

US Trauma Center Preparation for a Terrorist Attack in the Community

Donald D. Trunkey¹

Abstract

Background: Since the 2001 terrorist attacks on the United States, federal and state funding, primarily from the National Bioterrorism Hospital Preparedness Program, has resulted in a surge of hospital activity to prepare for future natural or human-caused catastrophes. Trauma centers were integrally involved in the response to the 2001 attacks as first receivers of patients, communication hubs, and as convergence sites for families, the worried well, volunteers, and donors. After the Madrid train station terrorist attack, Congress identified the need to study trauma center preparedness as an essential part of the nation's emergency management system.

Methods: The NHTC received a one-year grant funded by the Centers for Disease Control and Prevention (CDC/NCIPC) to survey the capability and capacity of trauma centers to respond successfully to mass casualty incidents, particularly those brought about by acts of terrorism. This report summarizes responses to a US CDC/NCIPC-funded survey, R 49 CE000792-01, sent to all designated or verified Level I and II trauma centers in the US, to which 33% or 175 trauma centers replied.

Results: The results are categorized by preparedness scoring, vulnerability, threats, and funding. Planning communication, surge capacity, diversion, sustainability, special populations, and finance represent additional categories examined in the survey.

Conclusions: Trauma centers are a major resource in disaster management. One-hundred and seventy-five centers candidly reported their resources and vulnerabilities. This inventory should be expanded to all trauma centers and recommendations for change as discussed.

Key Words

Trauma center · National Bioterrorism Hospital Preparedness Program · Terrorism · Mass casualty incidents · Survey · Preparedness

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Introduction

Evidence exists that blast-type explosive attacks are the most common terrorist threat worldwide, “with over 500 terrorist bombings between 2001 and 2003, resulting in 4,600 deaths” [1]. With this in mind, Congress directed this first attempt to inventory regional (Level I or II) trauma centers' preparedness for terrorist attacks in the community. In a recent publication, Ciraulo and coauthors note, “Although firearms remain popular, explosives are the most economical and readily available terrorist weapons, causing high numbers of casualties at a lower cost than any other weapons system” [2]. Worldwide, explosive attacks have caused the majority of deaths, casualties and property damage, but they are only one of fifteen National Planning Scenarios, and are 13th on the list of possibilities introduced by the Department of Homeland Security [3].

Although blast-type attacks, including those involving hazardous or radioactive materials, are the primary focus of this inventory and summary report, hospitals and trauma centers are commonly first receivers of patients resulting from all disasters because of the phenomenon of self-directed patient delivery [4]. Trauma centers have historically functioned as critical medical resources and communication hubs for both natural and human-caused catastrophes of mass scale. Injured patients in these centers are rapidly triaged, assessed, and treated within organizational structures and processes tested and refined since the 1993 and 2001 World Trade Center terrorist attacks, the bombing of the Oklahoma City Murrah Building, and natural disasters of all types nationwide, the most recent being Hurricane Katrina [3].

¹Oregon Health and Science University, Portland, OR 97239, USA.

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Trauma centers have also been borderless resources for aiding or receiving transfers and evacuees from other healthcare facilities that are overwhelmed or rendered inoperable during natural disasters. After Hurricane Katrina flooded New Orleans in 2005, many medical facilities outside the city, and Tulane University Hospital and Clinic locally, received large numbers of patients evacuating from the city hospitals and the Superdome arena. Of the out-of-state facilities responding, at least five were Level I trauma centers: Tennessee's Vanderbilt and Erlanger Medical Centers and Texas' Ben Taub, Hermann and Parkland Medical Centers. This aid was elicited through contacts within the hospital and trauma care community, resulting in mobilization of out-of-state community resources. Without these networks, many evacuees would have not gotten proper care, and more deaths or avoidable complications may have occurred.

A variety of threats based on geography, weather patterns, natural and manmade structures that are possible sites for terrorist targets have the potential for incidents of mass scale for which trauma centers need to be prepared. Examples of at-risk sites include landmarks or icons, transportation hubs, dams, stadiums or convention centers, governmental structures, military installations, munitions storage facilities, and nuclear plants, among others [1, 3]. Many of these sites could produce a mass casualty incident that may contaminate patients, inadvertently making portions of the trauma center inoperable [3]. OSHA has determined that such first receivers should have Class B equipment as a minimum for patients with unknown exposures. Therefore, the admitting trauma center must promptly identify, segregate, and treat these types of patients. The capacity for a trauma center to decontaminate large numbers of patients, bystanders, and caregivers may need to be considerable based on their regional vulnerabilities. Just as important is a trauma center's ability to lock down its facility to reduce the potential for inadvertent contamination or intentional terrorist attack as a secondary target. The application of this model to trauma centers and systems uses public funds wisely. Trauma centers maintain a constant state of readiness, are staffed for all types of injuries, and have broad communications with regional hospitals, air medical resources (including military) and emergency medical services. These preparedness components include emergency management planning, communications, resources plus surge capacity and decontamination, vulnerability and threat response, and clinical resources encompassing sustainability to recovery [3].

The NFTC received a one-year grant funded by the Centers for Disease Control and Prevention (CDC/NCIPC) to survey the capability and capacity of trauma centers to respond successfully to mass casualty incidents, particularly those brought about by acts of terrorism.

The basic components of the model for "all-hazards preparedness" were used in this study to develop the inventory tool sent to 531 Level I and II trauma centers and to organize a validation visit tool, best preparedness practice selection process, and summary reports. These categories were expanded in keeping with the national trend to promote the expansion of bioterrorism preparedness planning towards all-hazards preparedness. This approach offers the best use of scarce resources and fully integrates trauma centers into emergency preparedness processes in their regions and states.

This project addresses the CDC/NCIPC "Healthy People 2010" focus area(s) of injury and violence prevention and occurred in two phases. In phase I, the NFTC developed and conducted a survey of all known Level I and II trauma centers as verified by the American College of Surgeons' Committee on Trauma (ACS COT) or designated by state or local authorities. The objective was to identify the degree to which they meet key characteristics of a well-prepared trauma center in the event of a blast-type terror attack, including one with the potential for biological, chemical, nuclear agents and other hazards. In phase II, trauma centers that scored high in the survey responses volunteered to undergo a validation visit or conference call from an expert in both trauma and emergency preparedness, provide requested and other appropriate documents, and participate in a summary review of their preparation for a blast-type terror attack or other hazards of mass scale as defined in the grant.

Methodology

The self-reporting aspect of this study, and its two-stage approach, created a need for the design of multiple tools for the paper survey, the site visits, and the phone interviews. The study also required the development of a scoring system and selection processes for the five most highly prepared trauma centers and five trauma centers with notable practices in key preparedness areas.

Data Security

The CDC/NCIPC and the National Institutes of Health (NIH) approved the study. Both agencies agreed that

due to the potentially sensitive nature of the data collected (i.e., terrorism preparedness planning), all NFTC employees, advisory and research partners and contractors should sign an NFTC-approved confidentiality agreement. NFTC offices were secured by a monitored system with confidential data kept on an encrypted, removable hard drive that was secured each night. A unique, numeric identifier was used for each de-identified trauma center data record. No trauma center or regional information was or will be disclosed in any public manner that would create a security issue.

Preparedness Survey Tool and Data

In the first phase of this study, a group of trauma care experts developed a list of key characteristics of a well-prepared trauma center that can act as a first receiver and communication hub in their community in the event of a blast-type terror attack or other mass casualty type incident. These investigators have strong experience in disaster planning; indeed, the trauma center of one served as the primary first receiver of patients from the World Trade Center attacks in 1993 and 2001. Thereafter, the NFTC convened a diverse group of advisors with experience in trauma, emergency systems, and research.

Design

Seven preparedness components were identified by the PIs and advisors as crucial to the successful handling of any type of mass casualty incident. Questions were developed in the areas of vulnerability, planning, communication, resources, security, clinical resources, and sustainability. The questions were then subjected to a modified Delphi process in which the merits of any particular question were presented to the group and discussed. The survey tool was restricted to a maximum of four pages containing 154 “yes/no,” numeric or text responses in total. The “yes/no” questions did not allow a response of “do not know” or “not available.” Numeric responses were open-ended with no suggested ranges of response values.

Response Rate

The NFTC mailed surveys with cover letters in January of 2006 to the Trauma Medical Directors of 531 US Level I and II trauma centers, either verified by the American College of Surgeons’ Committee on Trauma (ACS COT) or designated by a state/local governmental agency. Trauma medical directors were selected based on their previous involvement in the Trauma Information Exchange Program (TIEP) funded by the CDC/NCIPC. Early response rates were

improved when Trauma program managers became involved. By the cutoff date in May, the final response rate was 33%, with 175 useable trauma center surveys.

Survey Data

As surveys were received from the trauma centers, they were first checked for data completeness, illegible faxed data, missing pages, etc. When incomplete surveys were identified, the trauma center was asked to clarify answers or resubmit. Each survey’s data was dually entered, cross-checked, and reconciled to a single record. The electronic data entry tool and analysis program incorporated valid value checks and response consistency checks. Where trauma centers were unable to provide corrected information, the response was changed to, or left as, “missing.” Surveys lacking a majority of answers were not included in study results.

Characteristics of Responders Versus Nonresponders

With the response rate for the survey being 33%, NFTC explored differences in trauma centers that responded to the survey and those that did not. Three publicly available characteristics were compared: region of the country where the facility is located, trauma designation level, and membership in an organized state trauma system as defined by West et al. [5, 6]. No significant response difference existed among trauma center members in an organized trauma system.

Responders

For the responding group, more trauma centers (49%) were Level I trauma centers compared to nonresponders (40%). Regional differences in numbers of surveys returned from the responder versus nonresponder groups, respectively, is as follows: South (11 vs. 16%) and West (22 vs. 17%). The other regions did not differ in response by level in either the East (both § 36%) or Midwest (both § 31%). These trends, while statistically significant, are from a small sample.

