

# Emergency Health and Risk Management in Sub-Saharan Africa: A Lesson from the Embassy Bombings in Tanzania and Kenya

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**Abbreviations:**

DALY = disability-adjusted life-years lost  
U.S. = United States of America  
YPLL = years-of-potential-life-lost

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**Abstract**

In 1998, terrorists simultaneously bombed United States Embassies in Dar es Salaam, Tanzania and Nairobi, Kenya. The local response to these bombings was unorganized and ad hoc, indicating the need for basic disaster preparedness and improvement of emergency management capabilities in both countries.

In this context, risk and risk management are defined and are related to the health hazards affecting Tanzanians and Kenyans. In addition, the growing number of injuries in Tanzania is addressed and the relationship between risk management and injury is explored. Also, an emergency medicine-based strategy for injury control and prevention is proposed. Implications of implementing such a protocol in developing nations also are discussed.

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**Background**

On 07 August 1998, terrorist bombings targeted United States Embassies in Dar es Salaam, Tanzania and Nairobi, Kenya during the morning business hours. In Nairobi, 213 people were killed, including 12 U.S. citizens and 32 Foreign Service Nationals. Approximately 5,000 others, including 13 U.S. citizens, were injured.<sup>1</sup> Initial rescue efforts were hampered by limited experience with incident command organizational management, mass casualty management, and search and rescue procedures. Controlling the scene was difficult, since all roads to the downtown area were jammed with traffic moving towards the explosion. Thousands of people converged on the site to investigate the cause of the explosion, which initially was believed to be the result of civil unrest. As a few U.S. Marines worked to establish a secure perimeter around the embassy, Kenyan riot

police set up a wider perimeter to push people back from the site. This interfered with rescue efforts. Most of the injured received no pre-hospital care, and most who sought treatment at hospitals did so without assistance from the formal responders on the scene. Hospitals soon were overwhelmed by casualties and flooded by citizens seeking news of relatives and friends. These crowds hindered patient access to the facilities. Many citizens in Nairobi volunteered to give blood at these institutions, but these efforts were restricted by the limited capacity to store or process the blood. Limited mortuary capacity hindered forensic investigation.

In Dar es Salaam, the affected area was largely residential, and as a result, there were fewer victims. Eleven people were killed in the explosion; seven were embassy employees, though none of these were U.S. citizens. At least 100 people were reported

Childhood
Gender
Disability
Lack of information and education
Lack of experience and process
Inadequate healthcare
Geographical location / isolation
Lack of integration and coordination
Malnutrition
Inappropriate developmental policies
Food insecurity
Societal stratification
Poor water and food quality
Limited state and local resources
Political perceptions
Social implications: graft, corruption, competition

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**Table 1**—Factors that increase vulnerability to health emergencies in developing nations

injured by the blast, most of whom were treated at Muhimbili Hospital in Dar es Salaam. Tanzania, however, is a much poorer nation than Kenya. Access to medical care is much more limited in Dar es Salaam as compared to that of Nairobi. Per capita national health care expenditures in Tanzania are a fraction of that spent for Kenyan healthcare. Thus, the vulnerability of the population was much higher in Tanzania than in the population in Kenya. Search and rescue efforts did not require outside assistance because there was no massive structural failure, as there had been in Nairobi. Scene management lacked coordination. Most victims were transported by private vehicles and commercial minibuses. Even though Muhimbili Hospital had received a large shipment of medical supplies before the explosion, and despite the availability of staff during weekday work hours, capacities were quickly overwhelmed and many victims received less than adequate acute or definitive medical care.

Both Kenya and Tanzania have a limited capacity to deal with disasters of any kind. The response on the part of the people, government, medical personnel, and volunteer organizations to this tragedy was commendable, given the lack of basic disaster preparedness and the deficiencies in their emergency medical management capabilities. These deficiencies exist despite the high level of vulnerability of the population, and the relatively high risks in this area of the world for acute onset of both manmade and natural events.

As part of the U.S. government's response to the bombing of its embassies, both acute response and long-term recovery efforts were explored. The risks faced by Kenyans and Tanzanians are predicated on a variety of factors (Table 1). The international relief community has worked extensively within this region to address many of these vulnerabilities. However, public health issues associated with emergency healthcare and injury prevention and control largely have not been addressed. Using the Embassy bombings as a context, the nature and magnitude of these public health issues is described, and possible interventions for addressing these issues are discussed.

