AND 2 AND 3
Terror attack	Mass shooting	Pre-hospital	
Terrorism incident	Active shooter	Prehospita care	
Terrorist incident	Firearms	Pre-hospital management	
Terrorism	Marauding attack	Emergency medical services	
Mass casualty incident	Suicide bombing	Tactical emergency medical services	
Multiple casualty incident	Vehicle attack	Tactical emergency medicine	
Major incident	Vehicular	Emergency medical management	
'Paris and Nice terrorist attack'	Stabbing	Lessons learned	
	Tactical medicine after-action report	Lessons identified	
	EPRR	Lessons learnt	
	'French emergency medical services'	'What have we learnt'	

Phrase searching Words within groups combined with AND/NOT/OR
*Truncation

Literature Summary

Table 2: Literature summary of selected studies for review.			
Citations	Event Summary	Key Findings	Limitations
Hunt, P. Lessons identified from the 2017 Manchester and London terrorism incidents. Part 1: introduction and the prehospital phase, (2018).	Five terrorists killed 36 people using IEDs, vehicles and knives in Westminster, London Bridge and Manchester Arena.	<ul style="list-style-type: none"> • Command and control structure is critical, with the ability to collapse and expand as the incident progresses. • Triage proved challenging due to the unsafe nature of the scenes. Over triage and changes in patient priority happened before arriving at hospital. • Multi-agency collaboration and training exercises are factors for a successful response. • Logistical issues, particularly stretchers, were a significant response constraint at Manchester Arena. • Patients self-presented at hospitals via private vehicles or police transport prior to EMS arrival, thereby impeding attempts at MCI triage. 	Sole author not involved in response. Qualitative methodologies.

<p>Bobko, J., Sinha, M., Chen, D. et al, A Tactical Medicine After-action Report of the San Bernardino Terrorist Incident, (2018).</p>	<p>In 2015, two terrorists carried out a marauding terrorist firearms attack (MTFA), killing 17 people and injuring over 30. IEDs were placed but not detonated.</p>	<ul style="list-style-type: none"> • TEMS were training nearby at the time of the incident and entered the hot zone alongside tactical units, performing triage and life-saving interventions. • Command posts were set up within discovered IED blast radii, requiring relocation and causing disruption to the tactical operation • Rescue Task Force (RTF) enabled warm zone operations and augmented TEMS personnel; SWAT medic. The combination of TEMS and RTF enabled synergistic operations throughout the event. • The first patients to arrive at medical facilities were by brought by police, not EMS. 	<p>Data was collected via an unstructured after-action review, rather than structured debriefs of all involved personnel. Qualitative methodologies.</p>
<p>Carli, P., Pons, F., Levraut, J. et al, The French emergency medical services after the Paris and Nice terrorist</p>	<p>In 2015, 137 people died and over 400 were injured during a multisite terrorist attack in Paris. In 2016, an 18-wheel heavy goods vehicle struck hundreds of</p>	<ul style="list-style-type: none"> • In the aftermath of the Paris attack, civilian EMS responders consulted with military medical services for education and staff training, including 	<p>Limited details. Qualitative review.</p>

<p>attacks: what have we learnt? (2017).</p>	<p>people, killing 87 and injuring 458 in Nice.</p>	<p>damage control resuscitative concepts and 'care under fire' awareness.</p>	
<p>Service Médical du RAID., Tactical emergency medicine: lessons from Paris marauding terrorist attack, (2016).</p>	<p>In 2015, three terrorists entered the Bataclan theatre and murdered 89 civilians using military grade firearms and IEDs. A specialist law enforcement team, RAID (research, assistance, intervention, deterrence), immediately responded to the Bataclan theatre scene.</p>	<ul style="list-style-type: none"> • TEMS physicians successfully operated within the inner perimeter, performing triage and life-saving interventions. • A pile of dead bodies may have obstructed identification and access to living patients with potentially survivable injuries. • A shortage of stretchers led to casualties being removed from the area on crowd barriers. • By the time civilian EMS teams were granted access, all surviving casualties had been extricated. 	<p>Qualitative review. Potential bias in favour of authors' methods.</p>
<p>Gates, J., Arabian, S., Biddinger, P. et al, The Initial Response to the Boston Marathon Bombing: Lessons Learned to Prepare for the Next Disaster, (2014).</p>	<p>At the 2013 Boston Marathon, terrorists planted two IEDs near the finish line (where the medical tents were located). Both detonated in quick succession, killing 3 and injuring 281 people.</p>	<ul style="list-style-type: none"> • Due to the nature of the event (ground-level IEDs), many casualties sustained injuries amenable to tourniquet use. • Rapid extraction to hospitals trained and prepared to manage surges of 	<p>Qualitative methodologies. No structured interviews.</p>

