

# An Update on the Surgeons Scope and Depth of Practice to All Hazards Emergency Response

David L. Ciraulo, DO, MPH, Philip S. Barie, MD, MBA, Susan M. Briggs, MD, H. Scott Bjerke, MD, Christopher T. Born, MD, Jeannette Capella, MD, Leopoldo Cancio, MD, Andrew Dennis, DO, J. Christopher DiGiacomo, MD, Ronald I. Gross, MD, Jeffrey S. Hammond, MD, MPH, John B. Holcomb, MD, Donald Jenkins, MD, Thomas E. Knuth, MD, MPH, Peter B. Letarte, MD, Mauricio Lynn, MD, Patricia A. O'Neill, MD, Jeffrey P. Salomone, MD, and David V. Shatz, MD

This article outlines the position of The Eastern Association of the Surgery of Trauma (EAST) in defining the role of surgeons, and specifically trauma/critical care surgeons, in the development of public health initiatives that are designed to react to and deal effectively with acts of terrorism. All aspects of the surgeon's role

in response to mass casualty incidents are considered, from prehospital response teams to the postevent debriefing. The role of the surgeon in response to mass casualty incidents (MCIs) is substantial in response to threats and injury from natural, unintentional, and intentional disasters. The surgeon must take an active role

in pre-event community preparation in training, planning, and executing the response to MCI. The marriage of initiatives among Departments of Public Health, the Department of Homeland Security, and existing trauma systems will provide a template for successful responses to terrorist acts.

*J Trauma.* 2006;60:1267-1274.

Terrorism is not new. Recorded history is replete with descriptions of acts by people against others in the hope of political or social change, acts that now would be considered acts of terrorism. The word "terrorism" was first used in 1795, deriving its origin from the French "Reign of Terror," where the guillotine was used in a public and highly visible fashion<sup>1</sup> to consolidate power. Although there is no consensus definition of "terrorism," it has been defined as "the unlawful use or threatened use of force or violence by a person or an organized group against people or property with the intention of intimidating or coercing societies or governments, often for ideological or political reasons."<sup>2</sup>

In 1974, Brian Jenkins stated that "Terrorists want a lot of people watching, not a lot of people dead." Unfortunately, the strategy and tactics of modern-day terrorists have evolved to cause the deaths of as many people as possible. In fact, in the last decade, a terrorist incident was nearly 20% more likely to result in death or injury than in the previous decade.<sup>1</sup> Although firearms remain popular,<sup>3</sup> explosives are the most economical and readily available terrorist weapons, causing high numbers of casualties at lower cost than any other weapons system. The bombing of the US Marine barracks in Beirut in 1983, the Oklahoma City bombing on November 22, 1995, the bombing of the US Embassies in East Africa in

1999, the several attacks on September 11, 2001 the bombings of the transit systems of Madrid in 2004 and London in 2005, and myriad other acts in East Africa, Indonesia, Iraq, and Israel stand as testimony. Almost all the casualties have been civilians.

The threat of terrorists' use of "nonconventional" weapons also looms large. The 1995 Tokyo subway attack by the Aum Shinrikyo and the multiple foiled plots to produce and use low-grade radiation "dirty bombs" within the United States in the last several years are evidence that terrorist groups are increasingly inclined to use chemical, biological, radiologic, or nuclear weapons of mass destruction (WMD). Public fear is accentuated by unfamiliarity with their use and with the consequences of use of WMD, which fear is an acceptable secondary endpoint in terrorism's designs.

Increasingly frequent and effective terrorist acts have forced public health systems worldwide to examine and improve their abilities to care for mass casualties. Frykberg and Tepas noted that the most efficient and effective medical response systems have been developed in countries where terrorist attacks are most frequent. The establishment and rehearsal of a disaster plan is the first essential element in minimizing morbidity and mortality from mass casualties. Furthermore, the authors asserted that "Such a plan should involve the immediate availability of surgeons who are trained and experienced in the principles of mass casualty triage and the treatment of the multiply injured victim."<sup>4</sup>

In 1966, the National Academy of Sciences and the National Research Council published a report, *Accidental Death and Disability: The Neglected Disease in Modern Society*.<sup>5</sup> A landmark study in the recognition of traumatic injury as a disease, the report was the impetus for the development of modern trauma systems and their integration into

Submitted for publication September 22, 2004.

Accepted for publication March 9, 2006.

Copyright © 2006 by Lippincott Williams & Wilkins, Inc.

From the Eastern Association for the Surgery of Trauma: Disaster and Medical Special Operations Committee, (DMSOC), 2004.

Address for Reprints: David L. Ciraulo, DO, FACS, MPH, Chairman: DMSOC/EAST, Maine Medical Center, Department of Surgery, 887 Congress St., Suite 210, Portland, ME 04102-3113; email: ciraud@mmc.org.

