

THE CAPABILITY OF EMERGENCY DEPARTMENTS AND EMERGENCY MEDICAL  
SYSTEMS IN THE U.S. TO RESPOND TO MASS CASUALTY EVENTS RESULTING  
FROM TERRORIST ATTACKS

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"This is not a place to have a wristwatch," Dr. Shmuel "Shmulik" Shapira observed as we looked at x-rays of suicide bombing victims in his office at Jerusalem's Hadassah Hospital nearly six years ago. He was describing the injuries to a young girl who had been taking the bus to school one morning in November 2001 when a bomb exploded. Twelve of her fellow passengers were killed and nearly 50 others wounded. The blast was so powerful that the hands and frame of her assailant's wristwatch had turned into lethal projectiles, lodging in the girl's neck and severing a major artery. The presence of such foreign objects in the bodies of his patients no longer surprised Dr. Shapira. "We have cases with a nail in the neck or nuts and bolts in the thigh . . . a ball bearing in the skull," he recounted.

Such are the weapons of terrorists today: nuts and bolts, screws and ball bearings or any metal shards or odd bits of broken machinery that can be packed together with enough home-made explosive or military ordnance and then strapped to the body of a suicide terrorist dispatched to attack any place that people gather: buses and trains, restaurants and cafes, hotels and bars, supermarkets and shopping malls, street corners and promenades. According to one estimate, the total cost of a typical Palestinian suicide operation, for example, is about \$150.<sup>1</sup> Yet this modest sum yields a very attractive return: on average, suicide

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<sup>1</sup> Nasra Hassan, "Letter From Gaza: An Arsenal of Believers," *The New Yorker*, 19 November 2001, p. 39.

operations worldwide kill about four times as many persons as other kinds of terrorist attacks. In Israel the average is even higher: inflicting six times the number of deaths and roughly 26 times more casualties than other acts of terrorism.<sup>2</sup>

The stress placed on the already over-worked, mostly under-funded, Israeli health system and its hospitals, doctors, nurses, therapists as well as emergency service personnel and first responders in such circumstances is enormous. Whether as a result of a suicide bomb attack or more conventional bombings, these emergencies—as Dr. Shapira notes—present unique medical challenges that to date the United States has mercifully rarely experienced. “Terror demonstrates a new type of epidemiology that is associated with a unique and oddly severe pattern of injuries, putting a heavy burden on society,” Dr. Shapira, the deputy director general of **Jerusalem's Hadassah Hospitals** and a pioneering figure in a new medical specialty that he and others term “terror medicine,” explained in a article published five years ago.<sup>3</sup> Indeed, medical studies have shown that the injuries to victims of terrorist bombings are far more severe and complex than those from other traumas.<sup>4</sup> “Bomb explosions,” for instance, one medical analysis explains, “cause combinations of burns, barotraumas, and penetrating, blunt crush injuries . . . . Blast victims (especially those with major burns) consume more resources, in volume and time than civilian trauma victims. Treating children and pregnant woman with bomb-blast trauma presents particular challenges.”<sup>5</sup>

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<sup>2</sup> The RAND Terrorism Incident Database.

<sup>3</sup> **Shmuel C. Shapira and Shlomo Mor-Yosef, “Applying Lessons from Medical Management of Conventional Terror to Responding to Weapons of Mass Destruction Terror: The Experience of a Tertiary University Hospital,” *Studies in Conflict & Terrorism*, vol. 26, no. 5 (September-October 2003), p. 385.**

<sup>4</sup> Ibid., p. 82. See also, Jeffrey V. Rosenfeld, et al., “Is the Australian hospital system adequately prepared for terrorism?” *eMJA: The Medical Journal of Australia*, vol. 183, nos. 11/12 (2005) accessed at [http://www.mja.com.au/public\\_issues/183\\_11\\_051205/ros10697\\_fm.html](http://www.mja.com.au/public_issues/183_11_051205/ros10697_fm.html); and R.G. DePalma, et al., “Blast Injuries,” *New England Journal of Medicine*, vol. 352 (2005), pp. 1335-1342 cited in Ibid.

Despite the potential array of atypical medical contingencies that the U.S. health system could face if confronted with mass casualty events (MCE)<sup>6</sup> resulting from terrorist attacks using conventional explosives, it is not clear that we are sufficiently prepared. Historically, the bias in most MCE planning has been towards the worst case scenarios, often entailing weapons of mass destruction (such as chemical, biological, radiological and nuclear weapons), on the assumption that any other MCEs, including those where conventional explosions are used, can simply be addressed as a lesser-included contingency.