		severely injured casualties is critical to patient survival.	
Sollid, S., Rimstad, R., Rehn, M. et al, Oslo government district bombing and Utøya island shooting July 22, 2011: The immediate prehospital emergency medical service response, (2012).	In 2011, a lone terrorist in Norway killed 77 people using a vehicle-borne IED, and later carried out an MTFA on an isolated island.	<ul style="list-style-type: none"> • The light emergency stretcher system (LESS), part of the disaster plan, proved highly effective in the extraction of large numbers of casualties. • No civilian medics were permitted access to the VBIED hot zone and were denied access to the island for an extended period. • Prior to the event. no triage system existed for major incident situations. 	Structured data collection. Limited data sources.
Wild, J., Maher, J., Frazee, R. et al, The Fort Hood Massacre: Lessons learned from a high profile mass casualty. (2012).	In 2009, an active shooter incident occurred at Fort Hood, Texas. Over a period of 10 minutes, 11 people were killed and over 30 were injured.	<ul style="list-style-type: none"> • Scene safety was a significant concern, due to conflicting information about location and number of attackers. • Scene safety concerns compromised patient triage. • Patients were transport by private vehicles rather than EMS, further impacting triage. 	Qualitative methodologies. On-going criminal investigation at the time of publication limited contents.

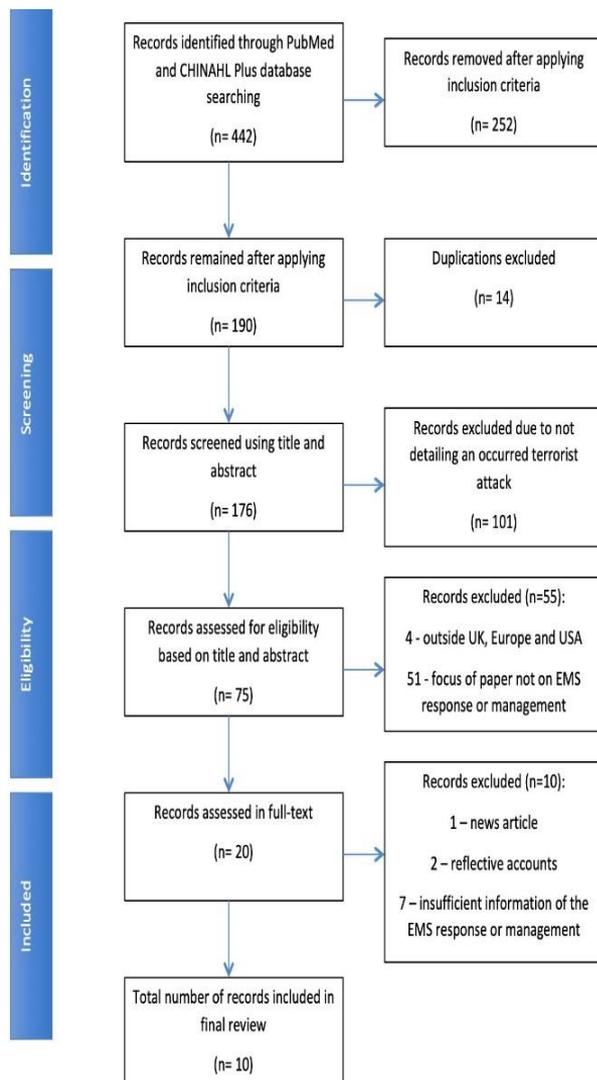
		<ul style="list-style-type: none"> To improve MCI response, regional training exercises and post-event debriefing sessions are required. 	
<p>Kaplowitz, L., Reece, M., Hershey, J. et al, Regional health system response to the Virginia Tech mass casualty incident, (2007).</p>	<p>In 2007, a single active shooter attacked a university, killing 32 students and injuring 26.</p>	<ul style="list-style-type: none"> Scene safety remained a significant concern throughout the event. Two TEMS medics were able to follow law enforcement teams into the hot zone to initiate treatment and stabilisation of victims. Due to the high proportion (67%) of seriously injured patients, emphasis was placed on rapid extraction and transport rather than triage. Mass over-triage subsequently occurred, which led to a strain on down-stream hospital resources. 	<p>Qualitative analysis.</p>
<p>Lockey, D., Mackenzie, R., Redhead, J. et al, London bombings July 2005: the immediate pre-hospital medical response., (2005).</p>	<p>In 2005, three terrorists detonated IEDs on the London Underground System, while a fourth terrorist detonated his bomb on a double decker bus in central London. This resulted in the deaths of 56</p>	<ul style="list-style-type: none"> On scene challenges during casualty extraction from all underground locations included heat, light, and distance from the point of explosion to the exit. 	<p>Qualitative study. Potential bias in favour of authors' methods.</p>