### Defining Risk and Risk Management

The World Health Organization has defined a disaster as "a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of affected society to cope using only its own resources."<sup>2</sup> An event that does not exceed a society's capacities to cope is then classified as an emergency — "a sudden and usually unforeseen event that calls for immediate measures to minimize its adverse consequences."<sup>2</sup> Thus, emergencies and disasters are part of a relative continuum of events that occurs when a population is both exposed and vulnerable to a "threatening event or potentially damaging phenomenon", referred to as hazard.<sup>2</sup> When a vulnerable population becomes exposed to any hazard, there are "lives lost, persons injured, property damaged and economic activity ... disrupted". These events are defined as risk. Thus, risk is the product of hazard and vulnerability.

Risk management is a comprehensive system of actions that includes prevention, mitigation, response, and recovery from the tragic event (Table 2).<sup>3</sup> The greater the capacity that a population has to manage emergencies, the less likely that unforeseen events will develop to an extent that would overwhelm local resources. Additionally, effective disaster management activities strengthen the ability of a population to respond to those everyday emergencies that occur in all societies. Thus, the more that Kenyan and Tanzanian officials can build a basic public health and medical system, the less vulnerable their populations will be to health hazards. Health officials will be able to respond more effectively to emergencies and disasters than they have in the past, and ultimately the quality of life of the nation's citizens will improve.

### Hazards Affecting Tanzanians and Kenyans

Describing risk as being caused by natural or technologic phenomena is limiting. Instead, effective strategies should seek to broaden the scope of risk management to include an all-hazard approach. Some of the factors related to the vulnerabilities common to both Kenyans and Tanzanians are listed in Table 1.

Poverty is one of the most significant hazards contributing to all disasters. Poverty limits the resources available to populations for management efforts in prevention, preparedness, mitigation, response, and recovery. Poverty also may be an additional causative factor by generating economic inequality and conflict, and ultimately, world instability. Unfortunately, poverty rarely is recognized as a major hazard associated with risk for disasters, and mitigating this hazard can be difficult for many reasons.

Table 3 lists other significant hazards that have occurred in this region of eastern Africa. The most frequent disasters for both Tanzania and Kenya have been droughts and floods. Floods caused 38% of all disasters recorded in Tanzania from 1872 through 1990.<sup>4</sup> Droughts affected about 6 million Kenyans from 1964–1994.<sup>4</sup> Epidemics have caused the most-reported mass mortality events in Tanzania during the period 1964–1994. These events already have received attention from the international relief community. Now, injury represents one of the most preva-

1. Primary Prevention	Seeks to prevent adverse events from ever occurring. Not possible in all cases.
2. Secondary Prevention	Takes measures in advance that will decrease or eliminate the impact of risks. (Mitigation)
3. Response	Undertakes actions to minimize loss of life and damage. Organizes the temporary removal of people and property from the threat and facilitates timely rescue, relief and rehabilitation. Includes persons knowing what to do and how to respond after risk has occurred.
4. Recovery	Initiates procedures directed towards returning to normal function.

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**Table 2—Phases of risk management**

Hazard Type	Category	Hazard
Human-Made	Economic setting	Poverty World economic patterns
	Violence	Interpersonal Civil conflict Warfare Terrorism
	Settlement Patterns	Displaced populations Flood plains Population density
	Environmental Degradation	Deforestation Improper utilization Overgrazing Desertification
	Hazardous Materials Transportation	Traffic Marine and shipping Private
	Occupation	
Natural	Ecological Setting	Precipitation Drought Flood Soil infertility
	Storms	Cyclones, Hailstorms
	Seismic threats	Earthquakes Volcanoes Landslides
	Disease	
	Pests	
	Wildfire	

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**Table 3—Hazards affecting Kenya and Tanzania**

No.	COUNTRY	KILLED	INJURED
1	United Kingdom	6	311
2	Canada	7	224
3	Australia	8	200
4	Japan	9	294
5	Kenya	55	500
6	Tanzania	56	643
7	Uganda	103	1326
8	Nigeria	125	1750

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**Table 4**—Morbidity and mortality per 10,000 registered vehicles, 1985 (Adapted from Nordberg E: Injuries in Africa: A review. *East Africa Med J* 1994;7(6):339–345)

lent daily emergencies causing death and disability for people living in this region.