This was exactly my concern nearly seven years ago when I testified before a subcommittee of this same committee ten days after the September 11<sup>th</sup> attacks. At that time, I had identified the need for

an overarching strategy . . . that ensures that the U.S. is capable of responding across the entire technological spectrum of potential adversarial attacks. The focus of U.S. counterterrorism policy in recent years has arguably been too weighted towards the "high end" threats from biological and chemical weapons and was based mainly on planning for extreme worst-case scenarios. This approach seemed to assume that, by focusing on "worst-case" scenarios involving these more exotic weapons, any less serious incident involving a different, even less sophisticated weapon, could be addressed simply by planning for the most catastrophic event. Such an assumption ignored the possibility that these less catastrophic, though

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<sup>5</sup> Rosenfeld, et. Al., "Is the Australian hospital system adequately prepared for terrorism?"

<sup>6</sup> The Israeli medical community defines a mass casualties event as "an incident in which the medical system is overwhelmed and the balance between resources and demands is undermined. Hence, the medical management of MCE presents a formidable challenge to the medical system. The principle aim of the overall medical management of the event is to decrease mortality and morbidity of the entire affected population, even at the cost of providing inferior treatment to the individual patient."

See Shmuel C. Shapira and Joshua Shemer, "Medical Management of Terrorist Attacks," *Israeli Medical Association Journal*, vol. 4 (July 2002), p. 489 accessed at [http://www.terrormedicine.org/publications\\_files/medicalmanagement1.pdf](http://www.terrormedicine.org/publications_files/medicalmanagement1.pdf).

The size of an MCE is defined as small if 8 to 24 are injured; medium if 25 to 59 are injured; and, large if casualties exceed 60 persons. See Jacob Sosna, et al., "Facing the New Threats of Terrorism: Radiologists' Perspectives Based on Experience in Israel," *Radiology*, vol. 237, no. 1 (October 2005), p. 29 accessed at [http://www.terrormedicine.org/publications\\_files/imaging1.pdf](http://www.terrormedicine.org/publications_files/imaging1.pdf).

still high casualty incidents, might present unique challenges of their own.<sup>7</sup>

This recommendation was based on my observation that a critical weakness in planning for MCEs before 9/11 may have contributed to that attack's success. U.S. counterterrorism efforts throughout the pre-9/11 time frame, I argued, had been inordinately focused on the more exotic high-end threats posed by biological and chemical weapons as well as cyber-attacks. Of more than 201 federal planning exercises conducted in the United States before 9/11, for example, at least two thirds were concerned only with defending against biological or chemical attacks, and thus ignored the possibility that other kinds of attacks—such as we saw at the World Trade Center and the Pentagon—might result in large numbers of casualties and might present unique challenges of their own in terms of emergency response and rescue.<sup>8</sup>

While I have not followed this issue closely since my 2001 testimony, it is my impression that this situation remains largely unchanged. For instance, a study published by the American Burn Association in 2006 reached the same conclusion I had five years before. "Contemporary planning for disaster response to terrorist events," it stated,

usually assumes the use of chemical, radiological, or biological weapons. Historically, most victims of terrorist attacks are injured by the use of conventional explosives rather than weapons of mass destruction. Such attacks will likely produce victims who have suffered burn injuries along with conventional trauma . . . .

Unfortunately, exercise planners continually side-step this reality, with most drills focusing on nuclear, biological, or chemical events. In July 2004, the Homeland Security Council released 15 planning scenarios for use in preparedness

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<sup>7</sup> Bruce Hoffman, "Preparing for the War on Terrorism,: Testimony presented to the Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, U.S. House of Representatives 21 September 2001" (Santa Monica, CA: RAND Corp. 2001), p. 7, accessed at <http://rand.org/pubs/testimonies/CT181/>.

<sup>8</sup> See Joby Warrick and Joe Stephens, "Before Attack, U.S. Expected Different Hit: Chemical, Germ Agents Focus of Preparations," *Washington Post*, 2 October 2001, pp. A1 & A11.

activities. Only one of these scenarios involved the use of uncontaminated explosive material.<sup>9</sup>

The focus of my testimony today, however, is not specifically on either current planning scenarios for MCEs or even specifically on the subject of this hearing: the status of the preparedness and the response capabilities of emergency rooms and trauma centers in the immediate aftermath of a terrorist attack. The former has not been the subject of any recent research I have undertaken; while the latter is beyond my expertise and outside my ken. Rather, what I would like to share with the Committee are the results of my research into the Israeli, Australian and British experiences with these kinds of attacks and the steps that the medical communities in those three countries have taken to minimize loss of life and cope with the unique emergencies created by MCEs caused by terrorists using conventional explosives. And, while the thrust of my remarks will be on the unique demands imposed by suicide bombings—and indeed the constellation of emergency medical preparedness capabilities required in response—my observations and conclusions in this context are equally applicable to MCEs involving more conventional explosive attacks.