Scoring and Analysis

The scoring system used to rank trauma center preparedness was based on the survey questions, favoring rankable scoring methods that were straightforward and simple. Different options for how a missing value should be scored were explored, including the issue of whether not knowing an answer should be penalized (i.e., a missing value should be assigned -0.5 points), or whether it would count as “no.” Four different scoring

methods were developed by applying the options to combinations of “yes/no” and numeric responses.

After consideration, the method selected used “yes” responses tallied as “1,” and “no/missing” answers tallied as “0.” Numeric answers were tallied as “1” if greater than zero, then as “0” if zero or if the answer was missing. The resultant summary score is the percentage the trauma center achieved of its potential maximum score. Other areas of interest were compared using averages, medians, and frequencies.

Results

Preparedness Scoring

NFTC’s scoring system – based on yes, no, or numeric answers to the survey questions – allowed the trauma centers to be ranked according to their level of preparedness. The average preparedness score of the 175 reporting trauma centers was 73.7%, with a low score of 31% and a high of 96.5%. For all trauma centers combined, averages varied little across region or level. However, when preparedness scores were averaged by designation level for those scoring above and below 73.7% and then compared, differences in scores appeared. Level I centers (68%) were more likely to have a preparedness score above the average; Level II centers (56%) were more likely to score below. When the top and bottom 20th percentiles were compared, the Level II centers (67%) were more likely to be in the lowest 20th percentile. The distribution of Level I centers across the lowest and highest 20th percentiles remained the same for above and below average.

Another variation in findings is the trauma centers’ perception of their own preparedness from a single self-assessment question in the survey, as compared to the level of preparedness determined from the overall scores. When asked how well their trauma center

performed in a drill, tabletop, or real event using five categories ranging from poorly to well prepared, 41% of the responders rated themselves between “poor” and “moderate.” However, 60% of hospitals scored “poor” to “moderate” when the range of scores was divided into five comparable categories, with poor being 0–54%, fair 55–65%, moderate 66–77%, significant 78–90, and well >90%. While 20% rated their own performance as “well prepared,” 3% scored in the equivalent “well prepared” category (i.e., score above 90%) overall (Figure 1).

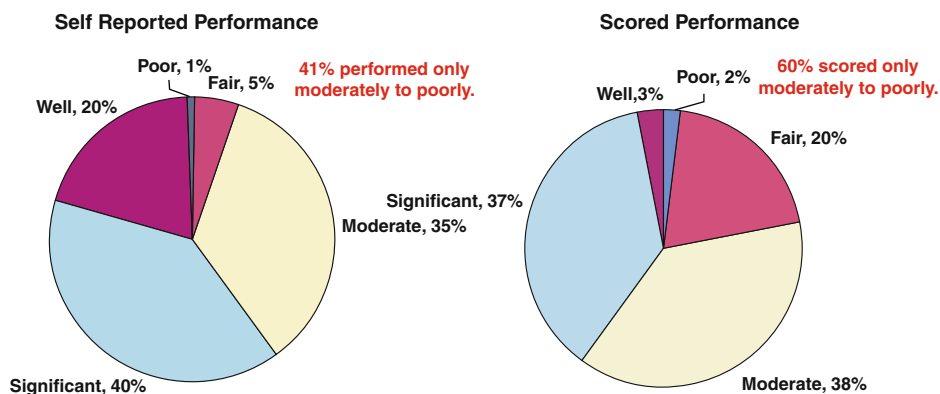
Vulnerability, Threats and Funding

The strongest correlation to preparedness funding was in trauma centers that reported proximity to a large number of hazardous sites, particularly those which, if impacted by a terrorist attack or other event, could require mass decontamination of victims. The average capacity for decontamination is 54 patients per hour, with a wide variation of capacity reported. Decontamination areas within the hospitals are commonly (85%) configured to separate patients by gender.

Planning

The emergency planning components where nearly all trauma centers report high levels of preparedness are those which have been a focus of and funded by HRSA’s National Bioterrorism Hospital Preparedness Program, communications and preparation for hazardous material contamination [3]. Virtually all (99%) are able to coordinate operations with their City/County Emergency Management. There are high levels of communications interoperability (92%), intra-hospital communication (94%), communications with local and state public health (99%), and nongovernmental organizations (NGO), such as the American Red Cross (95%). Planning for a variety of hazards has been conducted in 97% of reporting

Figure 1. Percent of hospitals in preparedness performance categories from self-reported rating and survey scoring.



trauma centers, with the focus mostly on chemical, biological, and radiological events (98%). Guidelines for nuclear (dirty bomb) and explosive devices are in place in 90% of trauma centers.

Communication, Surge Capacity and Diversion

In their Emergency Management Plan (EMP), 94% of trauma centers reported their surge capacity, with an average capacity of 59 patients within one hour. Virtually all trauma centers (99%) have either a phone tree, pager, and/or radio system to rapidly notify staff. All trauma centers have an Emergency Operations Center (EOC) and 91% have an alternate site identified or planned should their initial EOC become inoperable or inaccessible.

These capabilities are important in that mass casualty situations could overwhelm regional resources rapidly, requiring state or even multistate resources to be mobilized. In that event, the trauma centers' communication systems are nearly all capable of notifying EMS that they are on diversion or bypass status (97%). To facilitate patient destination, 87% of trauma centers have regional real-time monitoring systems to assess capacities of ED, overall bed, ICU or OR resources, and 13% report having a statewide system that accomplishes the same level of resource monitoring. When both regional and state systems are combined, about 94% of centers have real-time capacity monitoring systems for ED, overall beds, and ICU, and 81% of trauma centers can assess OR resources. To our knowledge, no one has a multistate system at this time, which is problematic given the borderless nature of mass-scale events.

Sustainability

Sustainability was assessed by asking if the trauma center's EMP provides for operating more than 72 h under emergency conditions. Although 82% said that their EMP includes this provision, only about half (42%) of the centers reported an actual ability to operate at peak capacity for more than three days. Additionally, 64% reported exclusive arrangements for acquiring or maintaining stockpiles of pharmaceuticals and supplies. Overall, the trauma centers reported an average of 53 ventilators on site and the ability to obtain an additional 35 devices within 2 h. They reported a lower rate of contract exclusivity for ventilator replenishment (39%), which would be needed in an epidemic such as avian influenza or an attack from biohazardous materials or gases.

Most (94%) trauma centers are able to provide both patients and staff with adequate food and water to

sustain operations for 3–4 days. Less often could they provide nutritional care to volunteers (83%) or patients' families (68%), and about half (51%) would extend nutrition to the media. With this in mind, education about emergency food supplies would be helpful for patients' families and noninjured persons, including staff, for a catastrophe that may last longer than several days.

Sustainability and Caregivers

Family care issues are an important part of emergency staffing plans. A means to assure continued availability of caregivers is to relieve their concerns for family members or dependents. In this, trauma centers were less prepared, with 62% having a defined family care plan for children of injured patients or essential staff. The plans often did not include assisting staff to locate family members (36%) or giving authority to others to pick up children (25%). Family communication plans are present (43%), but only 23% had plans that give medical authority to care for dependents or minor children of essential staff. Slightly less than one-third report a written plan for the staff's own family reunification. This lack of detailed planning, coupled with an average ability to cross-credential staff from other facilities of 65%, could impede the trauma center's ability to respond with adequate staff in a regional event of mass scale.

Special Populations

Plans to care for special populations were studied as well. Of the responders, 69% had plans for children, 57% address needs of pregnant women, and about 53% plan for elder care and immunocompromised patients. While 66% of trauma center plans address the special needs of psychiatric patients, fewer (58%) are prepared for the needs of the disabled, and 47% address the needs of obese patients. Nearly all (93%) reporting trauma centers plan for the mental health needs of patients, staff and volunteers, and 89% plan for mental health issues of visitors.

Finance

The public commonly responds to disasters of mass scale by offering donations for the affected [7]. The study results are that trauma centers were mostly unprepared for these gifts, with 27% having an established mechanism for accepting donations. Most trauma centers (89%) are capable of tracking disaster expenditures, but experience from actual events described in the body of this report show that collecting on these expenses is problematic.

Discussion

Vulnerability and Hazards

The trauma centers were asked about the number of threats, hazards and vulnerabilities within their catchment area. The catchment area was defined as the geographic region served by the hospital, even though other trauma centers and general hospitals may also be located within the region. Ninety-seven percent have performed a Hazard and Vulnerability Analysis (HVA) in the last twelve months. The most common hazard sites (i.e., those noted by more than 70% of responders) were public arenas, land transportation infrastructures, large universities, chemical factories, federal buildings or state capitals, and prisons (Table 1). However, many of the less common sites pose a risk of producing mass casualties that is just as great. Nuclear power plants, dams, airports and mass-transit facilities all potentially threaten large segments of the resident community if successfully attacked by terrorists. Incendiary tragedies could arise from either man-made or natural disasters at oil or natural gas refineries, at munitions plants or storage facilities, and even in certain port areas [8].

A trauma center’s capacity to decontaminate patients becomes especially important in communities close to chemical factories, hazardous waste dumps or storage facilities, munitions plants or storage facilities, nuclear power plants, and oil or natural gas refineries. The study found that a greater number of toxic hazard

Table 1. Percent of trauma centers reporting a hazard in catchment area.

Hazard type	Reporting (%)
Major interstate freeway, bridges, tunnels, etc.	94
Public arena, stadium, convention center, coliseum	94
Large university	84
Chemical factory	72
Prison	72
Federal building or state capital	72
Railroad hub	71
Dam or water-based hazard	65
International airport	65
Mass-transit facility	64
Military base	57
Hazardous waste dump or storage facility	56
Monument, landmark	54
Oil or natural gas refinery	40
Other	39
Port	36
Nuclear power plant	34
Munitions plant or storage facility	34

Table 2. Average decontamination capacity per hour by region.