	people and injured over 700.	<ul style="list-style-type: none"> • Multiple complex scenes led to difficulties with EMS command and control. • Scene safety concerns led to rapid extraction and transport of seriously injured patients. 	
Carresi, A., The 2004 Madrid train bombings: an analysis of pre-hospital management, (2008).	In 2004, 10 IEDs placed on trains in Madrid were simultaneously detonated via mobile phones by an unknown number of terrorists. 191 people died as a result of this terrorist attack.	<ul style="list-style-type: none"> • Inadequate command and control structure resulted in conflicting orders given to EMS personnel. • On-scene confusion led to inaccurate information provided by EMS to command and control structure. • Scene safety concerns compromised patient triage. • Only 33% of patients were transported to hospital by ambulance, with the rest transported by private vehicle. 	Single author analysis. Qualitative methodologies using limited face-to-face interviews.

Results

Four hundred and forty-two records were identified in the preliminary search, with 176 records further screened using the title and abstract. Ten papers were included in the final review, reflecting 13 events from five countries across two continents (Figure 1).

Figure 1. PRISMA Diagram.



After data abstraction, three major themes were identified (Table 3). These were:

1. Emergency preparedness, resilience and response (EPRR) with subgenres of multi-agency collaboration, disaster planning and command principals. Identified in 90% of analysed papers.
2. Triage, including impact of scene safety. Identified in 70% of analysed papers.
3. The role of specialised Tactical Emergency Medical Services. Identified in 40% of analysed papers.

Table 3. Major Themes in Papers.

Papers	Emergency Preparedness, Resilience and Response	Triage	Tactical Emergency Medical Services
Hunt, P., Lessons identified from the 2017 Manchester and London terrorism incidents. Part 1: introduction and the prehospital phase, (2018).	✓	✓	-
Bobko, J., Sinha, M., Chen, D. et al, A Tactical Medicine After-action Report of the San Bernardino Terrorist Incident, (2018).	✓	✓	✓
Carli, P., Pons, F., Levrant, J. et al, The French emergency medical services after the Paris and Nice terrorist attacks: what have we learnt? (2017).	✓	-	✓
Service Médical du RAID., Tactical emergency medicine: lessons from Paris marauding terrorist attack, (2016).	-	✓	✓
Gates, J., Arabian, S., Biddinger, P. et al, The Initial Response to the Boston Marathon Bombing: Lessons Learned to Prepare for the Next Disaster, (2014).	✓	-	-
Sollid, S., Rimstad, R., Rehn, M. et al, Oslo government district bombing and Utøya island shooting July 22, 2011: The immediate prehospital emergency medical service response, (2012).	✓	✓	-
Wild, J., Maher, J., Frazee, R. et al, The Fort Hood Massacre: Lessons learned from a high profile mass casualty, (2012).	✓	✓	-