**THE UNIQUE MEDICAL CHALLENGES CAUSED BY MCEs INVOLVING CONVENTIONAL EXPLOSIVES IN GENERAL AND SUICIDE TERRORISM IN PARTICULAR**

Suicide terrorism is fast becoming the preferred mode of attack for many terrorist groups throughout the world. Last year, according to the State Department's *Country Reports on Terrorism 2007*, released just last week, the number of suicide attacks worldwide increased by about 50 percent compared with 2006.<sup>10</sup> Indeed, 86 percent of the 1,840 suicide bombings that have occurred since December 1981 have taken place during the past seven years alone. These attacks have now spread to over 30

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<sup>9</sup> James Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," *Journal of Burn Care & Research*, vol. 27, no. 5 (2005), p. 577, accessed at: [http://www.terrormedicine.org/publications\\_files/Terroristbombing.pdf](http://www.terrormedicine.org/publications_files/Terroristbombing.pdf).

<sup>10</sup> "Release of the *Country Reports on Terrorism 2007*," Dell L. Dailey, Coordinator of the Office for Counterterrorism, Russ Travers, Deputy Director of the National Counterterrorism Center; and, Gonzo Gallegos, Director, Office of Press Relations, Washington, D.C., 30, 2008. Accessed at <http://www.state.gov/s/ct/rls/rm/2008/104233.htm>.

countries on five continents and have killed more than 21,350 person and injured about 50,000.<sup>11</sup>

Accordingly, the suicide bombers who struck the World Trade Center and Pentagon on September 11<sup>th</sup> 2001 may well be followed by other suicide bombers attacking targets in the United States. Even before 9/11, suicide attacks were either contemplated or planned in the U.S. but thwarted. Timothy McVeigh considered a suicide bomb attack on the Alfred P. Murrah federal office building in Oklahoma City before finding a plan that did not require suicide.<sup>12</sup> Four years before 9/11, two Palestinians plotted a suicide bombing of the New York City subway. Their plan was foiled when an informant tipped off police.<sup>13</sup> And, of course, suicide attacks have now long been conducted against American diplomatic and military targets abroad: from the 1983 bombings of the U.S. embassies and Marine barracks in Beirut to the current campaign of suicide attacks against U.S. troops in Iraq and Afghanistan.

The means of attack using suicide terrorist tactics can vary widely, involving:

- pedestrians—individual attackers wearing a specially-designed vest or belt or carrying a backpack or small hand-held bag containing explosives and connected to a manual or remote-control detonator; or
- vehicular bombs—with a driver and explosive-laden cars or trucks (as in the 1998 simultaneous attacks on the U.S. embassies in Kenya and Tanzania); or
- using either aircraft as human cruise missiles (as in the 9/11 attacks) or boats as human torpedoes (as in the 2000 attack on the *U.S.S. Cole*).

Similarly, the potential targets of these attacks can be equally diverse, embracing:

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<sup>11</sup> See Robin Wright, "Since 2001, a Dramatic Increase in Suicide Bombings," *Washington Post*, 18 April 2008; and, Bruce Hoffman, *Inside Terrorism* (New York: Columbia Univ. Press, 2006), p. 131.

<sup>12</sup> [Lou Michel and Dan Herbeck, \*American Terrorist: Timothy McVeigh & The Oklahoma City Bombing\* \(New York: Regan, 2001\), pp. 102, 144-145, 332, and 358.](#)

- High-value, symbolic targets involving mass casualties against buildings or installations (e.g., the World Trade Center and Pentagon on 9/11); and,
- Deliberately lethal attacks specifically targeting the public (e.g., against buses, trains and subways; shopping malls; cinema; sports stadiums; pedestrian malls or any public venue where people gather) also to inflict mass casualties.

To understand the unique medical challenges posed by MCE involving conventional explosives, it is useful first to understand the mechanics of the suicide terrorist attack.<sup>14</sup> The body bomb worn by a suicide terrorist is typically concealed around the waist or the upper torso. It is often detonated by a simple plunger device or by a toggle or rocker-type switch, running from the bomb to a trouser pocket. A back-up remote control detonation means may also be attached to the bomb enabling a second person to activate the explosive system with a radio signal, cellular phone connection, or beam from a radar gun that completes an electrical circuit. A timing device or igniting of a fuse may also be used. Explosive devices may be carried as well as worn. Backpacks, briefcases, suitcases, duffel bags, gym bags have been used in the past as have guitar and other musical instrument cases, computers, and reportedly even a large watermelon.

The typical explosive device weighs between 10-20 pounds. The standard size suicide jacket or vest worn by Tamil Tiger terrorists in Sri Lanka, for example, is about 18 pounds, containing an even mixture of explosives and ball bearings—the Tamil Tiger's preferred anti-personnel weapon. It is activated by two switches: one standby switch and one triggering switch. The explosives material itself can either be military ordnance (plastic explosive) or homemade explosives such as

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<sup>13</sup> MacNeil/Lehrer Productions, *Transcript of "The News Hour with Jim Lehrer,"* 1 August 1997.