DOI: 10.1097/01.ta.0000220665.03167.09

# Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>01 JUN 2006</b>	2. REPORT TYPE <b>N/A</b>	3. DATES COVERED -			
4. TITLE AND SUBTITLE <b>An update on the surgeons scope and depth of practice to all hazards emergency response</b>		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S) <b>Ciraulo D. L., Barie P. S., Briggs S. M., Bjerke H. S., Born C. T., Capella J., Cancio L., Dennis A., DiGiacomo J. C., Gross R. I., Hammond J. S., Holcomb J. B., Jenkins D., Knuth T. E., Letarte P. B., Lynn M., O'Neill P. A., Salomone J. P., Shatz D. V.,</b>		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>United States Army Institute of Surgical Research, JBSA Fort Sam Houston, TX 78234</b>		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>8</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

the public health infrastructure. Preparedness and rehearsal have become the keystones of the response to the threat of terrorism. Preparedness now generally falls within the domain of public health systems. Trauma systems can be utilized to strengthen the preparedness for, and the response to, terrorist activities using WMD.<sup>6</sup>

Surgeons within trauma systems should logically take a lead role in the development, implementation, and continued improvement of these responses, as well as being part of the initial triage and treatment of victims. Surgeons can advise on strategic planning for forward movement of patients, assessment of surge capacity and how to execute the expansion. Surgeons can also establish prehospital treatment protocols for injuries from WMD in conjunction with emergency medicine, critical care, and infectious disease colleagues, and establish provisions for security of the facility and hospital, employee, and patient safety.

The Eastern Association for the Surgery of Trauma (EAST) has published several position papers dealing with specific aspects of the public health crisis of trauma. The Association has assumed a leadership role in promoting the surgeon's role in the development of public policy and practice regarding the prevention and care of traumatic injury, and the role of the trauma systems in the public health domain. This position paper outlines the position of EAST with respect to the role of all surgeons, and specifically trauma/critical care surgeons, in the development of a public health initiative that is designed to react to, and deal effectively with acts of terrorism. Diverse aspects of the surgeon's role in the response to mass casualty incidents (MCI) are considered, from prehospital response teams to the postevent debriefing, so as to provide a framework upon which future actions can be based.

## MASS CASUALTIES

The American College of Surgeons Committee on *Trauma's Resources for Optimal Care of the Injured Patient* provides useful guidelines for basic disaster planning. Although useful and accurate as a tool to establish a well-organized hospital disaster plan, these guidelines do not meet the comprehensive needs of surgeons for disaster preparedness.<sup>8</sup> Disasters are difficult to envision from either a victim or caregiver perspective until experienced firsthand; inexperience may result in a cavalier attitude toward disaster planning. Surgeons often believe that managing the medical and surgical aspects of a MCI is simply an extension of their daily activities.<sup>8</sup> A review of published reports of surgeons who have been involved in various MCIs belies such perceptions.<sup>8-10</sup> The delivery of medical care during a MCI differs markedly from the routine. Today's increasing threats to civilian safety through terrorist attacks or natural disasters require all surgeons and healthcare personnel to have expanded knowledge of potential threats, large-scale disaster management, and WMD, both for delivery of care and civilian and personal safety.

Surgeons must have a general understanding of the types of MCIs and specific injury patterns associated with them. They must know their hospital's disaster plans and how they integrate with the local emergency systems response. Surgeons also must understand the concept of triage and be able to function in a role that may be outside their usual expertise. Communication and organization are essential. Most analyses of MCIs identify miscommunication as a cardinal feature (and failure) of the response. An individual functioning at any level within a disaster response must be able to communicate and integrate himself or herself within the response, whether at the disaster scene, an intermediate treatment center, or the hospital. The Incident Command System (ICS) and its application to the Hospital Emergency Incident Command System (HEICS), provides structure to facilitate organization and communication.

## INCIDENT COMMAND SYSTEM

The ICS is an organizational structure and management system adopted by the Federal Emergency Management Agency (FEMA) after analysis of the handling of the California wildfires of 1970.<sup>12,13</sup> The analysis demonstrated serious flaws in the design, management, planning, and communications among the various agencies and services responding to the disaster. The goal in creating ICS was to simplify communications and to establish clear lines of command and control. The ICS provides a common organizational structure and language that allows disparate agencies to work together effectively in response to a disaster.

The HEICS provides hospitals with a logical management structure, defined responsibilities, clear reporting channels, and a common nomenclature, reducing the chaos and confusion that results at the onset of a medical disaster. The effectiveness of a given hospital's response is improved; allowing resumption of normal operations as soon as possible. Given the effectiveness of the HEICS, the Joint Commission for Accreditation of Healthcare Organizations (JCAHO) now requires all hospitals seeking accreditation to utilize the HEICS format for their disaster plans.

The surgeon must be familiar with four important principles that govern the ICS: (1) The ICS needs to be activated early before the incident gets out of control. Some experts state that for every 5 minutes an incident continues before the ICS is implemented, it takes 30 minutes longer to bring the incident under control; (2) medical responders, often accustomed to working independently, must adhere to the structure of an ICS to integrate successfully into the rescue effort; (3) the EMS and medical responders are part of a unified command; and (4) the structure of the ICS is the same regardless of the nature of the MCI. The difference is in the particular experience of the key personnel. In a biological incident for example, key personnel would be experienced in infection control, whereas after an explosion the key personnel would include surgeons.<sup>11</sup> It is essential for surgical departments to

incorporate these principles into their departmental disaster plans and their staff and resident training programs.