Kaplowitz, L., Reece, M., Hershey, J. et al, Regional health system response to the Virginia Tech mass casualty incident, (2007).	✓	✓	✓
Lockey, D., Mackenzie, R., Redhead, J. et al, London bombings July 2005: the immediate pre-hospital medical response, (2005).	✓	-	-
Carresi, A., The 2004 Madrid train bombings: an analysis of pre-hospital management, (2008).	✓	✓	-

Discussion

Emergency Preparedness, Resilience, and Response (EPRR)

The London bombings of July 2005, which struck three underground trains and one bus, killing 54 people and injuring over 700, demonstrates the sheer complexity of managing four simultaneous mass casualty sites. Command systems were severely stretched as a result of patient numbers and locations, and ambulance commanders were posted to the control room to act as a central command source. Patients emerged from different underground stations (Kings Cross and Russell Square), leading to mistaken assumptions of two separate incidents at these locations. Unfortunately, the increasingly mobile nature of these events makes multiple site control an increasing reality, and one that must be planned for.

The Madrid train bombings of 2004 similarly involved multiple IEDs detonated on 10 trains during rush hour, resulting in 191 killed and more than 2000 injured. Command and control was identified as an area for improvement in the response to this event. Responders stated that the sheer confusion caused by the magnitude

of patients across a large area overwhelmed on scene ambulance commanders. A breakdown in command from the operations centre meant ambulance units were not reaching their destinations. In both Madrid and London, responding units were diverted to other locations, without necessarily informing control centres. In contrast, although more limited in scale, command and control at the San Bernadino MTF was improved by the presence of on-scene command assets and shared tactical decision making.

Further confounding initial on scene confusion and concerns regarding scene safety were frequently noted, leading to compromised decision-making in triage and patient care. Scene safety was a key factor in the overall response to the injured in the classrooms and buildings of Virginia Tech, based upon uncertainty over shooter location. Similarly, Wild et al (2012) describes the chaos of on-scene operations at the Fort Hood shooting. Unconfirmed reports and confusing statements led responders to believe the presence of multiple active shooters, leaving commanders to make difficult decisions about triage and transportation.

In contrast, sometimes the threat is underestimated. During the London Bridge attack, some initial calls suggested a simple traffic accident, resulting in responders being unaware of the actual threat, compromising scene safety. Similar findings have been noted in analyses in the United States, in which more than 15% of calls failed to relay a safety risk concern to responding EMS personnel (Klassen et al, 2018). Command structures must anticipate this “fog of war” and make decisions to mitigate the confusion. On-scene command and control may assist with this.

Direct threats from gunmen are not the sole concern for responding crews. During the San Bernardino MTF, lack of IED awareness resulted in the tactical command post and casualty collection point being located within the blast radius. Furthermore, the IEDs were only discovered during extrication of patients from the building by conventional EMS. This incident serves to highlight the adoption of militarised tactics even by active shooters (Bobko et al, 2018). Additional threats noted include risk of structural collapse, toxic atmospheres, contamination, and situational risks such as live rails (Lockey et al, 2005; Hunt, 2018).

Logistical concerns frequently impact the response to mass violence events. One frequently identified area for improvement is the means by which non-ambulatory casualties can be rapidly extracted. During both the 2015 multi-site MTF in Paris and the 2017 Manchester Arena bombing, responding emergency services were faced with a lack of available stretchers (Hunt, 2018; Service Médical du Raid, 2016; kerslakearenareview, 2018). As a result, patients were extracted from the

point of injury on makeshift stretchers such as crowd control barriers. Although mass casualties were encountered by responders in Oslo and Utoya Island, Norwegian EMS teams have developed a light emergency stretcher system (LESS) as part of major incident preparedness. Air ambulances transported LESS, which contains 5 light stretchers in a single bag, to the scenes at Utoya Island and Oslo (Sollid et al, 2012).

On-going major incident training is critical in responding to these extreme events. Lockey et al (2005) noted that an emergency services exercise was conducted on the London Underground network shortly prior to 7/7 as a preparedness response to the Madrid train bombings of 2004, which may have helped mitigate some of the issues noted in Madrid. Similarly, Manchester emergency services drilled a terrorist bombing attack months prior to the Manchester Arena incident as a direct response to events in France (Hunt, 2018; kerslakearenareview, 2018). Multiple US authors praised training exercises as an invaluable resource. EPRR elements should be a key aspect of such training.