### Injuries in Tanzania

Health statistics for Tanzania indicate that injury has a major impact on public health in Tanzania. Injury is among the five leading causes of death among men aged 15–59 years, accounting for more deaths in Dar es Salaam than malaria and acute diarrhea combined.<sup>4</sup>

In a study conducted by the United Kingdom's Department for International Development (UK DFID) and the Government of the United Republic of Tanzania, three areas were examined: one city (Dar es Salaam) and two rural districts (Morogoro and the Hai district, where the city of Arusha is located). Results of the study indicated that injuries were the third most common cause of death for men in both Dar es Salaam and Morogoro, and the second leading cause of death for men in the Hai district.<sup>5</sup> Injury was listed among the top 10 causes of death in all areas. Among adults aged 15–59 years, injury contributed to 11.5% and 2.3% of overall deaths among males and females respectively in Dar es Salaam, 20.0% and 7.8% for males and females in the Hai district, and 13.9% and 3.1% for males and females respectively in Morogoro. The probability of dying from injuries before age 60 years for a 15-year-old girl in the three areas was 1.2 to 2.4 times the rate for a 15-year-old girl in the United Kingdom. For boys aged 15 years, the probability was three to 45 times that for boys of the same age in the United Kingdom.<sup>5,6</sup>

Most injuries reported were caused by road traffic crashes.<sup>7</sup> These injuries have been attributed to the recent urbanization of the country. It has been shown that the majority of crashes with injuries involved local commuter buses (known as daladalas).<sup>8</sup>

The number of road traffic crashes appears to be increasing. In Dar es Salaam, the number of road traffic crashes from 1973 through 1978 was 12 times higher than it was from 1958 through 1962.<sup>8</sup> The number of registered cars also increased by a factor of 4.6, from 238 in 1990 to 1,086 in 1992.<sup>7</sup> Compared with rates in other developed countries, the rates of traffic fatalities and injuries in Tanzania and Africa are high (Table 4).<sup>9</sup> Most cars driven in Arusha, Tanzania were not registered there, and road intersections were found to be inadequate for vehicle-timing movements. The Arusha road network had deteriorated

and was out-of-date, traffic-control facilities were inadequate, and the municipality was found to be poorly planned, overpopulated, bankrupt, and disintegrating.<sup>7</sup>

Most other injuries reported were occupational or home injuries. As the Tanzanian economy continues to industrialize, the population is experiencing unfamiliar working conditions and environments. Increases in the number of people in the workforce (from about 700,000 people in 1987 to about 762,000 in 1990), and the diversity of imported technologies have contributed to the rise in the number of industrial injuries. For instance, there has been a 25% increase in the number of occupational injuries per 1,000 workers.<sup>10</sup> Injuries at mines and quarries, construction work sites, and in the manufacturing industry were major contributors to this increase.<sup>10</sup> In the Arusha municipality, the most frequently reported occupational injuries occurred in textile mill industries.<sup>7</sup> The most common causes of occupational injury resulted from falls or striking objects, involvement in powered transmission machinery, crime-related violence, and transportation. The average number of work days lost due to injury, was 31 in 1987–1988 and 27 during 1989–1990. The injuries tended to be more severe in community services, trade, building construction, and transport. The number of reports of fatal injuries increased from 94 in 1987 to 128 in 1990. People employed as farm laborers, railway and road-vehicle loaders, and plant and machine operators most frequently were involved in fatal injuries. Young people (aged 18–37 years) had the highest rate of injury among all age groups.<sup>10</sup>

The leading types of home injuries in Arusha were burns, fractures, and poisonings. Fractures most commonly were attributed to falls and the most vulnerable group was children. Of those injured, 64% were three to five years of age. These types of injuries can be attributed to poor environmental conditions, but they also can be associated with the rapid urbanization occurring in Tanzania.