East	Midwest	South	West	All
67	47	38	53	54

sites in the community of a hospital is correlated to an increased preparedness score. By region of the country, decontamination capacities of trauma centers ranged from 67 patients per hour in the East to 38 in the South (Table 2).

However, no correlation was detectable between a trauma center’s decontamination capacity and the number of toxic hazard sites. Across regions, decontamination capacity by number of toxic hazards reported in a trauma center’s catchment area climbs steadily up to three hazard sites, but then subsequently falls (Figure 2). Seventy-nine (45%) of the responding trauma centers are at risk from three or more toxic hazard sites in their regions. These centers have hazardous materials personal protective equipment (OSHA) for the following number of personnel on average: Level A TECP suits for two people; Level B positive pressure respirators and chemical-resistant garments for 11 people; Level C APRs and chemical-resistant garments for 50 people. OSHA has identified “B” equipment as the minimum recommended for unknown exposures [9]. Given the propensity for patients to self-deliver to the nearest hospital, making appropriate protective equipment available and conducting regular training in its use are increasingly important.

Differences in preparedness funding were examined by region as well. Figure 3 superimposes this funding on the average number of hazard risk sites for each region. Trauma centers in the East and West of the US report greater funding for bioterrorism preparedness from all sources, though the South reports more risks and hazards.

Planning

The trauma centers were asked specifically about their EMP, their integration into the city/county EOC, the status and redundancy of their Hospital Emergency Incident Command Center, and their post mass casualty incident recovery plans. Nearly all (>97%) were found to have either conducted tabletop drills or actual simulated drills, and 81% had applied their preparedness plan in a real event. These latter hospitals had higher scores (74.7%) for preparedness than hospitals who had never applied their EMP (69.9%) in a real situation. This trend was verified by the highly pre-

Figure 2. Trauma center decontamination capacity (average patients per hour by number of toxic hazards).

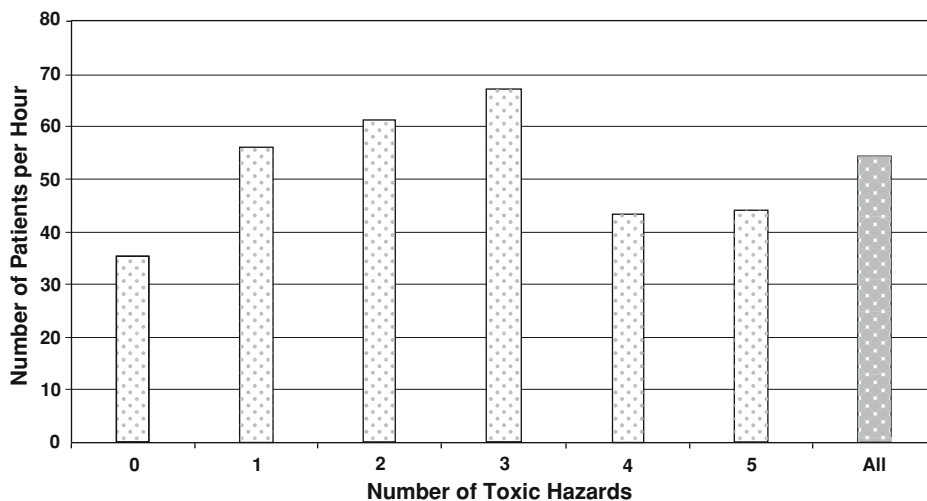
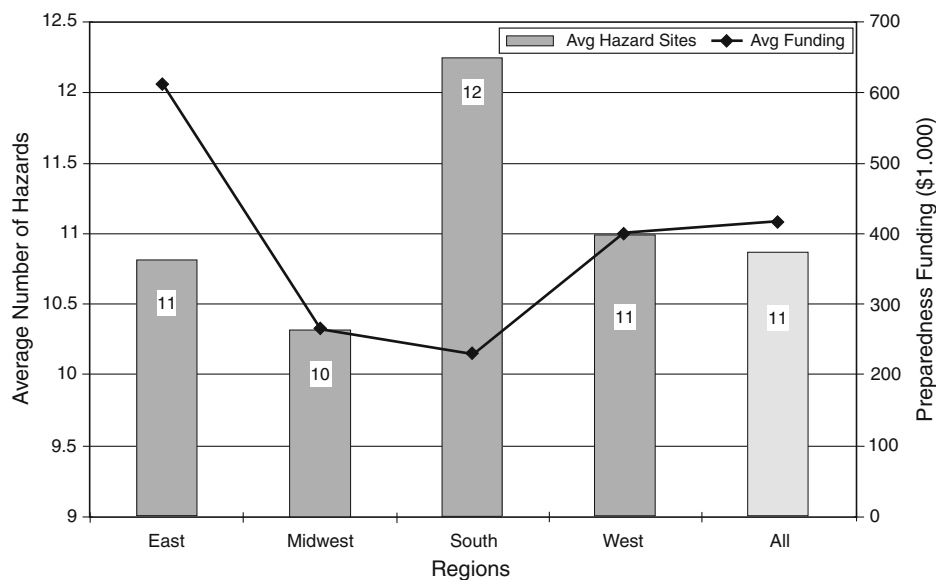


Figure 3. Trauma center communities with hazard risk sites and preparedness funding by region.



pared trauma centers, which have all activated their EMP in a real event.

Most trauma centers (>96%) have plans for patients injured in unconventional weapons attacks, i.e., illness due to chemical or radiological exposure, or caused by biological infectious materials (Figure 4). In keeping with strong indications that terrorists have access to low-grade nuclear materials (i.e., dirty bombs), most trauma centers (90%) also have plans for radioactive exposure [10, 11]. The same percentage (90%) of centers indicate preparedness for the simple incendiary and explosive devices that cost little, are in great supply to terrorists, and comprise the most

common terrorist acts [12]. Similar injuries also result from refinery fires, gas line explosions, rail car derailments and the like. All trauma centers EMPs allow for activation of the hospital's Incident Command Center, 94% plan for medical surge, and 82% have an EMP that provides for operating longer than 72 h (Figure 5). All trauma centers report a specific location for their Incident Command Center, and 91% identify an alternate location should the initial site become inoperative. Most centers (94%) have a Hospital Liaison Officer (Communication Coordinator) assigned to the city/county EOC. Some trauma centers note that the alternate Incident Command Center site is not desig-

Figure 4. Percent of hospitals with guidelines of care for different hazards.

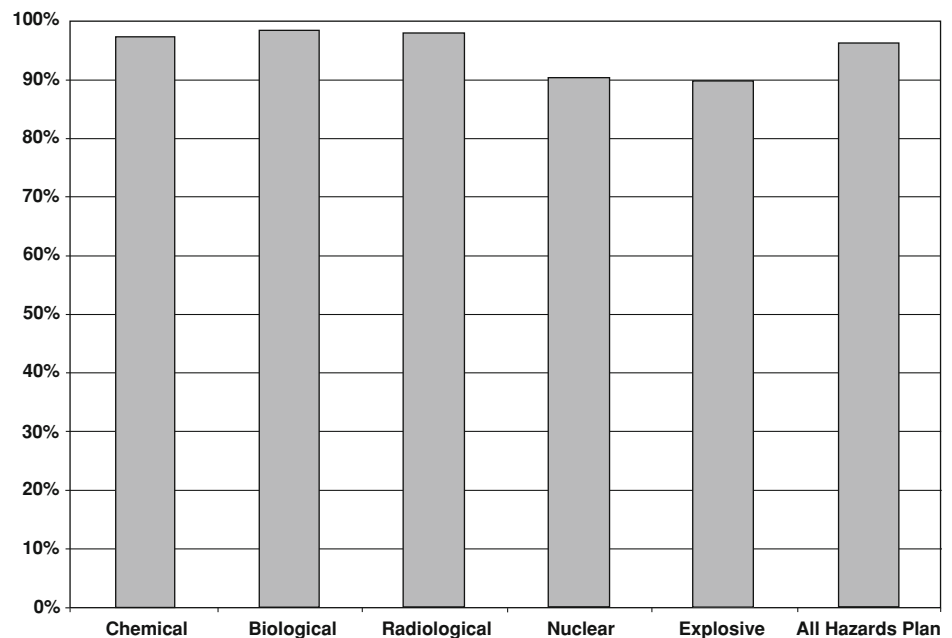
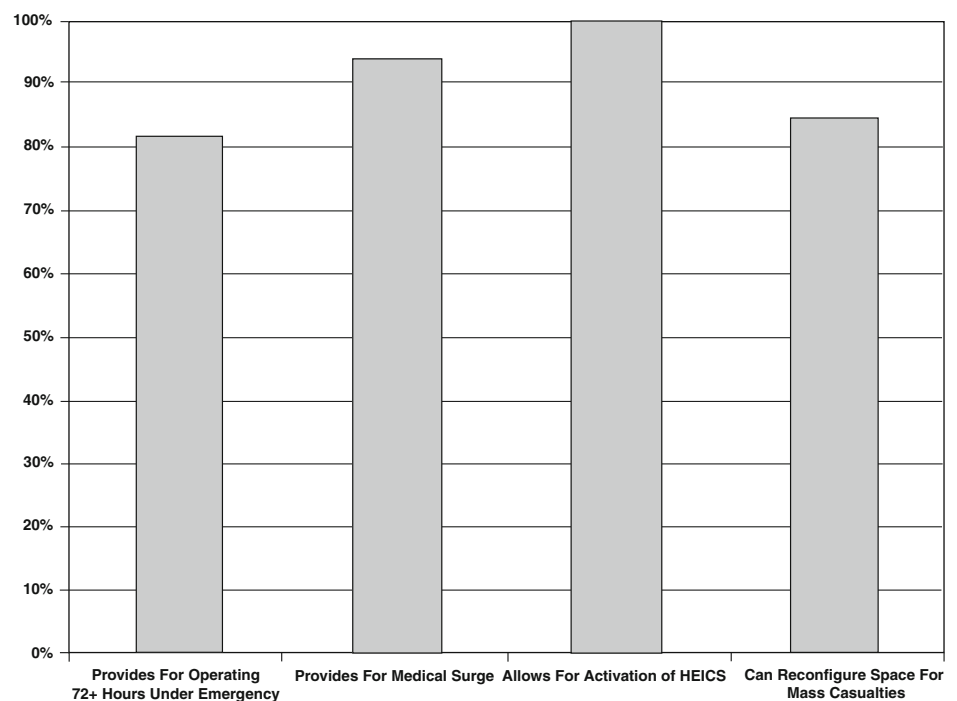


Figure 5. Percent of hospitals with emergency management plan for operations.