<sup>14</sup> Characteristics drawn from Los Angeles Police Department, "Terrorism Part I: Homicide Bombers," *Training Bulletin*, volume xxxiv, issue 8, September 2002; and, FBI, Bomb Data Center, "Improvised Explosive Devices Used in Suicide Bombing Incidents," *Intelligence Summary 2002-4*, 24 May 2002.

HMTD (Hexamethylene Triperoxide Diamine), a hydrogen peroxide-based mixture that was used by the 7 July 2005 bombers in London, or TATP (Triacetone Triperoxide), an improvised explosive fabricated with nail polish remover among other readily commercially-obtainable ingredients, long favored by Palestinian suicide terrorists targeting Israel. Electronic initiation can be achieved from a simple 1.5-volt (or larger) battery. Fragmentation materials may consist of ball-bearings (as noted above) but also of nails, bolts, or nuts sometimes placed between layers of sheet metal designed to break apart into shards of deadly shrapnel. This sandwich-like device is held together until the moment of detonation by tightly bonded glue. Belts containing the explosives and anti-personnel material, because of their thin silhouette and limited capacity, will likely weigh 10 pounds or less and therefore be commensurately less powerful and thus have a smaller blast radius.

Israeli surgeons have found that the metal debris and other anti-personnel matter packed around the explosive charge causes injuries to victims that are completely atypical of other emergency traumas in severity, complexity, and number.<sup>15</sup> This is because the blast generated by suicide bombs and other more conventional explosive devices occurs in milliseconds of time, with tremendous changes caused in ambient pressure, the generation of rapid winds, and a massive heat wave: all of which the victim often perceives as occurring simultaneously.<sup>16</sup> Such an explosion, especially if it occurs within an enclosed area (e.g., a bus or subway car, hotel lobby, restaurant or café) results in an array of injuries that, Israeli doctors note, "is otherwise rarely seen in a single individual: penetration wounds from small projectiles that damage soft tissues and vital organs; fracture bone and sever arteries and nerves; blast effects on lungs, ear drums, and other organs, and severe

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<sup>15</sup> Nadav Sheffy, et al., "Terror-Related Injuries: A Comparison of Gunshot Wounds Versus Secondary-Fragments-Induced Injuries from Explosives," *Journal of the American College of Surgeons* (2006), p. 298 accessed at

[http://www.terrormedicine.org/publications\\_files/GSWEXP2608.pdf](http://www.terrormedicine.org/publications_files/GSWEXP2608.pdf)

<sup>16</sup> Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," p. 579.

burns."<sup>17</sup> Those patients with head or torso injuries, including skull fractures, and with burns to more than 10 percent of the body, are also more likely to have lung injuries.<sup>18</sup> Moreover, unlike gunshot wounds from high-velocity bullets that generally pass through the victim, these secondary fragments remained lodged in the victim's body. Indeed, although much is known about the ballistic characteristics of both high-velocity bullets and the shrapnel used in military ordnance, very little research has yet been done on the ballistic properties of the improvised anti-personnel materials used in terrorist bombs.<sup>19</sup>

The medical profession commonly divides injuries from explosives into three main categories—primary, secondary, and tertiary blast injuries. An article published by four leading Israeli medical specialists in the field explains that

Primary blast injury occurs as a result of the blast wave-mediated atmospheric pressure change. Secondary damage is caused by missiles and fragments, either embedded inside the explosive device (e.g., bolts, ball bearings, nails) or its casing, or from the shattering effect of the blast on its surroundings (e.g., glass). These secondary missiles are propelled by the blast energy, hitting the patient. Tertiary damage is caused by displacement of the patient's body by the blast wind powerful energy and consequent impact with the ground or surrounding structures.<sup>20</sup>

A fourth category is also used to cover all other injuries caused by the blast: specifically burns; traumas caused by being pinned beneath rubble or crushed by walls, ceilings, retaining columns, vehicles, etc.; and, from the inhalation of toxic particles.<sup>21</sup>

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<sup>17</sup> Shmuel C. Shapira and Leonard A. Cole, "Terror Medicine: Birth of a Discipline," *Journal of Homeland Security and Emergency Management*, vol. 3, issue 2 (2006), article 9 accessed at [http://www.terrormedicine.org/publications\\_files/Terrormedicine](http://www.terrormedicine.org/publications_files/Terrormedicine)

<sup>18</sup> Rosenfeld, et al., "Is the Australian hospital system adequately prepared for terrorism?"

<sup>19</sup> Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," p. 581.

<sup>20</sup> Sheffy, et al., "Terror-Related Injuries: A Comparison of Gunshot Wounds Versus Secondary-Fragments-Induced Injuries from Explosives," p. 297.