## Triage

Triage is the most important mission of any medical response regardless of the type and size of the incident.<sup>7-12</sup> The concept of disaster medical triage is based on the assumption of a potential imbalance between the health needs produced by numerous casualties and the available medical resources. During a large-scale disaster response different levels of triage are performed. Successful triage requires basic knowledge of common injury patterns, consequences of various biological agents, and the ability to integrate and communicate with all other emergency responders, thus reiterating the need for prior training, planning, and preparedness. The objective is to do the greatest good for the greatest number of people. Under-triage misses critical injuries or delays stabilization or definitive therapy, increasing morbidity and mortality of salvageable injuries. Over-triage that results in the assignment of minimally injured victims to immediate treatment will strain the system and limit the capability to provide adequate care to those who are critically injured. The natural instinct of care givers to deliver as much care as needed for each patient in a MCI is not optimal and may be deleterious. The unexpected inability to perform triage, and the emotional consequences for those who do make triage decisions, are often underestimated or not anticipated. Personnel who cannot adapt must recognize their limitations and recuse themselves, without guilt, so that others can attend to these necessary tasks.

Time is crucial in a MCI. Most who are critically wounded will die within 4 hours of injury if appropriate intervention is not performed.<sup>12,13</sup> In most MCIs, field triage can be performed effectively by experienced paramedics; surgeons are needed only during unique circumstances. In the hospital, triage requires an experienced surgeon who is familiar with the triage principles and has knowledge of current hospital resources and operating room capacity, especially in large-scale MCIs with large numbers of casualties who require surgical intervention. Other professional specialists may be of assistance in incident-specific-type events. In a biological event, specialists from infectious disease would be helpful in assessing potential risks for contagion. In a chemical event, a toxicologist would be of assistance in determining the etiology of the chemical exposure and possible detoxification strategies. Likewise, a radiation oncologist could be complimentary to the response in the event of an exposure to a radiologic or nuclear WMD.

## Biological

On September 10, 2001, few trauma surgeons had given much thought to the genuine prospect of biological warfare against civilian populations. It was known that weapons stockpiles existed, and perhaps that some agents had the potential for nefarious use. Certainly, it was never suspected

that the US Postal Service would be used as a vector for transmission of “weapons-grade” spores of *Bacillus anthracis* a mere 2 months later, resulting in five American fatalities.<sup>14,15</sup> Given that clinically relevant exposures to *B. anthracis*—the anthrax bacillus—occurred in FL, NJ, NY, CT, and the District of Columbia, hopefully all healthcare professionals, regardless of specialty, realize now that malevolent dispersal of biological agents can happen anywhere, anytime, and may well occur again. Trauma and emergency response preparedness must be assessed on a continuous basis, and detailed plans must be in place for both real and suspected exposures (Table 1).<sup>16</sup> The crucial question is: Will exposure to biological warfare agents be recognized soon enough to institute appropriate prophylaxis and therapy, and to protect health care providers?

For many of the agents (*B. anthracis*, *Yersinia pestis*, *Francisella tularensis*, *Brucella* sp., *Coxiella burnetii*, *Burkholderia pseudomallei*, and *mallei*, several *Clostridium* sp., and several viruses), debilitating and potentially lethal doses are miniscule. Education and preparedness are the best defense, because most US physicians have never seen a clinical case of disease caused by any of these pathogens.<sup>17,18</sup>

The clinical presentation may be subtle; there is no guarantee that another attack will utilize *B. anthracis* again, or the same mode of transmission. Exposures may again be isolated, or manifest as a MCI. The etiologic agents might be single or multiple, or admixed with conventional high explosives, radioactive materials, or chemical agents. Without allowing paranoia to overtake rational thought and preparedness, trauma surgeons and emergency medicine physicians should be suspicious whenever an explosion occurs, or whenever clusters of patients appear with similar symptoms or lesions (especially skin lesions) and time of onset, especially if “out of season” (e.g. flu-like symptoms in mid-summer). Given the high degree of contagion associated with many of these biological agents, it may take only a single patient to expose a multitude of others, and contaminate

**Table 1** Elements of Infection Control Procedures for Exposure to Etiologic Agents (Association of Professionals in Infection Control and Epidemiology/ Centers for Disease Control and Prevention)<sup>16</sup>

Isolation precautions
Face and eye protection
Patient placement and transport
Cleaning, disinfection, and sterilization
Discharge management
Postmortem care
Postexposure management
Decontamination of patients and the environment
Prophylaxis and postexposure immunization
Triage and management of large-scale exposures
Psychological support
Laboratory support and confirmation
Collection of diagnostic samples
Transport requirements
Laboratory criteria for processing

an entire emergency department or receiving hospital, as simulations have shown repeatedly. Security, environmental, and infection control considerations are paramount if excess casualties are to be avoided.