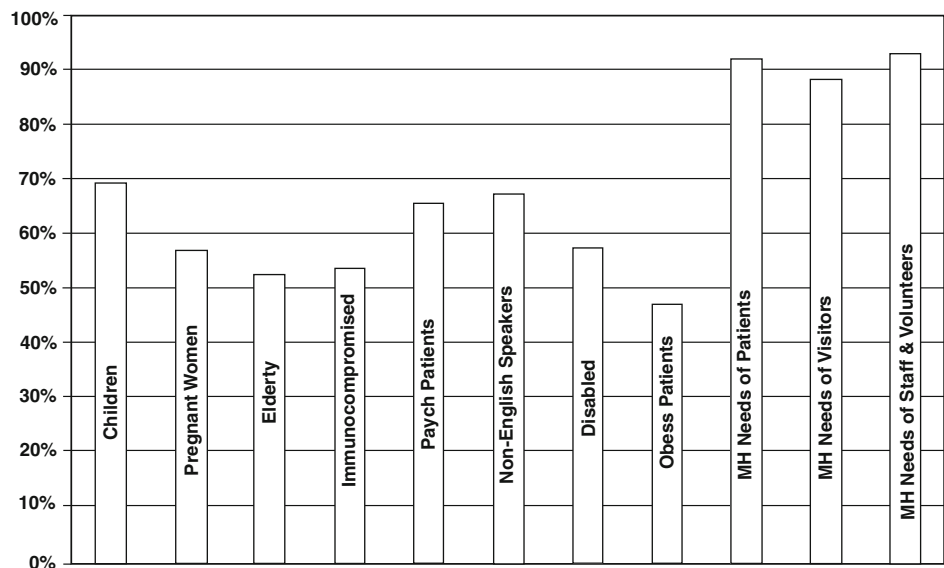
nated but will be relocated based on the hospital’s circumstances, including to a possible off-site location.

The plans of most trauma centers (89–93%) for special needs encompass the immediate psychosocial needs of inpatients, staff, and visitors. Special needs of children (69%), psychiatric patients (66%), and pregnant women (57%) are not as commonly addressed

(Figure 6). Of other special needs patients, plans to care for immunocompromised, elderly, and obese patients are present about half of the time (54, 53 and 48%, respectively).

Financial planning as part of the EMP activation is in place in most trauma centers (89%), but as noted previously, only 27% have plans to accept donations of

Figure 6. Percent of hospitals with mass-casualty incident plans for special and mental health needs.



money, goods, or blood. In several previous events, blood donors and other “convergers” caused congestion problems at hospitals and blood banks [7]. For example, after the World Trade Center attack, donors, volunteers, and individuals searching for family members overwhelmed St. Vincent Hospital in Manhattan until they were redirected by city buses to other locations while staff were preparing for mass casualties [13].

Communications

Internal and external communications have proven to be vital, but are often the greatest barriers to successful operations of trauma centers in disasters of mass scale of all hazards [14]. Key to successful communications is the ability to link disparate radio frequencies, satellite communications and landlines. Communications interoperability has plagued disaster response efforts in virtually every major event [3]. For example, problems with interoperability increased the loss of lives at the World Trade Center when it became known that the buildings would inevitably collapse [15]. Interoperability problems also left the Gulf area incommunicado, with only a few cell phones and Blackberry’s™ providing the means to call for outside aid during Hurricane Katrina [16]. With this primary aspect of preparedness in mind, trauma centers were asked whether they could communicate outside the hospital using interoperable technology with EMS, fire, police, and other hospitals and trauma centers (Figure 7).

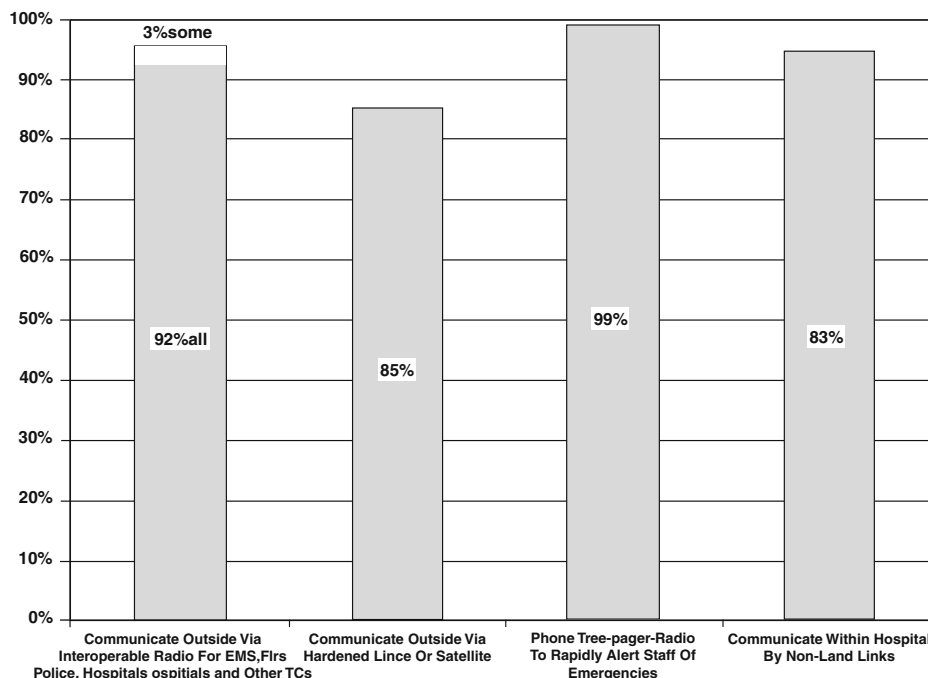
Ninety-two percent (92%) said they had fully interoperable communications capability, two-way radio or satellite phones, with all other providers and

services, while 3% said they could communicate with some. Slightly fewer (85%) reported that their external communications could be connected through hardened (able to withstand nuclear or attacks by being placed deeply underground or shielded by copper and concrete) telecommunication lines, or satellite. Virtually all (99% of) reporting trauma centers have a telephone tree, pager, radio or other system to directly and rapidly alert key staff and others of an impending emergency. At least one highly prepared trauma center does not use phone trees because of their lack of reliability.

Ninety-four percent (94%) of trauma centers report communications capabilities within their own facility that do not depend on land lines. These devices consist of “walkie-talkies” and other non-telephone means to communicate. Not asked was whether the trauma centers had a backup paper method for ordering, communicating, and supporting operations during a true power blackout using runners or other communication chains. This aspect of intra-hospital communications was observed during the onsite validation visits to the five highly prepared trauma centers, and those findings are detailed in their reports.

Table 3 shows the percentage of trauma centers able to communicate with a local military base, intelligence agencies including Homeland Security, local and state public health, Red Cross or other family reunification agency, and all prehospital services including commercial air medical and Military Assistance to Safety and Traffic (MAST) transport. While nearly all can communicate directly with local agencies and aid organizations, 81% can communicate with intelligence agencies and 65% with the military base

Figure 7. Percent of hospitals with external and internal communication systems.



present in the community. However, their dependence on functioning electrical power and telephone circuitry is not known.

Approximately 94% of Level I and II reporting trauma centers are able to monitor resource availability, including staff for ED capacity, overall bed capacity, and ICU beds, and 81% can monitor OR suites. This capacity to monitor hospital resources mainly occurred at the regional level (87%). Statewide monitoring systems are present less often (13%). New Mexico, North Carolina and Maryland use a proprietary system configured to track both prehospital and hospital resources and capacity. The New Mexico system can also track the availability of air-medical services. These systems are commonly updated each morning, and when connected by pager or Blackberry™, key personnel can be alerted as to the status of current resources within 20–30 min 24/7. These systems have also been developed in Connecticut and the southern portion of New York State encompassing New York City.

Security

The trauma centers were asked if they have established and practiced security plans. Over >97% of trauma centers indicated they had a plan to lock down their facility, had a security system in place, and were able to control access (Figure 8). Fewer (74%) have a written

Table 3. Percent of trauma centers able to communicate with community entities.