The minute differences in timing and more substantial differences in blast effect and impact accounts for the variety and intensity of injuries.<sup>22</sup> In this respect, it is less important in terms of treatment and diagnosis for medical personnel to know what type of bomb exploded or what kind of ordnance was used than to have information on where exactly the blast occurred. Depending on whether the explosion occurred in an open or confined area will often help medical authorities determine the likely number of injured that will require treatment, the severity of their injuries, and the type of injuries suffered. One study, for example, compared four different bombings—two that occurred within the confined space of a bus and two that occurred in an open environment. It found that the bombs that exploded inside of the two buses had a 49 percent mortality rate compared with just 7.8 percent of fatalities among those injured outdoors. The differences in injuries sustained by the survivors hit with the force of the explosive blast were less dramatic, but still significant: 77.5% of persons inside the buses were injured versus 34 percent of the survivors of the open-air bombings.

Thus it is not surprising that in Israel buses still remain among the bombers' most preferred targets. Winter and summer, in fact, are the favored seasons for suicide bus bombings in Jerusalem. The windows are generally kept closed either to keep in the heat in winter or allow the air conditioning to circulate in summer. In either case, a hermetically enclosed environment is created where the force of the blast is at once contained and intensified: thereby maximizing the a bomb's killing potential. Hence, in addition to the hail of shrapnel piercing flesh and breaking bone, the explosion's shock waves mercilessly tear lungs and bronchi and pulverize internal organs. Burns caused by the fireball unleashed when the bus's fuel tank explodes and the subsequent respiratory damage to the survivors caused by smoke inhalation thus produces for the terrorist a very handsome return for a

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<sup>21</sup> Shapira and Cole, "Terror Medicine: Birth of a Discipline."

<sup>22</sup> Sheffy, et al., "Terror-Related Injuries: A Comparison of Gunshot Wounds Versus Secondary-Fragments-Induced Injuries from Explosives," p. p. 301.

relatively modest investment. For example, two to three kilos of explosive on a bus achieves the same kill ratio as 20 to 30 kilos left on a street or placed in larger, open air spaces such as markets, malls and restaurants. The ease and simplicity of the bus bombing, the concentration of accessible victims and its lethal effectiveness, thus explains its peculiar attraction to terrorists.<sup>23</sup>

The over-pressure caused by the explosion is especially damaging to the air-filled organs of one's body. For this reason, the greatest risk of injury is to the lungs, gastrointestinal tract, and auditory system. The lungs are the most sensitive organ and ascertaining the extent of damage can be particularly challenging given that signs of respiratory failure may not appear until up 24 hours after the explosion. Although damage to hearing is the most common effect of a bomb blast, the heart is also extremely vulnerable "in a manner similar to blunt trauma, with contusions and microscopic injuries predominating."<sup>24</sup> Indeed, over 40 percent of victims injured by secondary fragments suffer multiple wounds in different places of their body. By comparison, fewer than 10 percent of gunshot victims typically are wounded in more than one place on their body. A single victim may thus be affected in a variety of radically different ways.<sup>25</sup> In addition, severe burn injuries may have been sustained by victims in addition to all the above trauma. Finally, traumatic limb amputation is also not uncommon and it is these victims that have the highest mortality rate and often never make it to the hospital alive.<sup>26</sup> Thus, critical injuries account for 25 percent of terrorist victims overall compared with three percent in non-terrorism related injuries.<sup>27</sup>

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<sup>23</sup> Interviews conducted with Israeli police and medical personnel, Jerusalem, Israel, December 2002 and September 2003.

<sup>24</sup> Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," pp. 579-580.

<sup>25</sup> Sheffy, et al., "Terror-Related Injuries: A Comparison of Gunshot Wounds Versus Secondary-Fragments-Induced Injuries from Explosives," p. p. 301.

<sup>26</sup> Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," pp. 582.

<sup>27</sup> Sosna, et al., "Facing the New Threats of Terrorism: Radiologists' Perspectives Based on Experience in Israel," p. 237.

#### **EMERGENCY RESPONSE IN ISRAEL, AUSTRALIA, AND THE UNITED KINGDOM**

In Israel, the first call for help following a bombing will most likely be made to 101, the emergency telephone number of the Magen David Adom (MDA), Israel's version of the Red Cross, which is responsible for the country's medical-response teams and ambulances. MDA dispatchers follow a strict procedure. First they alert the ambulance teams, who are summoned by pager. Then, by both radio and pager, they notify

- the MDA's national headquarters, in Tel Aviv;
- the police (Israel has a national police force, not individual local forces); and,
- MDA regions and hospitals neighboring the site of the attack

