

# Minimizing Postdisaster Fatalities

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Speed of care, efficient use of resources, appropriate triage, quick-response strike teams, and pre-disaster planning are strategies that can reduce fatalities after an environmental catastrophe.

**E**nvironmental disasters can overpower local medical resources. Fortunately, such crises are rare in the U.S. This situation, however, has not always been the case. For example, in 1812, an earthquake along the New Madrid fault of the Mississippi Valley caused the Mississippi River to flow backward for 3 days.<sup>1</sup> Today, in urbanized America, an earthquake of that magnitude would be devastating and severely overwhelm medical systems. All nations, including highly modernized nations, would need help in such disasters.<sup>2</sup> A response system that is nimble, well-trained, scalable, and rapidly deployable can mitigate disaster sequelae. This article focuses on key aspects of effective rapid response, including speed, appropriate triage, quick-response strike teams, and disaster dynamics.

## WHY SPEED MATTERS MOST

Response time arguably is the most important factor in increasing survival in a disaster. In a 1996 study of earthquake disasters worldwide, Schultz and colleagues found a lower

survival rate for victims who received medical care outside a 24-hour window.<sup>1</sup> Studies of earthquakes in China have suggested that unless aid is rendered within 2 to 6 hours, fewer than half the victims will survive.<sup>3</sup> Regarding a 1980 earthquake in Italy, de Bruycker and colleagues emphasized the importance of engaging in rescue activities within the first 48 hours.<sup>4</sup> Safar reviewed mass disasters and reported that 25% to 50% of the injured and dead could have been saved if first aid had been provided immediately.<sup>5</sup> In 1992 and 1994, Pretto and colleagues wrote that in earthquakes in Armenia and Costa Rica, many deaths could have been prevented had the victims received medical attention within the first 6 hours.<sup>6,7</sup> The question is: How can responses to such crises be improved? Confederate Army Lt. Gen. Nathan Bedford Forrest's dictum "[Get] there first with the most men" holds true in disaster medicine as well: get there fast with the right people, training, equipment, and supplies.<sup>8</sup>

Deaths in disasters can be de-

scribed in a 3-phase distribution: immediate, early, and delayed. Stringent building codes and public warnings and evacuations reduce immediate deaths, but victims also die of catastrophic injury soon after an event. Early deaths are preventable with use of rapid interventions, such as tourniquets and airway adjuncts, but these must be administered within minutes or hours. Delayed deaths occur days or weeks after injury secondary to infection or organ system failure—which emphasizes the value of early wound care.

## EMERGENCY SUPPLIES

What items are most needed? As each disaster is different, it would be presumptuous to provide a one-size-fits-all list, but some common supplies have been suggested. In 2010, Ginzberg and colleagues reported that during the first 24 hours of the Haiti earthquake of 1996, the overwhelming need was for IV hydration, narcotic analgesics, and casting supplies for the splinting of fractures.<sup>9</sup> During the next 24 hours, IV stabilization was key, along with monitoring by Foley and supra-public catheters. In the third 24-hour period, providers began to see sepsis-related deaths. In response to this challenge, teams began aggressive treatment with open surgical

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debridement of wounds, amputation of severely injured limbs, and administration of broad-spectrum IV antibiotics. Regional anesthesia with conscious sedation was mandatory because supplemental oxygen and ventilators were unavailable. By day 4, wound debridement, amputations, and fasciotomies were being provided by newly arrived anesthesiologists and orthopedic surgeons. Ginzberg and colleagues emphasized that rapid response was key in maximizing survival and by day 4, there was a greater need for surgical teams and broad-spectrum antibiotics (eg, piperacillin, tazobactam) to combat sepsis.

Pereira and colleagues reported that in a catastrophe caused by a tropical storm and landslides in Brazil, the most common injuries involved the extremities; the majority of wounds required only cleaning, debridement, and suture; and the most commonly performed operations were for orthopedic injuries.<sup>10</sup> Incidentally, population baseline morbidity and mortality continue during disasters, and rescue personnel invariably sustain injuries, which contribute to the total medical burden. These additional injuries must be anticipated, and plans to manage them must be included in any disaster contingency planning.