%	Community entity
81	Intelligence agencies including Homeland Security
65	Local military base (when present)
90	All prehospital services, air-medical and MAST
95	Family reunification organizations
99	Local and state public health

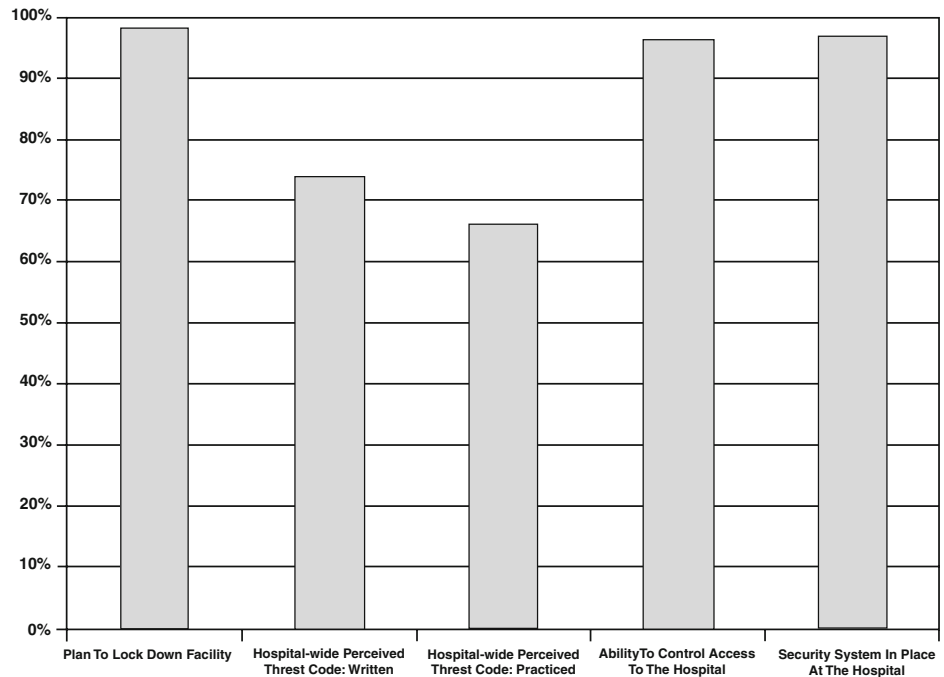
“Perceived Threat” code for use throughout the hospital, and 66% had practiced the plan.

It is recommended that the lockdown plan be practiced, with the results recorded and evaluated to assure effectiveness and, if needed, improved. While nearly all hospitals had lockdown plans and 96% knew how much time it would take to lock down all entrances, 80% were able to, or were aware of the time needed, to lock down individual departments or units. Average lockdown times were 16.3 for hospitals and 15.2 min for individual departments. A few hospitals indicated that local fire marshall’s codes prevented them from locking down individual departments.

Resources and Clinical Resources
Surge Capacity

In a mass-casualty incident, one of the first resources needed is additional staffed bed capacity in all clinical

Figure 8. Percent of hospitals with security plans by type.



areas. Figure 9 shows the average reported extra staffed bed capacities for three of these critical resources. Trauma centers reported that 99 staffed beds could be added on average, constituting a 23% increase over their normal capacity. Their surge capacity within 1 h averaged 59 staffed beds, indicating that the hospitals could be at 60% of their average maximum bed capacity within the first hour of a disaster.

Decontamination capacity averaged 54 patients per hour (Figure 9) with a large capacity for waste water,

but most of the highly prepared trauma centers that were visited stated that wastes would be disposed into the general sewer system or onto the ground in mass-scale decontaminations. The resources needed to work with contaminated patients include different levels of staff protection. Level A protection, the most strict, is a self-contained breathing apparatus and a totally encapsulating chemical-protective (TECP) suit normally available to field (i.e., HazMat) personnel. Level B protection involves the use of a positive-pressure

Figure 9. Average extra capacities of hospitals for emergency conditions.

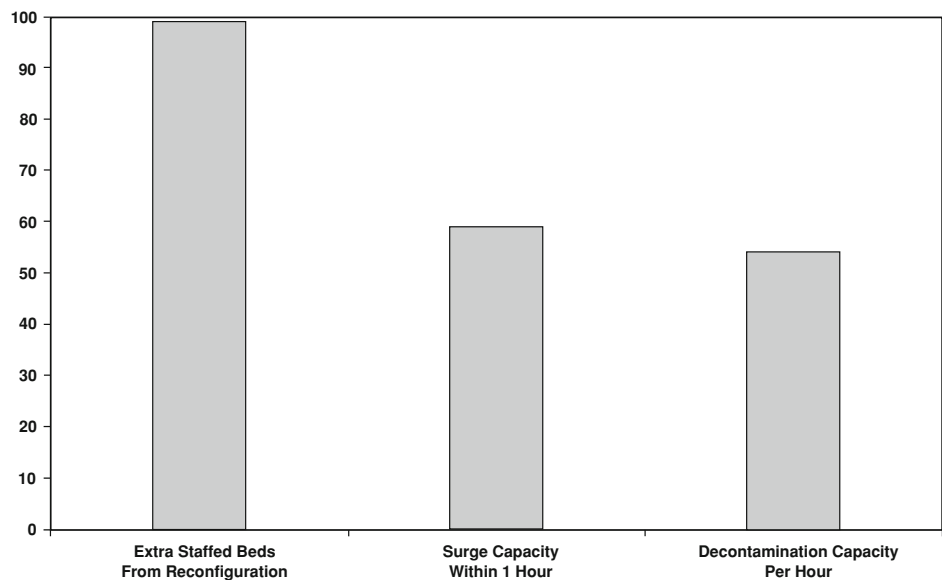


Table 4. Average numbers of personal protective equipment by protection level and region.

	Level A	Level B	Level C
East	2	11	56
	1	6	31
South	5	30	102
West	2	8	36

respirator (self-contained breathing apparatus or supplied air respirator) and nonencapsulated chemical-resistant garments, gloves, and boots. This level of protection is now recommended by OSHA as the minimum standard for unknown exposure. Level C consists of air-purifying respirators and Level B clothing. Level D is the standard universal precautions found in all hospitals. On average across all regions, each trauma center possessed two Level A suits, 11 Level B suits and 50 Level C suits. The median scores for protective equipment were zero (0) A suits, zero (0) B suits, and 30 Level C equipment when data were adjusted by frequency distribution. Equivalent measures for each region are shown in Table 4.

Mutual Aid

Another resource issue that is often overlooked prior to a disaster is cross-credentialing of critical manpower resources [17, 18]. Sixty-five percent (65%) of the trauma centers have memorandums of understanding (MOUs) or other agreements for cross-credentialing staff from other general hospitals. For the critical staff that would be needed from other trauma centers during a mass casualty incident, 55% have established MOUs or agreements. Since injuries from a mass-scale attack would ordinarily overwhelm an area, MAA/MOUs with trauma centers outside of the local area are advised.

Resupply

During a disaster that impacts a wide area, hospitals in the region without exclusive supplier contracts have found that the demand for resources and equipment rapidly exceeds supply. Among respondents in this study, 64% have exclusive contracts for pharmaceutical and medical supplies. Fewer (39%) have exclusive contracts with ventilator vendors. This lack of exclusivity was identified during one of the highly prepared trauma center validation visits, where it was noted that the entire large metropolitan area is served by the same ten durable medical supply vendors. In another visit, the State Trauma System is working on a problem

with overlapping commitment for ventilators for the entire state.

Funding

Preparedness funding is critical to successful hospital and trauma center response to disasters. A total of \$69.9 million (median \$182,500) was granted to trauma centers in 2004 from a variety of governmental funding sources. Although trauma centers that received more of this money had somewhat higher preparedness scores, this trend was from too small of a sample to determine statistical significance. The average scores for hospitals above and below \$182,500 are 76.0 and 72.8, respectively. By far the largest amount of funding provided, \$45.6 million or 65%, was from the Health Resources and Services Administration (HRSA) under the National Bioterrorism Hospital Preparedness Program (NBHPP). The survey results found that as the number of any type of hazard site increased in the hospitals' catchment area, their preparedness funding went up. When funding was regressed on each type of hazard, it was determined that toxic hazards drove this statistically significant correlation.

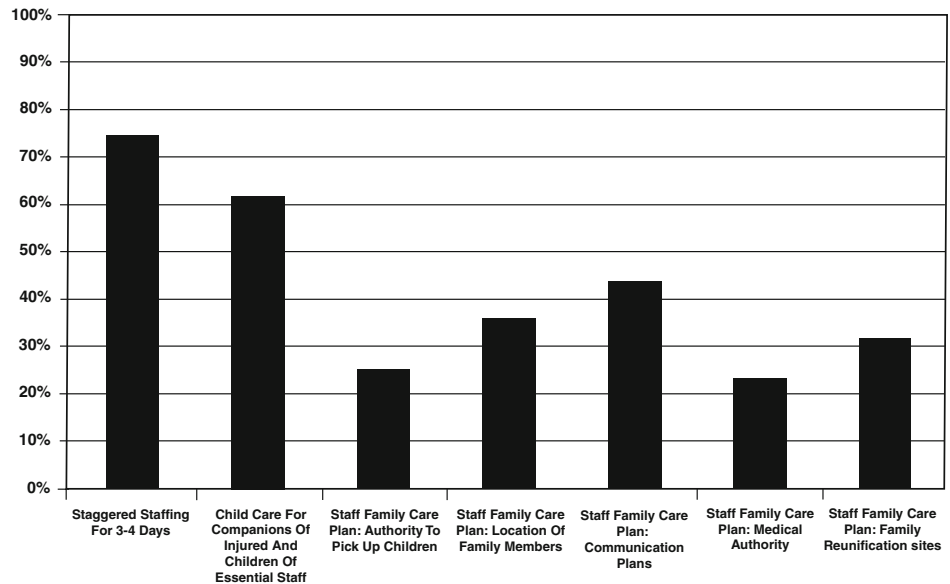
Sustainability

Along with coverage for added capacity, qualified credentialed personnel are needed to staff extra beds for prolonged periods, and to open and sustain external operations at supplemental care sites in an emergency situation. While willing staff are often quick to respond to a disaster, sustaining their involvement is more difficult unless provisions are made for care of dependent family members (elderly or disabled), children and pets, and for duty rotations. Three-fourths (75%) of responding trauma centers had plans to stagger staffing over 3–4 days (Figure 10). These plans will be challenging if the natural disaster causes the employees' or physicians' own homes to be endangered or even destroyed. In that case, their families could be at risk, injured, or scattered, making staff participation or mutual aid less likely for the long term.