Surgeons must become familiar with the “typical” clinical manifestations of anthrax, botulism, plague, smallpox, tularemia, and the viral hemorrhagic fevers (filoviruses, e.g. Ebola; arenaviruses, e.g. Lassa fever)<sup>8–22</sup> that constitute Category A (high risk) agents according to the US Centers for Disease Control and Prevention (CDC)<sup>18</sup> (Table 2).

**Table 2 US Centers for Disease Control and Prevention (CDC) Classification of Potential Agents of Bioterrorism<sup>22</sup>**

Category A (high priority)
High-priority agents include organisms that pose a risk to national security because they:
Can be easily disseminated or transmitted from person to person;
Result in high mortality rates and have the potential for major public health impact;
Might cause public panic and social disruption; and
Require special action for public health preparedness
Anthrax ( <i>Bacillus anthracis</i> )
Botulism ( <i>Clostridium botulinum</i> toxin)
Plague ( <i>Yersinia pestis</i> )
Smallpox (variola major)
Tularemia ( <i>Francisella tularensis</i> )
Viral hemorrhagic fevers (filoviruses [e.g. Ebola, Marburg] and arenaviruses [e.g. Lassa, Machupo])
Category B (second priority)
Second highest priority agents include those that:
Are moderately easy to disseminate;
Result in moderate morbidity rates and low mortality rates; and
Require specific enhancements of CDCs diagnostic capacity and enhanced disease surveillance
Brucellosis ( <i>Brucella</i> species)
Epsilon toxin of <i>Clostridium perfringens</i>
Food safety threats (e.g. <i>Salmonella</i> species, <i>Escherichia coli</i> O157:H7, <i>Shigella</i> species)
Glanders ( <i>Burkholderia mallei</i> )
Melioidosis ( <i>Burkholderia pseudomallei</i> )
Psittacosis ( <i>Chlamydia psittaci</i> )
Q fever ( <i>Coxiella burnetii</i> )
Ricin toxin from <i>Ricinus communis</i> (castor beans)
Staphylococcal enterotoxin B
Typhus fever ( <i>Rickettsia prowazekii</i> )
Viral encephalitis (alphaviruses [e.g. Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis])
Water safety threats (e.g. <i>Vibrio cholerae</i> , <i>Cryptosporidium parvum</i> )
Category C (third priority)
Third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of:
Availability;
Ease of production and dissemination; and
Potential for high morbidity and mortality rates and major health impact
Emerging infectious diseases such as Nipah virus and hantavirus

Suspicion of exposure in a MCI requires an immediate response, including activation of hazardous materials abatement protocols.

## Chemical

In many modern disaster plans, emergency physicians have assumed the role of senior triage officers, leading some to conclude that surgeons, relegated to the operating room, do not need an understanding of the treatment of chemical casualties. Recent experience proves that this conclusion is incorrect for many reasons. Surgeons are likely to play a large role in any MCI involving the deployment of chemical weapons because cutaneous burns will be commonplace.

In the two large-scale chemical attacks in recent history—the Tokyo subway sarin nerve gas attack of 1995 and the Moscow Nord Ost hostage incident of 2002, Emergency Departments received hundreds of casualties before the etiologic agent was ascertained.<sup>23–26</sup> Each instance highlighted the fact that a chemical attack may be mistaken for, or superimposed on, a conventional explosion. In such cases, surgeons may be treating patients before it is known that a chemical attack has occurred.

In the Tokyo sarin attack, the initial report was that an explosion had occurred in the subway system. Hospitals activated plans to receive victims with burns, inhalation injuries, and carbon monoxide poisoning. In the Nord Ost event, an opioid gas was used to neutralize terrorists who had deployed high explosives among hostages throughout the theater.<sup>23–26</sup> Had a detonation occurred, large numbers of blast injuries would have been added to the scenario.

These situations are probably not unique. If surgeons are likely to be treating casualties before it is known that a chemical attack has occurred, a heightened awareness of the manifestations and treatment of chemical casualties will allow surgeons to recognize the danger and institute measures immediately to treat the victims and to protect themselves, other staff, and the facility from further contamination. In Tokyo, lack of awareness on the part of staff did lead to some staff illness from the nerve gas.<sup>23</sup>

It is unlikely that any institution could manage an influx of chemical burns without surgical input. A MCI that includes a deployment of chemical weapons would likely overwhelm resources; pressing all available into service. The Swedish disaster medicine community learned this lesson from the December 3, 1984 leak of methylisocyanate from a chemical plant in Bhopal, India. As many as 200,000 people were injured, with more than 10,000 severe injuries and approximately 2,500 deaths. The Swedes emphasized that “There must be planning for treatment of thousands of patients at the same time, a circumstance that will often require temporary ‘satellite hospitals’ to be opened. As symptoms and injuries are of the same kind, even if the magnitude and the effect may differ, treatment can, in many ways, be standardized. Therefore members of the health-care team, irre-

spective of their daily different specialty fields, can work with the most urgent missions."<sup>27</sup>