## TRIAGE

Speed and correct triage are essential building blocks of disaster response. When resources are limited, triage is crucial in providing the right treatment to the right patient. There are numerous triage methods, some more rapid and straightforward; others more effective and cumbersome.<sup>11</sup> In 2012, Sasser and colleagues wrote that the purpose of triage is to ensure injured patients are transported to a trauma center or the hospital best equipped to manage their specific in-



P03 Cameron Croteau,  
USCG, in Haiti 2010;  
U.S. Coast Guard photo  
by P03 Brandyn Hill.

juries in an appropriate and timely manner.<sup>12</sup> Their report focused on prehospital emergent care, not mass-casualty or disaster situations.

Triage is sometimes performed inconsistently. In a 2013 study, Kleber and colleagues found that 24% of providers overtriage and 16% undertriage.<sup>13</sup> In the U.S., simple triage and rapid treatment (START) is commonly used to sort traumatized patients. All these methods take a “worst gets first treatment” approach. Depending on the magnitude of an event, however, providers may take a reverse-triage approach, in which they better use resources for the least injured patients and provide palliative care to the gravely ill.

During pandemic disasters, trauma triage protocols are ineffective. Instead, these events demand assessments that are sensitive to infectious diseases. Timely, didactic, hands-on training must be conducted before the fact so responders can adapt to react appropriately to a given disaster.<sup>14</sup>

Accurate, timely triage in mass-casualty incidents was conceptually demonstrated by Mekel and colleagues who reviewed the medical management of bombing victims in metropolitan Haifa, Israel during the period 2000 to 2006.<sup>15</sup> Providers initiated a predetermined triage system in which patients are assigned to the appropriate echelon of care. Of 342 injured patients, 9.5% had severe injuries, 2.4% had moderate-severe injuries, and 88.9% had mild injuries. Correct and timely triage

directed trauma victims to the appropriate medical care. Such action prevents the highest level facility from becoming overcrowded with less severely injured patients and ensures that the more critically injured receive a level of care comparable to that given under nondisaster circumstances.

The handheld ultrasound device, which can be used to correctly diagnose fractures, is an efficient triage resource for prehospital teams. In a 2008 study, McManus and colleagues suggested that ultrasound (vs traditional radiography) could be used to identify fractures in an emergency room.<sup>16</sup> A handheld ultrasound device could be used outside the hospital, in the field, potentially reducing the number of referrals to overwhelmed orthopedic hospitals.

In 2007, Dean and colleagues reported on using ultrasound to rapidly triage disease during an earthquake in Guatemala.<sup>17</sup> In that disaster, 23% of injuries presented within the first 24 hours, and a handheld ultrasound device was used to assess orthopedic injuries—ruling in 12% and ruling out 42%. The handheld ultrasound device is an example of a tool that small medical teams can use to speed triage, enhance patient care, and relieve overcrowded medical centers of the unrelenting pressure.

## ON-SITE VS HOSPITAL

Complicating disaster response is self-triage. Victims with injuries of all severity levels go to the nearest

hospital and overwhelm it. In 1991, Waeckerle reported that within the first 30 minutes of a disaster, a wave of victims arrives, usually with minor injuries, and impedes care for the more severely wounded.<sup>18</sup> Correct triage instead would have directed these patients to a hospital other than the overwhelmed level I trauma center.<sup>15</sup> This is not to say that patients with mild or moderate injuries are unimportant—just that their care may take scarce space and resources from the more severely injured.

Mallonee and colleagues reported that of the 759 people injured in the 1996 Oklahoma City bombing, 167 (22%) were fatalities, 83 (11%) were hospitalized, and 509 (67%) were treated on an outpatient basis.<sup>19</sup> Most of the injuries could have been managed by quick-response medical teams operating in the affected area, outside the hospitals. This action would have reduced operational pressure on hospitals and improved severely injured patients' access to care.

### Specialized Teams

In 2008, Barillo and colleagues suggested that having standardized medic bags would allow a small detachment of medical professionals to provide care nimbly—and doing so would represent a leap forward in access to care.<sup>20</sup>

Because of their unique ability to understand the culture and coordinate military assets with local authorities, DoD international health specialists are crucial interfaces for any population, foreign or domestic. Seyedin and colleagues and Merin and colleagues suggested that in both the Bam earthquake in 2003 and the Nepal earthquake in 2015, understanding the culture played a vital role in health care delivery and in adhering to cultural norms in deciding when to perform surgery, making end-of-life decisions, communicating with family, establish-

ing trust with local and regional leaders, and other matters.<sup>21,22</sup>

Strike teams are small groups of variably trained health care providers who are dispatched to underserved, outlying, or overwhelmed areas to deliver precached basic medical care and triage significant injuries to medical centers. The handheld ultrasound device is an example of a strike team tool. During a local emergency, it is understood or assumed that response is inundated and that people are going untreated.