Given the complexities of responding to mass violence events, multi-agency collaboration is a critical factor for successful response. Both Hunt (2018) and Carli et al (2017) note the utility of military assistance to civilian authorities, both from an educational and operational perspective. Knowledge translation of military injury patterns and appropriate treatments, including tourniquets and other elements of damage control resuscitation, to the civilian sector is critical for future response at both the prehospital and hospital levels (King, 2019; Cannon, 2018).

Hunt (2018) noted how responders were at risk by quaternary factors such as structural debris (as witnessed during 7/7); showing the consistency in bombing characteristics. However, it is worth highlighting the success of the response due to the availability of specialist resources such as advanced paramedics and the Hazardous Area Response Team (HART).

HART was developed in the wake of 7/7, realising the demand for a special unit to respond to these types of threatening environments. With the ability to operate within the warm zone of an MTF, HART was utilised to extricate patients to the cold zone where ordinary paramedics had erected a casualty clearing station and command point (NARU, 2018). These actions made by the commanders and paramedics on the night were correct in adhering to the well-established policies. The Joint Emergency Services Interoperability Program (JESIP) was developed in 2013 and offers command and control principals in which police, fire and rescue and ambulance services now practise (JESIP, 2017). These command principals may have contributed to the success of the management by the ambulance service at Manchester arena. On the contrary, few ambulance personnel volunteered to enter the hot zone and commence the triage of patients. This is against conventional practice in the UK, however, the police authorised the access due to the perception of there being minimal threat. These actions by the personnel were directly credited by Lord Kerslake, chairman and author of the Kerslake Report evaluating this terrorist attack. Kerslake continues to show admiration for the ambulance service, as patients were treated and transported incredibly effectively, with only 1 patient

requiring a secondary transfer (Kerslake Review, 2018). These points echo the fluidity of operations in regard to scene safety, zoning, command structure and decision-making.

Triage

Triage refers to the rapid sorting of casualties, with the intent of doing “the most for the most.” Triage has been noted to be an issue at almost every mass casualty incident, often due to lack of systems-knowledge or lack of ability to perform due to concern for on-going threats. Although numerous triage systems exist, the best triage system remains unclear and is continually debated (Vasallo, Smith and Wallis, 2018; Silvestri et al, 2017).

At the Madrid train bombings, EMS crews were unable to use the existing triage system due to both a lack of knowledge and a lack of triage tags (Carresi, 2008). Similar issues with triage were noted in the Norway attacks. At the time, Norwegian EMS had no national triage system, and so responders defaulted to the primary survey consisting of catastrophic haemorrhage, airway, breathing, circulation, disability and exposure in order to identify critical patients (Sollid et al, 2012). Although a formal triage system was lacking in this response, the ad hoc approach was still successful as no patients died on their way to hospital. A standardised triage system might minimise errors in casualty prioritisation. As highlighted by the Manchester Arena attack, responders should prepare to triage and treat large numbers of pediatric casualties which poses as a unique challenge.

In contrast to lack of knowledge, scene safety concerns limited use of triage

systems at several events, with resultant over- and under-triage. During both Fort Hood and Virginia Tech, a decision was made to prioritise rapid transportation in precedence to over accurate triage. Even in circumstances where triage was performed appropriately by EMS providers, patients were transported to hospitals by private vehicles or law enforcement, arriving unannounced. Hospitals should anticipate and plan for an initial wave of victims arriving outside the EMS system, especially where hospitals are in close proximity to the point of injury. This may particularly impact specialty or general hospitals not equipped to manage major trauma patients, as witnessed by a children's hospital near to the Nicé lorry attack site.

Tactical Emergency Medical Services

Tactical emergency medical services (TEMS) involves the incorporation of specially trained medical assets into police or paramilitary tactical units. Traditionally associated with US Special Weapons and Tactics (SWAT) teams, it more recently has been adopted and advanced by European counterparts. TEMS was specifically noted to be a key component of the medical response in four papers.