For example, the al Khanjar Navy-Marine Trauma Center in Kuwait prepared to take chemical casualties during Operation Desert Storm. Whereas primary triage was performed by a nonsurgeon, immediate subsequent stabilization and treatment was performed at assessment and stabilization areas staffed by surgeons.<sup>28</sup> Presumably, if chemical weapons had been deployed, surgeons would have been stabilizing patients who were suffering the effects of chemical attack, and would require treatment therefor as part of their resuscitation. Part of trauma resuscitation has always been to identify nontraumatic conditions such as myocardial infarction and stroke. The Advanced Burn Life Support (ABLS) course has always emphasized a complete approach to the patient, whereby fractures and lung injury are identified and treated rapidly along with the patient's burn. Lessons from ABLS should be extrapolated to identify and treat chemical injury as part of complete, integrated patient care.

## Radiation

Radioactivity was a seminal scientific discovery of the 19th century; unfortunately, notoriety stemmed from its military use.<sup>29</sup> Since then, its application in medicine, industry, the production of electricity, and commercial science has become commonplace. The late twentieth century was consumed by concern of the threat of nuclear warfare; today, the threat comes from accidents at power plants and terrorism, including the intentional dispersal of radioactive material via "dirty bombs;" explosives contaminated with radioactive material.<sup>30</sup> The threat exists also for terrorist groups to acquire weapons-grade plutonium or uranium for production of small, low-yield devices,<sup>30</sup> which could be delivered anywhere in luggage, shipping containers, or other concealments.

The surgeon's role encompasses management of acute injury from burns and radioactive shrapnel from dirty bombs to the critical care of acute radiation syndrome. Of utmost importance is an understanding of the concepts of external and internal decontamination of victims.<sup>31</sup> Although external decontamination removes the majority of risk, internal absorption of material and excretion via feces, urine, and exhaled breath must be monitored.<sup>31</sup> The simple removal of all clothing eliminates approximately 90% of contamination in a radioactive emergency. The surgeon must not rush to treat until the patient has been decontaminated insofar as possible. Personal risk should be monitored by wearing a dosimeter. Extensive surface contamination is not likely to result in over-exposure of medical personnel, as demonstrated by an evaluation of the Chernobyl medical personnel, who received less than 10 mGy of radiation.<sup>32</sup> If a person has surface contamination and no physical injuries, decontamination should proceed as usual with water and detergent. However, if there are also substantial physical injuries, the patient should be stabilized physiologically before decontamination proceeds.<sup>32</sup> The cardinal rules of time, distance, and shielding

should be adhered to in the resuscitation of victims exposed to radioactive material.<sup>30</sup> Patients who experience greater than 2 Gy of exposure must be considered for early surgical intervention, if needed, before the effects of hematopoietic depression and resultant poor wound healing.<sup>30</sup>

The surgeon must also be prepared to assist in the management of delayed radiation sequelae, including gastrointestinal, respiratory, cardiovascular, hematologic, and central nervous system dysfunction.<sup>30,31</sup> For example, an understanding of the different sources of radiation is important in choosing chelation agents that reduce absorption, block uptake, and displace radioactive material from cells and mobilize material for excretion.<sup>29-31</sup>

As a consequence of Cold War-era threats, potential accidents at nuclear power plants, and industrial radiation accidents, JCAHO requires hospitals to have plans for managing radiation-contaminated patients.<sup>31</sup> Therefore, in principle, almost all acute-care facilities should be prepared to handle radiation emergencies.

## Blast/Penetrating/Incendiary

Historically, the greatest threats facing countries have been attacks from conventional weapons. Explosives and injury from penetrating armaments have been the weapons of choice for terrorist groups. In the event of a MCI from blast or penetrating injury, the trauma surgeon's leadership will be paramount, both clinically and administratively in disparate roles as triage officer, medical director of several clinical units, and supervisor or performer of complicated operations.

Blast injuries are complex. Unlike most blunt or penetrating injuries, the approach to blast injuries requires consideration of the physical properties of blast potential, pressure waves, and the resulting alteration of human physiology.<sup>33</sup> Primary blast waves cause mainly pulmonary injury, hollow viscus perforations, eye injuries, and amputations.<sup>33</sup> Some of the injuries sustained will be obvious, but only through training and experience can the subtle injuries of the effects of overpressuring be appreciated.<sup>33,34</sup> The surgeon must understand blast lung physiology, alveolar-capillary disruption, cerebral and coronary air emboli, and the potential for gastrointestinal injury. Secondary blast effects cause injury from flying shrapnel and debris. Tertiary blast injuries include those caused by landing on the ground or sharp objects or being buried by debris, whereas quaternary blast injuries are caused by thermal exposure. The systemic effects of crush syndrome, including hypotension, renal failure, acidosis, hyperkalemia, hypocalcemia, cardiac arrhythmias, and compartment syndrome must be recognized and treated rapidly.<sup>35</sup>

## Emergency Response Teams

Most hospital-based personnel, including surgeons, are ill-prepared and ill-equipped to enter hazardous sites. The only person to die in the Oklahoma City bombing who was not a victim of the initial attack was a nurse, without proper

protective gear, who sustained a fatal brain injury during rescue efforts.