Crucially, strike teams must be trained, prepared, and readily dispatched ahead of larger response elements. Though quickly deployable, disaster medical assistance teams (DMATs) and National Guard Chemical, Biological, Radiological, Nuclear and High-Yield Explosive Enhanced Response Force Package units, take time to mobilize. Therefore, strike teams should consist of community citizens or local National Guard assets, the latter being particularly suited to rapid response given their training, effective command and control, and intrinsic logistics.

The efficacy of strike teams was demonstrated during the 2011 earthquake in Japan.<sup>23</sup> Disaster medical assistance teams were invaluable in triaging and treating patients during the first 3 days. A team left 34 minutes after the event to render aid to people caught in a roof collapse. During triage, 17% of the injuries were classified urgent, 22% intermediate, and 61% minor. On day 7, a DMAT was dispatched to assist with emergency medicine and primary care; 3% of the injuries were severe and required urgent care, 50% required intermediate care, and 47% required minor care.

The value of strike teams is 3-fold: It provides rapid, professional care at a crucial place and critical time; it correctly triages pa-

tients and thus allow hospitals to maintain resources for the more severely injured; and augments overwhelmed providers at crucial sites. The roles of strike teams were echoed in 2006 by Campos-Outcalt, who reported that DMATs deployed to austere locations had the flexibility to augment existing medical staff and to rapidly deploy, self-sustain, and treat patients until a situation was resolved.<sup>24</sup> This nimble strike team mentality could become a rapid and flexible model to save more lives, relieve significant suffering, and offload pressure from local hospitals by treating the less critically injured.

### WHAT COMES NEXT?

After a disaster, space is at a premium, and nonmedical residents who make up 40% to 70% of the shelter population require resources as well.<sup>25</sup> Family members and the lightly injured may be conscripted to augment the overwhelmed medical staff. In 1988, Halbert and colleagues described how Afghan volunteers with minimal medical experience were given training and supplies and served as advanced emergency medics, delivering medical care and performing well under austere conditions.<sup>26,27</sup> Strike teams thus may provide on-scene training in addition to medical care.

In 2012, Kirsch and colleagues found that Haiti earthquake victims who received treatment and remained in camps showed no improvement in income, employment, or food access 1 year after the disaster compared with victims who remained outside the camps and in their own neighborhoods.<sup>28</sup> This finding underscores the need for accurate and timely triage by strike teams outside hospitals and quick treatment and return of patients to their homes.

Conceptually, strike teams need

not be confined to medical response. Team members also might be specialists in epidemiology, disease surveillance, public health, culinary water protection, municipal security, and civil engineering. Noji reported that malnutrition, diarrheal diseases, measles, acute respiratory infections, and malaria consistently accounted for 60% to 95% of reported deaths among refugees and displaced populations.<sup>29</sup> In 2005, Spiegel found that the potential for epidemics of communicable diseases was increased by overcrowding and poor sanitation in both natural disasters and complex emergencies.<sup>30</sup> In 2007, Watson and colleagues suggested that communicable diseases may account for two-thirds of the deaths in conflict areas, and malnutrition significantly increases the risk of these diseases.<sup>31</sup> Effective disaster care may be better accomplished through decentralized strike team interventions, which avoid the pitfalls of displacement and overcrowding.

## CONCLUSION

Crises of all magnitudes can be greatly eased by well-trained, quick-response, all-hazards medical detachments—small teams that can be rapidly mobilized and deployed to establish casualty collection points, provide accurate triage, and render emergency care. These highly mobile teams can bridge the gap between the occurrence of a disaster and the arrival of substantial assistance from state, federal, and nongovernmental organizations—a most vulnerable time. These competent, flexible teams then can be absorbed by the larger force when it arrives for sustained disaster operations. Predisaster planning must take into account the possibility of long-term care for casualties and the displaced. Careful attention should be given to the potential for epidemics—immuniza-

tions should be administered quickly to achieve herd immunity—and a program that will provide food, water, shelter, sanitation, and security should be established. ●

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