Though 62% of reporting trauma centers plan for child care of staff and companions of the injured as part of the EMP, less contain details that would relieve their staff of child care concerns. For the responding hospitals, 25% have authorizations to pick up children of their staff, 23% can medically treat their minor children, and 43 and 31%, respectively, have plans for staff family communication and reunification (Figure 10).

Sustainability also includes the ability of the trauma center to provide nutrition, water, and sanitation

Figure 10. Percent of hospitals with staff sustainability plans.



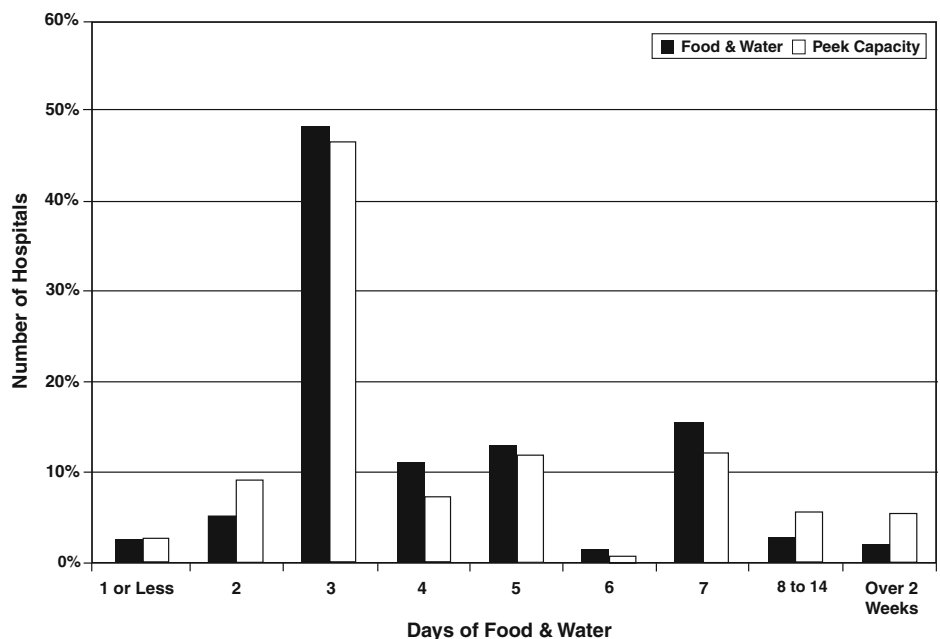
for a large number of patients, staff, volunteers, and even media in the event of a prolonged disaster response. Nearly all (94%) of trauma centers can provide both patients and staff with adequate food and water to sustain operations for 3–4 days. They are less able to offer nutritional care to volunteers (83%), patients’ families (68%), and only half are prepared to feed the media (51%). While 82% say that their EMP provides for operating more than three days under emergency conditions, less than half (42%) of the centers report

an ability to operate at peak capacity for more than three days. The number of days a hospital could operate at peak capacity was positively correlated to preparedness score (Figure 11).

Above- Versus Below-Average Preparedness Score Characteristics

Trauma centers were scored (0–100) using their survey responses to measure their preparedness in the case of a blast attack and/or disaster in the community. Ini-

Figure 11. Percent of trauma centers able to sustain days of self-contained food/water and peak capacity.



tially, these results were analyzed by reviewing characteristics of trauma centers that fell above or below the average score of 73.7. Three types of characteristics were compared by location by region, trauma designation level, and membership of a state trauma system. Additionally, if no significant differences appeared for that categorization, then characteristic differences between trauma centers in the top 20% and the bottom 20% were also analyzed.

Membership of a state trauma system did not appear to influence whether the center scored above or below average in preparedness. Within systems, those states that linked bioterrorism preparedness to the trauma system (FL, NC, CT, NY) also showed no difference, but this finding was from a sample that was too small to determine statistical significance. When only centers in the top and bottom 20th percentiles of scores were compared, 64% of centers in systems linking bioterrorism to trauma appeared in the top fifth, while 42% of centers in systems not linking bioterrorism to trauma appeared in the top 20%.

Trauma designation level exhibited a strong influence on a trauma center's preparedness score. More Level I trauma centers (68%) scored above the average preparedness score than did Level II centers (44%), but the average scores for Level I and II centers were fairly close at 76.3 and 71.1, respectively, which is not statistically significant due to the small sample size.

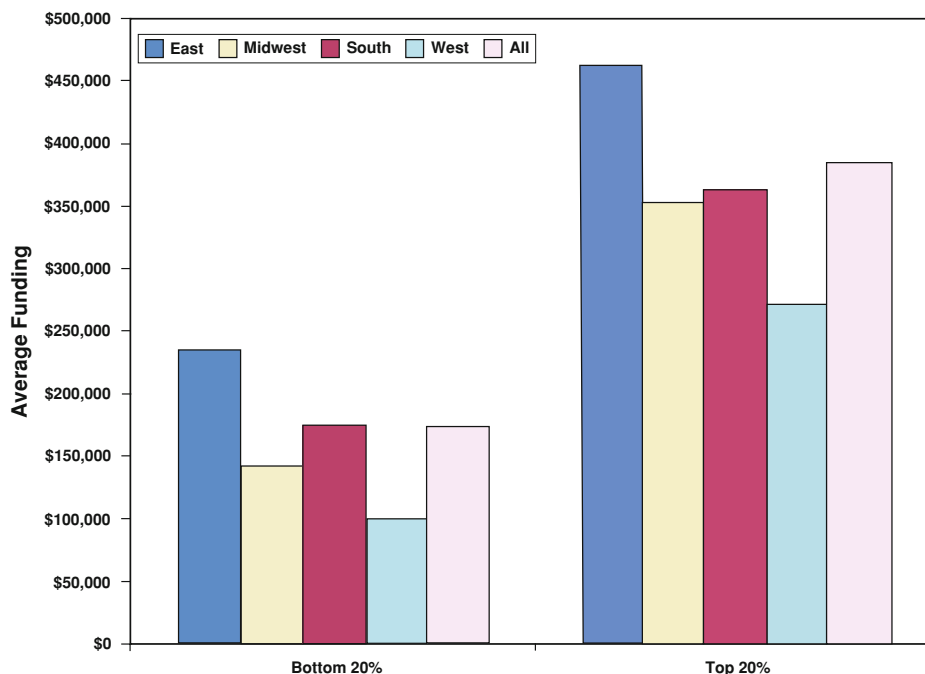
No regions differed in terms of being above or below the average preparedness score or in the top or bottom 20th percentiles. Though differences between the South and other regions appear large, the South's small sample size makes statistical significance difficult to detect.

For the 168 trauma centers that provided funding information, significant regional differences in average reported preparedness funding exist for the East (\$606,520) compared to the Midwest (\$266,161) and to the South (\$229,893). For trauma centers with above-average scores, significant regional differences in funding exist for the East (\$761,556) compared to the average of all other regions (\$361,651). In breakdown, the East's funding is different from the Midwest's (\$314,927) and from the South's (\$280,154) (Figure 12).

Financing Emergency Management Preparedness and Response

Trauma centers have historically been first receivers of severely injured patients, a communication hub for hospital response and patient redistribution, rescuers of regional facilities including nursing homes during natural and human-caused catastrophes, and integral to the preparedness and response to any type of terrorist attack or natural disaster. Despite this, there has been no supplemental funding to enhance trauma-

Figure 12. Comparison of average preparedness funding by region for hospitals scoring in the bottom 20 versus the top 20%.



center preparedness for large-scale events or those requiring special resources. Worse yet, they have been inadequately reimbursed for their “good samaritan” role in a number of instances, as described in the following cases.

Totals for individual trauma center preparedness funding averages showed considerable differences by region. The Eastern region trauma centers report receiving 270% more funding than the Midwest and West and 925% more than hospitals in the South, as defined by NHTC standard criteria.

Trauma centers constitute only 10% of all health-care facilities and have unique economic impediments [19]. They are less able to muster additional funds than other general or specialty hospitals with fewer economic burdens. Despite running a 14% loss for their trauma services nationally, trauma centers were at the forefront of the response to 9/11/2001 attacks in NYC and Washington and engineered the rescues of the majority of evacuees from the Gulf State hurricanes in 2005 [19].

Opportunities for Improvement

This survey identified areas of preparedness that would benefit from performance improvement (PI) measures. Improvements in some areas may require only for trauma centers to adopt the successful practices shared by the highly prepared and best preparedness practice trauma centers selected from the 175 responders to this survey and others published in the reference list at the end of this paper. Other improvements require an investment of time and monies. Many will not occur without regional, state, or federal investment and directives. General hospitals and trauma centers are inevitably first receivers of patients who self-deliver to the nearest hospital. Without planning and advanced communication technology, severely injured patients will not be directed to a trauma center, although that is where they could have a better chance of survival [7, 20]. This section describes areas for improvement divided into the optimal preparedness components guiding this project.

Vulnerability

The trauma centers that reported a high number of terrorist targets and natural hazards within their catchment area have a more difficult path to optimal preparedness. Inequities in funding, as compared to the number of regional hazards, places a higher burden on centers located in less well funded regions such as the South. Decontamination capacity showed a wide variability, from a low of 38 patients per hour in the South, the area with the highest average number of hazards, to

a high of 67 per hour in the East. Since many patients will bypass the prehospital systems and their HazMat teams, decontamination may be done at a hospital poorly prepared for a large influx of contaminated patients. If the patient bypasses security and enters the facility, contamination could render it inoperable and place staff and other patients at risk. Scarcity of Class B suits, ranging regionally from 6 to 30 but averaging 11 overall, makes decontamination from highly hazardous materials less likely. This level of decontamination is considered a hospital function that will require training and equipment as indicated by OSHA. The propensity for patients to self-deliver to the hospital makes it more important that hospitals have a higher capacity to decontaminate patients and be better equipped [20].