The surgeon's locus during a MCI, in most instances, is and should remain the hospital setting. However, opportunities exist for specially trained surgeons to make a contribution in the field. Involvement with fire-rescue EMS providers offers training opportunities and proper preparation for on-scene involvement as a physician. Federal programs such as the Urban Search and Rescue (USAR) task forces under FEMA<sup>36</sup> have a primary role of response to heavy structure collapse. The newly formed International Medical-Surgical Response Teams (IMSuRT),<sup>37</sup> under the auspices of the National Disaster Medical System (NDMS),<sup>38</sup> are designed to provide field surgical capabilities in both domestic and international disaster responses. Disaster Medical Assistance Teams (DMAT)<sup>39</sup> function similarly under NDMS, establishing and operating field hospitals at domestic disaster sites. Both FEMA and NDMS are now within the Department of Homeland Security,<sup>39</sup> with responsibility for mitigation of both natural and man-made disasters. Surgeons wishing to become involved in emergency response teams will find NDMS to be a major resource to facilitate skills acquisition for advanced medical treatment in austere environments.

In addition to the aforementioned, it is essential for all responders to be familiar with the second-strike phenomenon. Terrorists being opportunists, they try to inflict casualties among responders, fostering further disorganization to a timely response to a MCI. Hospitals are prime targets for a secondary strike, causing additional casualties, but also crippling the community's response to the casualties created by the primary event. Therefore, it is crucial for any hospital to have alternative plans for forward movement of victims and alternative facilities that can function as an alternative trauma triage and resuscitation area. The sur-

geon's input in planning is indispensable in this arena as he or she knows best the resources that would be essential in creating a secondary location for the provision of care to severely injured patients.

### Health Maintenance for Health Care Providers

Healthcare, prehospital, and rescue workers involved in disaster responses are susceptible to a variety of stress-related psychologic and physical sequelae.<sup>40</sup> A powerful stressor can overwhelm an individual's ability to adjust emotionally. Common signs and symptoms of excessive stress include cognitive, emotional, behavioral, and physical aspects (Table 3). If not addressed appropriately, these may become debilitating and manifest as the symptoms of post-traumatic stress disorder (PTSD).

Critical incident stress management (CISM), of which debriefing is a component, can mitigate the response to these stressors. Critical incident stress debriefing is a peer-driven, trained therapist-guided, structured, group intervention designed to accelerate emotional recovery.<sup>41</sup> Alternative approaches such as psychologic debriefing also exist.<sup>42</sup> With each, the goal is to improve the recovery environment and facilitate adaptation and adjustment to events. Neither psychotherapy nor counseling, debriefing promotes emotional health through oral expression, normalization of reaction, health education, and preparation for possible future reactions. An infrastructure for CISM should be incorporated into trauma centers and regional disaster response plans. However, the CISM process is controversial. Some believe that CISM may, in fact, increase the risk of PTSD. Review of negative studies, however, generally reveals intervention in the wrong population, at the wrong time, or by untrained therapists. Serious CISM mistakes include failure to have an adequate number of trained staff, misunderstanding and mis-

**Table 3** Common Signs and Symptoms of a Stress Reaction

Physical	Cognitive	Emotional	Behavioral
Fatigue	Blaming someone	Anxiety	Change in society
Nausea	Confusion	Guilt	Change in speech patterns
Muscle tremors	Poor attention	Grief	Withdrawal
Twitches	Poor decisions	Denial	Emotional outbursts
Chest pain*	Heightened or lowered alertness	Severe panic (rare)	Suspiciousness
Difficulty breathing*	Poor concentration	Emotional shock	Change in/unusual communications
Elevated blood pressure*	Memory problems	Fear	Loss or increase of appetite
Rapid heart rate*	Hypervigilance	Uncertainty	Alcohol consumption
Thirst	Difficulty identifying familiar objects/people	Loss of emotional control	Inability to rest
Headaches	Increased or decreased awareness	Depression	Antisocial acts
Grinding of teeth	Surroundings	Inappropriate Emotional response	Nonspecific bodily complaints
Weakness	Poor problem solving	Apprehension	Hyperalert to environment
Dizziness*	Poor abstract thinking	Feeling overwhelmed	Startle reflex intensified
Chills	Disturbed thinking	Irritability	Erratic movements
Shock symptoms*	Nightmares	Agitation	Change in sexual Functioning
Fainting*	Intrusive images		

\* Definite indication of the need for immediate medical evaluation.

application of the CISM process, not having a team strategy, attempting to turn CISM into psychotherapy, and breaking confidentiality. Because this is a peer-based approach, surgeons should be familiar with, supportive of, and participate in the formation and operation of CISM teams. Critical incident stress management should be regarded as part of a systematic approach that includes preincident stress education, on-scene support, peer-support programs, and follow-up and referral services.<sup>43</sup>

## CONCLUSIONS

The role of the surgeon in response to MCIs is multi-dimensional in response to threats and injury from natural, unintentional and intentional disasters. The surgeon must take an active role in the pre-event preparation of the community in training, planning, and execution of a response to MCIs. The importance of ICS has been recognized for its efficacy by the JCAHO, making accreditation of hospitals contingent upon their adaptation to HEICS. The surgeon's leadership within hospital organization structure makes a working knowledge of ICS essential.