During the response to the Virginia Tech shooting, EMS were denied access to the scene during the period of on-going threat. Two tactical medics attached to responding law enforcement teams were deployed to the hot zone (Kaplowitz et al, 2007). The medics were able to begin triaging the wounded, perform life-saving interventions, and prepare the casualties for extraction, prior to the arrival of conventional EMS. These key actions contributed to the success of the prehospital response.

During the San Bernardino MTF, a perimeter was established which prevented responding EMS units entering to gain immediate access to victims. Current US law enforcement doctrine defines an active shooter event as a patrol level response, in contrast to a SWAT response, in order to minimise response delays. Serendipitously, a local SWAT team was training nearby and so was able to rapidly deploy to the scene. The tactical medic proceeded to triage and treat the casualties in the hot zone, performing initial lifesaving interventions. As the TEMS provider carries only limited supplies, the TEMS response was subsequently augmented by a secondary Rescue Task Force (RTF) response in the warm zone (Bobko et al, 2018).

The RTF is a joint law enforcement-medical response, in which law enforcement provides security to medical personnel who rapidly treat and extract casualties. The medical component of the RTF model can be most comparable to the newly developed Hazardous Area Response Team (HART) in the UK. Both teams are trained to enter the warm zone and initiate treatment and extract patients to the cold zone where conventional EMS awaits. The UK currently lacks both civilian medical response in the hot zone and consistent security for medical teams in the warm zone, which may limit efficacy of HART.

Most US TEMS providers are trained at either the paramedic or EMT level. Physician integration is unusual. In contrast, French TEMS has advanced the process by consistent physician integration (Service Médical du RAID, 2016; Carli et al, 2017). During the Bataclan siege, tactical physicians supporting SWAT teams from Service

Médical du RAID were able to enter the concert hall downstairs while the terrorists were barricaded upstairs. Physicians were able to direct triage and extraction, a process made difficult by piles of dead bodies, often covering living casualties with survivable injuries (Service Médical du RAID, 2016). Once patients had been extracted to the casualty collection point (warm zone), advanced medical procedures were performed. By the time civilian EMS crews were allowed forward into the building, every single living patient located in the hot zone had already been extracted to the warm zone. By providing life-saving interventions without delay at the point of injury, this approach was reported to save numerous lives. Whether the presence of a physician changes outcomes in the hot zone compared with paramedics has yet to be determined.

The presence of TEMS provides comfortable operations in the hot zone and when integrated into tactical teams permitted both rapid triage and treatment, without placing unnecessary delays on first patient contact. None of the UK incidents mention provision of medical care by police officers or any other medical care available to victims inside the hot zone. This suggests the presence of a potential delay in providing patient care, in an environment too hostile for conventional EMS teams to operate. This grey-area hints that the UK may benefit from the addition of a TEMS framework similar to that of the USA and France, and to that currently found amongst UK special operations forces.

Conclusion

Based upon the available data, prehospital organisational response to mass violence events continues to evolve and improve. In response to incidents in neighbouring jurisdictions, specific exercises have been undertaken to test local responses to similar events. Practice gaps and necessary changes have been identified as part of the after-action review process. However, society needs to be vigilant and approach such changes with a degree of caution, as to prepare for the next event rather than the last.

Despite great strides in preparedness and response, there remain opportunities for improvement, some of which have been previously identified. The lack of casualty extraction devices noted in Paris and Manchester had previously been highlighted in Norway, and a solution identified. Even when gaps have been identified, they have not always been closed. Some identified problems may require significant redesign of current response systems. For example, the impact of scene safety concerns upon patient triage has been in part mitigated by the use of trained TEMS providers in the hot zone in both the US and France. This capability does not currently exist in the UK.

The international community continues to acknowledge the severity of terrorism and the challenges it poses to EMS providers, but gaps still remain. Formal study of these events is difficult due to the unpredictable and chaotic nature of actual events and artificialities inherent in drills. Continued dissemination of lessons learned is critical in developing a robust response infrastructure, designed to both protect responders and save the lives of terror casualties.

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