Planning

The survey results reinforce informal evidence that clearly defined plans for the administrative aspects of emergency management are in place in the nation's trauma centers. However, details about daily operations, issues that became problematic during the isolation of staff and patients at Charity Hospital in New Orleans, were not requested in the survey due to the length of the questionnaire. Literature describing that event shows that these details were critical to the emotional and physical ability of caregivers to sustain operations under extreme duress (Brock N – Associate Administrator, Harris County Hospital District, personal communication, 17 July 2006; [21]).

Plans need to address issues such as adequate numbers and correct types of batteries to replenish flashlights, allowance for sanitary disposal of body wastes, requirement for staff and volunteers to bring extra clean clothing, and stockpiles of prophylactic medications for inevitable breaches in sanitation. Charity Hospital's lack of emergency generator fuel resupply was especially problematic, with reserves available within blocks of the hospital but denied due to lack of interagency cooperation and prioritization. Another significant need evidenced by Charity's situation was its inability to secure the building and its perimeter from convergers and keep the facility from being a secondary target [22].

Information derived from lectures at the Annual Conference of the Eastern Association for Surgery of Trauma (EAST) showed that a prolonged siege can be more emotionally hazardous to rescuers and caregivers. In New Orleans, nearly 25% of one facility's staff suffered near or complete psychotic episodes during their almost week-long plight [22]. These conditions would also presumably increase the incidence of post-

traumatic stress disorder (PTSD). It is reported that some rescuers displayed insensitivity to the caregivers' emotional status during Charity's long-awaited evacuation [20]. Training rescuers, including military and law enforcement, to better deal with patients, families, and caregivers whose emotional reserves have been exhausted is appropriate, as well as providing post-event critical incident stress debriefing (CISD).

Communications

Most trauma centers indicate that they are well prepared in the area of interagency and regional communications. However, very few states have comprehensive healthcare resource capacity monitoring, and there are no multistate systems. These systems are needed to rapidly notify and direct staff to appropriate care sites, move patients from threatened facilities, track the number, identity, and location of victims for worried families, and inform the media in real time. Patient tracking was at times referred to as an American Red Cross issue in survey responses, whereas the trauma centers involved in major disasters have found their communications systems deluged with phone calls from the media, worried families, and volunteers [13]. Tracking of displaced persons and patients who became separated from their families after Hurricane Katrina was problematic to the extent that some families are still missing information a year after the event.

The ability to communicate with military (65%) and federal assets (81%) was present in the majority of survey responses. Even better integration of these resources will be needed for a seamless and unified response to mass-scale disasters [22].

Resources

The ability to respond to disasters of mass scale is dependent on the adequacy of pharmacy and medical supply stockpiles and their accessibility, as well as essentials such as food, water, and sanitation. Most trauma centers are able to mobilize staff and maintain operations for three days and increase capacity by 60% over time. This level of surge capacity relies on the trauma center being accessible to staff and on a continuous supply of water and power.

The study results show some lack of preparation for patients with special needs, such as obese, immunocompromised and chronically ill patients, that needs particular attention. There is also a low rate of contract exclusivity, particularly for ventilators (<40%), at a time when pandemic influenza and airborne forms of bioterrorism are predicted to be an imminent public health threat. Overall, one solution is for mutual aid agree-

ments (MAA) or MOU with other facilities both within and outside of the region to collaborate on distributing the staff and supplies needed to rapidly react and moving patients to the most appropriate destination. Local planning to store and distribute CDC Strategic National Stockpile supplies and coordinate all available healthcare resources is a priority. Ideally, general hospitals will participate by accepting patients who do not require specialty care as well as by providing alternative forms of transportation, so that those with the severest injuries are ultimately treated at a trauma center. This will not occur spontaneously due to the acknowledged problem of patient self-delivery to the closest hospital.

Basic supplies, including fuel and water, need to be available in adequate amounts to respond initially and then to maintain high care volumes for at least three days. The problems of complete blackout at Charity Hospital and other facilities in New Orleans resulted in staff having to manually ventilate patients for prolonged periods [22]. It is also rare for the emergency power supply to preserve air conditioning. Power failures that impact the information technology (IT) system can delay care, impede patient tracking, and slow resource availability. Testing of IT services under power outage conditions and reversion to paper systems should be familiar to both staff and physicians.

Security

The ability to lock down the entire trauma center is well planned but not as commonly practiced, less so at the departmental level. Convergence of medical voyeurs and other nonessential persons, including media, poses a specific problem that requires lockdown. Diversion of such persons (including the worried well, families, and those emotionally traumatized by the event) away from clinical areas will best occur when access to the facility is controlled.

The survey did not address perimeter control. However, the validation visitors did review that particular security measure on-site. They found that highly prepared trauma centers pay particular attention to managing their extensive properties, authorize staff to secure remote clinics and buildings immediately, and provide special identification for incoming staff, vendors and other essential personnel so that inappropriate persons are confined and redirected. These highly prepared facilities assigned nonclinical personnel such as painters and maintenance personnel to redirect convergers to nonclinical areas. Although most hospitals have security plans in place, about two-thirds have practiced them. Regular lockdown drills should be practiced and improvements made as needed.

Clinical Resources

Careful planning for locating stored supplies is critical to them being available in a catastrophe of mass scale. At times, ample supplies are inadequately stored in areas of the campus or building prone to flooding, damage or pilferage. Supplies stored in the basement of Granada Hills Medical Center in California were inaccessible, broken, or damaged during the magnitude 6.7 Northridge earthquake. The central supply basement area shelves tipped over despite being harnessed in accordance with seismic safety practices of that time. No supplies other than those in the ED could be accessed when over 600 patients arrived. Emergency care was provided on the hospital grounds using supplies and staff sent urgently from the adjacent county's Level I trauma center. Full evacuation of neonates, who had oxygen tanks but no heat in their infant warmers, was performed well before DMAT or other federal resources were available.

Collaboration for this aid was a result of urgent physician-to-physician cell phone calls to University of California, Irvine Medical Center (UCI) shortly after the earthquake. UCI responded with two teams recently returned from Bosnia, and vans loaded with simple suturing, pharmaceuticals, dressings, IV supplies, and additional cell phones. UCI, although approved for the task by Los Angeles EOC in the absence of other resources, had no transfer agreement or MOU with Granada Hills and relied on the goodwill of the hospital's administration to be paid for the supplies sent the morning of the earthquake. Ultimately, Granada Hills repaid UCI for all of the supplies sent [21, 23].

The study results show MAA with other hospitals at 65% on average, and less often with other trauma centers (55%). Trauma centers would benefit not only from MAA/MOUs with hospitals in their community, but others they establish through a mutual aid network with prepared and willing trauma centers outside their catchment area. Such a trauma network would have written agreements (MAA or MOUs) for cross-credentialing staff, assigning outside personnel to be supervised by trauma center staff, facilitating rapid acceptance of transfers and coordinating patient transports, accessing needed supplies, sharing patient information, and accepting fiscal responsibility for aid rendered.

Sustainability

The ability of the trauma center to provide nutrition, water and sanitation for a large number of patients, staff, volunteers and even media is essential in the event of a prolonged disaster response, but is not as prevalent as desirable. If the facility becomes isolated,

it will find it difficult to resupply fuel and other essential resources for days. Emergency and mutual aid agreement staff need to be prepared to bring their own supplies of special foods, extra clothing, sensible shoes, chargers and extra batteries for their personal cell phones, and medications. Family members, however helpful they may be in caring for their injured relative, may impose a further drain on resources if they do not bring supplies with them.

Most essential to the sustainability of operations is the generation of power. Disasters which were already creating regional crises were worsened by poor engineering and planning errors. For example, flooding in Houston resulted in total darkness at Hermann Hospital when water reached the underground garage of the facility where the electrical switchgear was located. Even with the emergency generator above ground and having adequate fuel, a complete power outage occurred. The hospital was evacuated in total darkness, through stairwells and under dire conditions (Brock N – Associate Administrator, Harris County Hospital District, personal communication, 17 July 2006).

Staffing and supplying child and elder care allows responding clinicians and essential support staff to concentrate on the medical aspects of the disaster, rather than its personal consequences. Comprehensive family care plans can help the trauma center operate for extended periods of time and assure that essential personnel are available and not overly distracted by concerns for their own families.

Replenishment of material stores and personnel is not enough if the trauma center does not address fatigue and emotional issues. Hospitals need to rotate staff for rest periods, provide communication access to their families, and stockpile nutritional and sanitation supplies for the long term. The data from this study show an average capability of three days, whereas recent natural disasters have isolated some trauma centers and extended their recovery for nearly one week. Plans for rationing, replenishing fuel and water, and upholding morale are less tangible and often not present in the EMPs. There is a common assumption that essential needs will be provided for, which was shown to be invalid during the Gulf Coast catastrophe [20].

Measures that helped Charity Hospital sustain semihuman conditions included providing for adequate rest through shift assignments, disposal of human wastes in a planned and careful manner using commodes and plastic bags, rationing of food supplies (stored in the basement, which was the first area to flood), and psychological support measures such as nondenominational religious services, singing and other forms of respite [20].

Recommendations

Given the extremely high level of preparation for a mass-casualty situation already in place at these leading trauma hospitals, further attention to the specific areas below will move these centers toward a status of optimal preparedness for all types of hazards. Many of these suggestions are already being addressed or are being planned.