The surgeon's clinical response to victims suffering injury from WMD will vary by degree of participation. Permeating all events is the leadership role the surgeon must play as an expert in mass casualty management and triage of victims. In response to biological weapons, surgical intensivists (and infectious disease specialists) will be intimately involved because of the number of victims. In response to chemical and radiation events, the clinical skills of surgeons will be challenged with the management of burns, traumatic injury, and physiologic derangements.

With recent events, the role of the surgeon in response to MCI and disaster management has grown without question, as has the importance of the trauma system in the United States. The marriage of the initiatives of Public Health departments and the Department of Homeland Security to the existing trauma system in the management of victims from terrorist acts is a prescription for a successful response to threats of terrorism.

### EAST President 2004

Philip S. Barie, MD, MBA

### Chairman

David L. Ciraulo, DO, MPH

### Committee Members

Susan M. Briggs, MD, MPH

H. Scott Bjerke, MD

Christopher T. Born, MD

Jeannette Capella, MD

Leopoldo Cancio, MD, LTC, MC, US Army

Andrew Dennis, DO

J. Christopher DiGiacomo, MD

Ronald I. Gross, MD

Jeffrey S. Hammond, MD, MPH

John B. Holcomb, MD, COL, MC, US Army

Donald Jenkins, MD

Thomas E. Knuth, MD, MPH, COL, US Army

Peter B. Letarte, MD

Mauricio Lynn, MD

Patricia A. O'Neill, MD

Jeffrey P. Salomone, MD

David V. Shatz, MD

## ACKNOWLEDGMENTS

Eastern Association for the Surgery of Trauma: Disaster and Medical Special Operations Committee (DMSOC) 2004.

## REFERENCES

1. Walker M. A brief history of terrorism. *Europe, Magazine of the European Union*. 2001;410:26–29.
2. *American Heritage® Dictionary of the English Language*, 4th Edition. Boston: Houghton Mifflin, 2000.
3. *Countering The Changing Threat of International Terrorism: Report from the National Commission on Terrorism*. Pursuant to Public Law 277, 105th Congress, 2000. Available from: <http://www.fas.org/irp/threat/commission.html>.
4. Frykberg ER. Medical management of disasters and mass casualties from terrorist bombing: how do we cope? *J Trauma*. 2002;53:201–212.
5. Committee on Trauma, and Committee on Shock, Division of Medical Sciences, National Academy of Sciences, National Research Council. *Accidental Death and Disability: The Neglected Disease in Modern Society*. Washington, D.C.: National Academy of Sciences, National Research Council, 1966; 5th printing by the Commission on Emergency Services. Chicago: American Medical Association, 1970.
6. Jacobs LM, Burns KJ, Gross RI. Terrorism: a public health threat with a trauma system response. *J Trauma*. 2003;55:1014–1021.
7. American College of Surgeons, Committee on Trauma. *Resources for Optimal Care of the Injured Patient: 1999*. Chicago: American College of Surgeons, 1999.
8. Klein JS, Weigelt JA. Disaster management. Lessons learned. Contemporary problems in trauma surgery. *Surg Clin North Am*. 1991;71:257–266.
9. Frykberg ER, Tepas JJ, Alexander RH. The 1983 Beirut airport terrorist bombing: injury patterns and implications for disaster management. *Am Surg*. 1989;54:134–141.
10. Frykberg ER, Tepas JJ. Terrorist bombings: lessons learned from Belfast to Beirut. *Ann Surg*. 1989;208:569–576.
11. Briggs SM, Brinsfield KH, eds. *Advanced Disaster Medical Response Manual for Providers*, 1st Edition. Harvard Medical International Trauma & Disaster Institute. Boston: University Press, 2003.
12. Waeckerle JF. Disaster planning and response. *N Engl J Med*. 1991; 324:815–821.
13. The San Mateo County Health Services Agency, Emergency Medical Services. *The Hospital Emergency Incident Command System (HEICS)*, 3rd Edition. San Mateo, CA, 1998.
14. Eachempati SR, Flomenbaum N, Barie PS. Biological warfare: current concerns for the healthcare provider. *J Trauma*. 2002; 52:179–186.
15. Horn JK. Bacterial agents used for bioterrorism. *Surg Infect*. 2003; 4:281–287.
16. English JF, Cundiff MY, Malone JD, et al. APIC Bioterrorism Task Force and CDC Hospital Infections Program Bioterrorism Work Group. *Bioterrorism Readiness Plan: A Template for Healthcare Facilities*. Available from: <http://www.cdc.gov/ncidod/hip/Bio/13apr99APIC-CDCBioterrorism.PDF>.