The police or the MDA crews arrive first, depending on who is closer to the scene when the call comes in. The top priority is to tend to the victims and, simultaneously, to secure the area—to make sure that no other attacker strikes just as medical teams and more police officers arrive, among them counterterrorist, forensics, bomb-disposal, and intelligence squads. For the MDA the highest priority is to follow what Dr. Shapira, the deputy director general of **Jerusalem's Hadassah Hospitals**, calls the "golden half-hour rule": Get to victims during the critical minutes after an attack, when prompt medical attention—maintaining airways, controlling external hemorrhages, can mean the difference between life and death. This is termed "scoop and run."<sup>28</sup> That is, "only minimal treatment is provided at the attack site, like maintenance of an airway and pressure to stop external bleeding" before the victim is whisked into an ambulance and rushed to hospital. In Israel, ambulances carrying the injured will begin to arrive at hospitals within 20 minutes of the attack. Triage decisions will have already been made at the scene of the bombing: "The most severely injured survivors are triaged to a 'level 1 trauma center,' a hospital

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<sup>28</sup> S.C. Shapira, et al., "Mortality in Terrorist Attacks: A Unique Modal of Temporary Death Distribution," *World Journal of Surgery*, vol. 30 (2006), p. 2 accessed at [http://www.terrormedicine.org/publications\\_files/Mortality%20related%20to%20terror.pdf](http://www.terrormedicine.org/publications_files/Mortality%20related%20to%20terror.pdf).

with advanced equipment and special expertise in trauma therapy. The less seriously injured may be sent to level 2 or 3 trauma centers, with efforts not to overload any single hospital."<sup>29</sup>

The Israeli emergency response thus comprises two protocols: "the organization of the pre-hospital phase and the cooperation and communication between the different rescue teams and medical systems in the region," as recounted immediately above; and, another regarding the hospital itself and the "general algorithm of hospital management throughout the MCE."<sup>30</sup> Hospitals in Israel are required by the government to be able to surge on very short notice and handle at least 20 percent more emergencies beyond its normal capacity. The newly-constructed Center for Emergency Medicine at Jerusalem's Hadassah Ein Kerem Hospital, for instance, can quickly double its emergency bed capacity to accommodate more than a 100 patients. Equally important, the center's four-foot-thick walls can withstand a major explosion and two sets of shatterproof glass can confine and re-circulate indoor air for more than a week. Not surprisingly given Israel's perpetual state of war with terrorists, tremendous priority is attached to ensuring the safety of emergency hospital personnel, the hospitals themselves and the victims brought to these care facilities.<sup>31</sup> Other hospitals, such as Tel Hashomer in Tel Aviv and the Western Galilee Hospital in Nahariya, actually have secure underground emergency treatment facilities "with hundreds of empty beds and IV stands at the ready."<sup>32</sup>

A second triage occurs at each hospital where patients may arrive as often as one every 20 seconds<sup>33</sup> (A U.S. Centers for Disease Control and Prevention analysis warned that in the event of some urban disasters, half of all casualties will arrive at a hospital over the period of an hour).<sup>34</sup> An 11-step procedure is followed, whereby the medical personnel in charge:

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<sup>29</sup> Shapira and Cole, "Terror Medicine: Birth of a Discipline."

<sup>30</sup> Shapira and Shemer, "Medical Management of Terrorist Attacks," p. 489.

<sup>31</sup> Ibid., " p. 490.

<sup>32</sup> Shapira and Cole, "Terror Medicine: Birth of a Discipline."

<sup>33</sup> Ibid.

- Confirm information
- Gather data; Type of event, location, estimated number of casualties, severity of injuries, estimated time of patients' arrival
- Evacuate emergency department
- Call for extra medical and paramedical staff
- Notify operating rooms, imaging, blood-bank
- Stop elective operations
- Assign a triage officer
- Decide whether decontamination will be needed
- Decide whether to set up extra admission areas
- Open control station
- Open public information center<sup>35</sup>

Suicide bombings are among the most lethal of all terrorist attacks. Almost 83 percent of those killed in a suicide bombing die at the scene. Of the survivors on average only about 17 percent subsequently die in hospital.<sup>36</sup> But, at the same time, many of the casualties may only be lightly wounded and indeed more than half of them are often discharged from the hospital within twenty-four hours of admittance.<sup>37</sup>

Israel's experience with MCEs arising from suicide and other terrorist bombings contrasts sharply in many important ways with New York City's experiences on 9/11. Fewer than a 1,000 injured survivors from the World Trade Center towers, for example, were admitted to two lower Manhattan hospitals in the hours after the attack. Of these, only 13 percent required surgery and hospitalization while 85 percent were both ambulatory and had mostly minor injuries. By comparison, about a third of Israeli victims of terrorism had severe trauma, 26 percent of

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<sup>34</sup> Rosenfeld, et al., "Is the Australian hospital system adequately prepared for terrorism?"

<sup>35</sup> Shapira and Mor-Yosef, "Medical Management of Conventional and WMD Terror," p. 383.