- Develop disaster response “cost centers” for finance accountability that provide precise cost accounting and the necessary documentation for reimbursement by the Federal Emergency Management Administration (FEMA) if the disaster is federalized. This practice also facilitates future budget projections.
- Develop and test the capability and assets to open an alternate treatment site remote from the hospital in coordination with regional EMS providers, health-care facilities, and governmental agencies.
- Provide training to Board of Trustees/Governing Body regarding their role during a full-scale disaster.
- Review newly issued (7/1/06) JCAHO Emergency Management Standards.
- Use disaster tags for all incoming patients, including those self-presenting (could be used in conjunction with existing triage documentation).
- Expedite timing for the creation of post-disaster drill action plans; consider conducting debriefings immediately after the exercise to ensure that the critique is quickly performed and the action plan promptly developed (within five days of the drill). Use e-mail “approval votes” from the Disaster Committee on these action items if the next Committee meeting is not within 30 days of the disaster drill.
- Consider using HealthStream™ or another web-based training system for disaster role orientation for attending physicians and residents; ensure that personal disaster preparedness is incorporated into this training.
- Review the decontamination water containment system to determine whether there is a need for a more environmentally conscious method to contain wastewater.
- Review the “new hire” orientation curriculum to ensure that personal disaster preparedness and family disaster planning are addressed as a training opportunity. Review Red Cross or other family disaster planning tools to provide handouts. Consider placing a Family Disaster Planning Home Page on hospital website.
- Lead efforts to develop a unified patient tracking system for both ambulance and ambulatory patients presenting to hospitals throughout the region.
- Ensure an MCI or similar alert system is developed to link regional hospitals, public safety, EMS, and blood bank.
- Develop a single All-Hazard Emergency Response Plan that establishes a uniform, comprehensive framework for the management of incidents. The hospital EMP and hospital incident command system should be in compliance with National Response Plan (NRP) and the National Incident Management System (NIMS).
- Reconsider the organizational chart and reporting structure of the Safety Officer to provide a direct operational and day-to-day programmatic relationship to the EMS Division.
- Support the development of a statewide process to assure that there is redundancy in the vendors for durable medical supplies and pharmaceuticals.
- Establish space, assign manpower, and develop protocols for managing donated goods or items, including blood donations from walking volunteers, during a disaster event.

Conclusion

Application of disaster preparedness principles comes readily to trauma centers. In their daily operations, trauma centers are expected to expand rapidly to an event’s scale, based on the random nature of trauma, and many centers have already responded exceptionally well to both natural and human-caused catastrophes. The trauma profession has a long history of stringently reviewing its practices and outcomes, which afforded the researchers a rich reserve of publications and textbooks, as well as lectures given at professional conferences, as reference materials. The expert panel worked as a team to develop the inventory based on accepted preparedness components, evaluate survey results, and recommend opportunities for improvement in order to assure that our nation’s trauma centers continue to upgrade their preparedness for future inevitable catastrophes of mass scale.

It is notable that 175 reporting trauma centers out of 531 surveyed voluntarily critiqued their operations and candidly assessed their preparedness. Their diligence in finding answers to the detailed inventory questions demonstrates commitment to the internal review and research processes that characterizes trauma care. Each of the reporting facilities is commended and held in the highest regard for their participation. Their efforts will benefit all trauma centers. Those that conveyed a lack of knowledge about their preparedness plans are highly motivated to take advantage of the project products. Historically, trauma professionals have shown a keen

interest in improving their center's readiness and response to terrorist attacks or natural disasters, as seen in the high scores for regional disaster planning. Another indication of this interest is the strong attendance at trauma courses, where disaster "lessons learned" have become an educational standard.

Since the NFTC was founded a decade ago, its success has been its ability to identify high-performing facilities, practices or clinical models, and disseminate them through a broad array of learning modalities. These modalities include a website, scheduled conferences, audioweb lectures, slide shows, and printed materials such as policies, protocols and procedures. This approach allows the trauma professional to select from a menu that suits their work schedule and learning style. The NFTC's approach is practical, affordable, and adaptable to the size and locale of the trauma center. NFTC staff offer support and guidance once materials are disseminated through scheduled conference calls, emails, and correspondence.

The NFTC relies on a broad team of advisors who are some of the most esteemed and experienced surgeons, physicians, administrators, and nurses in trauma care. These professionals commit to projects such as this survey, serve on NFTC's Board of Directors, chair or serve on committees, lead national initiatives, and advise other trauma professionals on an ad hoc basis. These volunteers are the real drivers that have built the NFTC into a creative, collaborative force to lead real and lasting positive change in a difficult and unstable healthcare niche.

Acknowledgments

INVESTIGATORS

PRINCIPAL INVESTIGATOR

Donald Trunkey, MD, FACS Professor, Department of Surgery, Oregon Health Sciences University

CO-INVESTIGATORS

Mark Ackermann Chief Administrative Officer and Director of Preparedness, St. Vincent Catholic Medical Centers of New York

Ron Anderson, MD, MACP President & CEO, Parkland Hospital & Health System

David Jaffe Executive Director, Harborview Medical Center

ADVISORY BOARD

Peter Angood MD, FACS, VP & Chief Patient Safety Officer, Joint Commission on Accreditation of Healthcare Organizations

Erik Auf der Heide MD, MPH, FACEP Agency for Toxic Substances & Disease Registry, US Dept. Health & Human Services

Linda Bourque PhD Professor, Community Health Sciences, UCLA School of Public Health

Susan Briggs MD, MPH, FACS Trauma Surgeon, Massachusetts General Hospital

Jeffrey Hammond MD, MPH Trauma Director, Robert Wood Johnson Medical Center

Jorie Klein RN, MA Director, Trauma & Disaster Programs, Parkland Hospital & Health System

Vivian Lane RN, MSN Trauma Program Consultant, Hartford Hospital/CCMC

Chris Martin RN, MSN Admin. Director, Emergency Services, Harborview Medical Center

Norman E. McSwain Jr. MD, FACS Professor of Surgery, Tulane University Trauma Director, Charity Hospital

Avery Nathens MD, PhD, MPH, FACS Division Head, General Surgery; Director of Trauma, St. Michael's Hospital, Toronto, Canada

Jim Pettyjohn BA, BSN, RN State Trauma System Manager, Health Systems Emergency Preparedness Coordinator, New Mexico Department of Health

Stuart Reynolds MD, FACS Medical Director, Montana Hospital Bioterrorism Preparedness Program

Sharon Rhyne MHA, MBA Health Promotion Manager, North Carolina Division of HHS Chronic Disease & Injury Section

Mark Smith MD, FACS Dir. Emergency Medicine, Washington Center Hospital; Professor Emergency Medicine, Georgetown University

Christine Wachsmuth, RN MS Project Leader, Air Medical Access Project, San Francisco General Hospital

PROJECT STAFF

PROJECT DIRECTOR

Connie J. Potter, RN, MBA Executive Director, National Foundation for Trauma Care

PROJECT ADVISOR

Lisa Irwin, RN, MSN, MPA:HA Trauma Systems Advisor, National Foundation for Trauma Care

PROJECT DATA ANALYST

John H. Song, MS National Foundation for Trauma Care

DATA ANALYST/TECHNICAL WRITER

Wallace Crain, BA National Foundation for Trauma Care

PROJECT COORDINATOR

Michelle Santos Associate Director, National Foundation for Trauma Care

PROJECT ASSISTANT

Pablita Ramirez Administrative Assistant, National Foundation for Trauma Care

VALIDATION VISITORS

Mark Ackermann Chief Administrative Officer and Director of Preparedness, St. Vincent Catholic Medical Centers of New York

Susan Briggs MD, MPH, FACS Trauma Surgeon, Massachusetts General Hospital

Chris Martin RN, MSN Admin. Director, Emergency Services, Harborview Medical Center

Jim Pettyjohn BA, BSN, RN State Trauma System Manager, Health Systems Emergency Preparedness Coordinator, New Mexico Department of Health

Christine Wachsmuth, RN, MS Project Leader, Air Medical Access Project, San Francisco General Hospital

EDITORS

Mary Beachley, RN, MS Director, Hospital Programs Maryland Institute for EMS Systems

David Hoyt, MD, FACS John Connolly Professor of Surgery, University of California at Irvine School of Medicine

Ronald Maier, MD, FACS Jane and Donald D. Trunkey Professor and Vice Chair of Surgery, Harborview Medical Center, University of Washington

DATA ANALYST/TECHNICAL WRITER FOR THIS ABRIDGED PUBLICATION

Wallace O. Crain, BA National Foundation for Trauma Care

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The authors declare that there is no actual or potential conflict of interest in relation to this article.

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Address for Correspondence

Donald D. Trunkey, MD
Oregon Health and Science University
3181 SW Sam Jackson Park Rd
L223, Portland
OR 97239
USA
Phone (+1-503) 494-9145
Fax -9145
e-mail: trunkeyd@ohsu.edu

National Foundation for Trauma Care

The National Foundation for Trauma Care (NFTC) is America's premier trauma center trade association. NFTC, a non-profit 501(c)6, is dedicated to securing the economic viability of trauma centers and systems across the country. The Foundation's mission is to foster the development of a national system of trauma care so that access to excellent care for the seriously injured is assured. NFTC's members receive

education on best practices, advice on trauma billing and system development, access to the most comprehensive trauma database, and linkages to other trauma centers and systems. Members include over 215 trauma centers in more than 40 states and 15 state and regional trauma agencies responsible for trauma system development and oversight. The NFTC Board of Directors includes the most qualified and influential professionals

in the trauma care industry. These leaders direct the NFTC in all member initiatives and NFTC national advocacy efforts. The Foundation's eight established committees actively guide member services and activities. The committees consist of representatives from active NFTC members and include Advocacy, Development, Disaster Response Education, Pediatric Trauma, Reimbursement and System Management.