17. U. S. Centers for Disease Control and Prevention. Recognition of illness associated with the intentional release of a biologic agent. *MMWR*. 2001;50:893–897.
18. Emergency Preparedness & Response. Department of Health and Human Services, Centers for Disease Control and Prevention. Available at: <http://www.bt.cdc.gov>. Accessed May 3, 2006.
19. Dennis DT, Inglesby TV, Henderson DA, et al. Consensus statement: tularemia as a biological weapon. Medical and public health management. *JAMA*. 2001;285:2763–2773.
20. Inglesby TV, Dennis DT, Henderson DA, et al. Plague as a biological weapon. Medical and public health management. *JAMA*. 2000;283:2281–2290.
21. Smallpox. Emergency Preparedness & Response. CDC. Available at: <http://www.bt.cdc.gov/agent/smallpox/index.asp>. Accessed May 3, 2006.
22. Bioterrorism Agents/Diseases. CDC. Available at: <http://www.bt.cdc.gov/agent/agentlist-category.asp>. Accessed May 3, 2006.
23. Okumura T, et al. The Tokyo subway sarin attack: disaster management, Part 2: hospital response. *Acad Emerg Med*. 1998; 5:618–624.
24. Cable News Network. *Russia Names Moscow Siege Gas*. Accessed: October 30, 2003. Available from: <http://www.cnn.com/2002/WORLD/europe/10/30/moscow.gas/index.html>.
25. Cable News Network. *Chechen Gunmen Seize Moscow Theatre*. CNN. Accessed: October 24, 2002. Available from: <http://www.cnn.com/2002/WORLD/europe/10/23/russia.siege/index.html>.
26. Cable News Network. *Moscow Hostage Horror; Gas Attack*. 2002. Available from: <http://www.cnn.com/SPECIALS/2002/moscow.standoff/>.
27. Lorin HG, Kulling PE. The Bhopal tragedy-what has Swedish disaster medicine planning learned from it? *J Emerg Med*. 1986; 4:311–316.
28. Burkle FM, Orebaugh S, Barendse BR. Emergency medicine in the Persian Gulf war-part 1: preparations for triage and combat casualty care. *Ann Emerg Med*. 1994;23:742–747.
29. de Boer J, Dubouloz M, eds. *Handbook of Disaster Medicine: Emergency Medicine in Mass Casualty Situations*. International Society of Disaster Medicine, 1st Edition. Utrecht, The Netherlands: VSP Intl Science and Van der Wees Uitgeverij, 2000.
30. Briggs BM, Brinsfield KH, eds. *Advanced Disaster Medical Response Manual for Providers*, Chapter 12, 1st Edition. Harvard Medical International Trauma & Disaster Institute. Boston: University Press, 2003.
31. Pollack CV. Radiation emergency. In: Kravis TC, Carmen GW, Jacobs LM, eds. *Emergency Medicine: A Comprehensive Review*, 3rd Edition. NY: Raven Press, 1993.
32. Mettler FA, Voelz GL. Major radiation exposure: what to expect and how to respond. *N Eng J Med*. 2002;346:1554–1561.
33. Briggs SM, Brinsfield KH, eds. *Advanced Disaster Medical Response; Manual for Providers*, Chapter 13, 1st Edition. Harvard Medical International Trauma & Disaster Institute. Boston: University Press, 2003.
34. Briggs SM, Brinsfield KH, eds. *Advanced Disaster Medical Response; Manual for Providers*, Chapter 17, 1st Edition. Harvard Medical International Trauma & Disaster Institute. Boston: University Press, 2003.
35. Briggs SM, Brinsfield KH, eds. *Advanced Disaster Medical Response Manual for Providers*, Chapter 14, 1st Edition. Harvard Medical International Trauma & Disaster Institute. Boston: University Press, 2003.
36. Urban Search and Rescue (US & R). FEMA. Available at: <http://www.fema.gov/emergency/usr/index.shtm>. Accessed May 3, 2006.
37. Federal Register, Volume 67, Number 231, December 2, 2002, p. 71568–71570.
38. National Disaster Medical System. US Department of Homeland Security. Available at: <http://www.oep-ndms.dhhs.gov/>. Accessed May 3, 2006.
39. Disaster Medical Assistance Team. US Department of Homeland Security. Available at: <http://www.oep-ndms.dhhs.gov/dmat.html>. Accessed May 3, 2006.
40. Hammond J, Brooks J. The World Trade Center: Helping the helpers; the role of critical incident stress management. *Crit Care*. 2001;5:315–317.
41. Mitchell JT. When disaster strikes: the critical incident stress debriefing process. *J Emerg Med Serv*. 1983;8:36–39.
42. Dyregrov A. Caring for helpers in disaster situations: psychological debriefing. *Disaster Management*. 1989;2:25–30.
43. Mitchell JT, Everly G Jr. The scientific evidence for critical incident stress management. *J Emerg Med Serv*. 1997;22:86–92.