<sup>36</sup> Shapria, et al., "Mortality in Terrorist Attacks: A Unique Modal of Temporary Death Distribution," p. 1.

victims required admission to intensive care units, and one-half needed surgery. Duration of hospitalization of Israeli terrorist victims typically lasted longer than two weeks for about 20 percent of the injured.<sup>38</sup>

Australia's principal experiences with terrorist MCEs has primarily been as a result of the October 2002 suicide bombings in Bali, where 91 Australian citizens were killed and 66 injured (total deaths were 202 persons with 209 others wounded). The survivors were airlifted to Darwin, where the vast majority (61 persons) were treated at the Royal Darwin Hospital. Forty-five percent of these survivors were suffering from major trauma and all had severe burns. The large number of burn victims presented a special challenge to the Royal Darwin Hospital, as no one hospital in the country had the capacity or capabilities to manage that many blast and burn victims. Accordingly, Australian medical authorities decided to move them to other hospitals across Australia. The length of stay in hospital varied from 13 to 91 days. As an American public health analyst studying the Australian response to the suicide attack has noted, "The Bali experience serves as a warning of what could easily happen in a terrorist bombing [in the U.S.]. An incident producing '61 patients with severe burn and blast injuries' would overwhelm the resources of most areas of the country and would require secondary triage and redistribution of patients to other burn centers."<sup>39</sup>

Australia accordingly has drawn six key lessons from this experience and from studying that of other countries' emergency response to terrorist MCEs:

- Australian hospitals need to be prepared to deal with mass casualties from terrorist strikes, including bomb blasts and chemical, biological and radiation injury.

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<sup>37</sup> Interview with Dr. Shapira, Jerusalem Ein Kerem Hospital, 13 September 2003.

<sup>38</sup> Sosna, et al., "Facing the New Threats of Terrorism: Radiologists' Perspectives Based on Experience in Israel," p. 237.

<sup>39</sup> Crabtree, "Terrorist Homicide Bombings: A Primer for Preparation," pp. 583.

- Injuries from bomb explosions are more severe than those commonly seen in Australian hospitals.
- In disasters involving mass casualties in urban areas, many of the injured make their own way to hospital, often arriving before the more seriously injured casualties. Major hospitals in Australia should plan for large numbers of undifferentiated and potentially contaminated casualties arriving with minimal warning.
- It is critical that experienced and trained senior medical officers perform the triage of casualties in emergency departments, with frequent reassessment to detect missed injuries (especially pulmonary blast injury).
- Hospitals require well developed standard operating procedures for mass casualty events, reinforced by regular drills.
- Preparing for a major event includes training staff in major incident management, setting up an operational/control unit, nominating key personnel, ensuring there is an efficient intra-hospital communication system, and enhancing links with other emergency services and hospitals.<sup>40</sup>

London's emergency preparedness and response in the event of terrorist MCEs had been based on New York City's experience with the 9/11 attacks. However, the suicide terrorist bombings of three subway cars and bus on 7 July 2005 was a significantly different medical challenge. In New York City on 9/11, many persons died and only a few survived. The opposite occurred on 7/7 when only a small proportion of the victims lost their lives (52), but over 500 persons were injured.<sup>41</sup> London's long experience with Irish terrorism coupled with extensive planning, drills and other exercises ensured that the city's emergency services responded quickly and effectively in a highly coordinated

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<sup>40</sup> Rosenfeld, et al., "Is the Australian hospital system adequately prepared for terrorism?"

<sup>41</sup> Andrew Berkman, "Lessons from London," Emergency (Queensland Australia), 6 July 2006, p. 11 accessed at: [http://www.emergency.qld.gov.au/publications/emergency/2006\\_jul/pdf/Emergency\\_July\\_06\\_p10-13.pdf](http://www.emergency.qld.gov.au/publications/emergency/2006_jul/pdf/Emergency_July_06_p10-13.pdf).

manner.<sup>42</sup> For example, according to the official lessons learned report,

All five London Strategic Health Authorities played a part in the response and all London hospitals were placed on major incident alert, with 1,200 beds rapidly made available for more than 700 casualties arriving at accident and emergency departments over a period of several hours. The vast majority (more than 80%) were fit for discharge on the same day. Of the 103 casualties admitted to hospital, including 21 critically injured, three were to die of their injuries.<sup>43</sup>

The initial deployment of ambulances and emergency service personnel to the four blast sites entailed 73 ambulances and 12 response units, with many additional vehicles drawn from other sources.<sup>44</sup>

But even London's well-honed response to the MCE on 7/7 was not without problems:

- First, communications between first responders with hospitals or their control rooms were not as good as it should have been which resulted in the uneven and inappropriate distribution of casualties among area hospitals. In one instance, 300 casualties were transferred by double-decker bus from Tavistock Square (the scene of the bus bombing) to Royal London Hospital.
- Second, some hospitals weren't officially notified of the MCE and warned to expect casualties.
- Third, it proved extremely challenging to provide timely and accurate information, especially on casualty numbers, to government and the media.
- Lastly, multiple MCE sites within relatively close geographical proximity to one another created problems with some ambulance

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<sup>42</sup> Australian Government, Attorney-General's Department Emergency Management Australia, *Lessons from London and Considerations for Australia: London Terrorist Attacks, 7 July 2005*, 2007, p. 6 accessed at [http://www.ema.gov.au/agd/ema/rwpattach.nsf/VAP/\(A80860EC13A61F5BA8C1121176F6CC3C\)~LessonsfromLondon\\_220507.pdf/\\$file/LessonsfromLondon\\_220507.pdf](http://www.ema.gov.au/agd/ema/rwpattach.nsf/VAP/(A80860EC13A61F5BA8C1121176F6CC3C)~LessonsfromLondon_220507.pdf/$file/LessonsfromLondon_220507.pdf)

<sup>43</sup> Home Office, *Addressing Lessons From The Emergency Response To The 7 July 2005 London Bombings*, 22 September 2006, p. 22 accessed at: <http://security.homeoffice.gov.uk/news-publications/publication-search/general/lessons-learned?view=Binary>.

crews diverting themselves to the more visible sites than the less visible, but more critical ones, they had been sent to.<sup>45</sup>

## CONCLUSION

What emerges from this discussion of the medical community's emergency response and preparedness for terrorist MCEs involving conventional explosions are two main points. First, that there are lessons we can learn from other countries' experiences with terrorist bombings and suicide terrorist attacks that would significantly improve and speed our recovery should terrorists similarly strike here. The experiences of foreign medical and emergency response communities and hospitals particularly in Israel, Australia, and Britain is highly relevant to their American counterparts.

Second, is that the best way to save as many lives as possible after a terrorist bombing or suicide attack is for physicians and other health care workers to undergo intensive training and preparation before an attack, including staging drills at hospitals, to cope with sudden overflow of victims with a variety of injuries from terrorist attacks. First responders must also understand that the specific demands of responding to bombings and suicide attacks are uniquely challenging. Death and injury come not only from shrapnel and projectiles but also from collapsed and pulverized vital organs, horrific burns, seared lungs and internal bleeding. It is crucial that emergency responders evaluate their response protocols and be prepared for the unusual circumstances created by a suicide attack. Moreover, given the increased financial stress on our nation's health system in general and urban hospitals in particular, any degradation of our existing capabilities will pose major challenges to our nation's readiness for an attack. Indeed, the opposite is required: a strengthening of our the capabilities at hospitals and for the emergency services that we require to effectively respond to a terrorism MCE involving conventional bombings or suicide attacks.

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<sup>44</sup> Attorney-General's Department Emergency Management Australia, *Lessons from London and Considerations for Australian*, p. 6

<sup>45</sup> *Ibid.*, p. 17; and, Berkman, "Lessons from London," p. 17.

Let me conclude with a prophetic paragraph from the Gilmore Commission's (more formally known as the *Advisory Panel To Assess Domestic Response Capabilities For Terrorism Involving Weapons of Mass Destruction*) first annual report on national preparedness to address the threat of terrorist use of WMD in the U.S. that, as the commission's then executive director, I drafted nearly ten years ago.

The Panel concludes that the Nation must be prepared for the entire spectrum of potential terrorist threats—both the unprecedented higher-consequence attack, as well as the historically more frequent, lesser-consequence terrorist attack, which the Panel believes is more likely in the near term. Conventional explosives, traditionally a favorite tool of the terrorist, will likely remain the terrorist weapon of choice in the near term as well. Whether smaller-scale CBRN or conventional, any such lower-consequence event—at least in terms of casualties or destruction—could, nevertheless, accomplish one or more terrorist objectives: exhausting response capabilities, instilling fear, undermining government credibility, or provoking an overreaction by the government. With that in mind, the Panel's report urges a more balanced approach, so that not only higher-consequence scenarios will be considered, but that increasing attention must now also be paid to the historically more frequent, more probable, lesser-consequence attack, especially in terms of policy implications for budget priorities or the allocation of other resources, to optimize local response capabilities. A singular focus on preparing for an event potentially affecting thousands or tens of thousands may result in a smaller, but nevertheless lethal attack involving dozens failing to receive an appropriate response in the first critical minutes and hours.<sup>46</sup>

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<sup>46</sup> *First Annual Report to The President and The Congress of the Advisory Panel To Assess Domestic Response Capabilities For Terrorism Involving Weapons of Mass Destruction: I. Assessing The Threat*, 15 December 1999 (Washington, D.C., RAND Corp., 2001) p. 20 accessed at: <http://rand.org/nsrd/terrpanel/terror.pdf>