The trend toward urbanization now is occurring among most developing nations throughout the world. However, injury mortality not only is a product of industrialization. In fact, rates in developing countries often exceed those in developed countries. For instance, overall mortality rates due to injury in Tanzania were 2.5 to 4 times higher than were those for either England or Wales.<sup>4</sup> The probability that a 15-year-old male would die from an injury before reaching an age of 60 years was 3 to 4.5 times higher for areas in Tanzania than for all of England.

The impact of injuries on African society is even more profound considering the years of potential-life-lost (YPLL), disability-adjusted life-years-lost (DALY), health-care costs (including treatment and rehabilitation), and wages lost.<sup>11</sup> In 1990, injuries were responsible for more DALYs lost than any other single health condition in sub-Saharan Africa,<sup>12</sup> and throughout the world, injuries rank among the leading causes of lost years of productive life.<sup>13</sup>

### Risk Management and Injuries

Injuries are the most common cause of mortality resulting from disasters of sudden-onset events. The greatest numbers of fatalities from earthquakes during this century have



occurred in developing countries.<sup>14</sup> However, until recently, disaster planning and relief efforts in Kenya and Tanzania have involved mostly management of disasters that are of slow-onset and/or chronic in nature.<sup>15</sup> Despite the significant public health threat caused by injuries in Tanzania, little attention has been given to the impact of disaster-related injuries. There are no major programs among donor nations, international organizations, or non-governmental organizations that address the problem of injuries despite the enormous impact they have on Kenya and Tanzania. Tanzanian nurses and physicians are not specifically trained in the skills required to manage injuries, nor does injury prevention and control exist as a specific program within either the Kenyan or Tanzanian Ministries of Health.

Risk management, injury prevention and control, and trauma care are new concepts in the public health sector worldwide. The health implications of injuries and their causes have been studied and identified with a focus on prevention only recently. Merely educating people to be more careful is not sufficient. Instead, the fundamental paradigm of injury prevention and control should be based on the premise that injuries do not occur in a random manner.<sup>15</sup> Haddon recognized that injuries can be placed in the same epidemiologic context as other diseases.<sup>16</sup> Investigation into the root causes of injury indicates that causes are multi-factorial, and effective interventions require integration across many sectors of the society and government.

### Development, Emergency Medicine, and Strategies for Risk Management

One reason for the relatively recent public health emphasis on injuries is that, as nutrition and infection-related death rates have fallen, injury has become a leading cause of death and years of productive-life-lost. The challenge for public health involving emergencies and disasters then, is to focus limited health resources on the most efficient, sustainable, and cost-effective means of minimizing risk. It is impossible to prevent and mitigate emergencies and disasters to the point of zero risk.

The general concept of injury control and prevention emphasizes the importance of developing interventions designed to: 1) prevent injury-causing events; 2) reduce or prevent injuries during potentially hazardous events that do occur; and 3) enhance survival and minimize adverse outcomes when injury does occur.<sup>14</sup> For instance, refraining from alcohol consumption before driving is an example of "pre-event" counter-measures. Those elements that focus on reducing the rate of energy transfer and the likelihood of injury and its severity are referred to as "event phase" measures. Such strategies include the use of safety belts and airbags. "Post-event" or "tertiary" prevention measures include the treatment and rehabilitation phase for injuries after they occur. The emergency care of fractures and head injuries illustrates this aspect.

An effective strategy for reducing the impact injuries has on society has been to enhance secondary and tertiary prevention. One way to do so is to implement appropriate informal and formal emergency medical care and emergency

medical service systems. The contribution of emergency medicine among developed nations is not based solely on trauma care. Emergency medical care also provides an organizational framework for the development of prehospital care that may increase patient access to care for a variety of medical and surgical complaints. In addition, emergency medical care provides a basis for the time-critical resuscitation of patients involving a wide variety of illnesses such as malaria, pneumonia, or diarrhea.

Providing emergency medical services does not always involve treating critically ill patients. In fact, most care provided in many nations in emergency departments does not constitute an emergency. Rather, emergency medical services offer a way to expedite access to acute care that may involve a wide variety of potential specialties, such as surgery, obstetrics, and cardiac care. In this sense, the emergency care provider becomes a generalist specializing in rapid diagnosis and acute care. Patients may receive obstetrical, pediatric, occupational, medical, or surgical care from a single source. The abilities of the care-givers are not limited to primary care; but, they also may care for those with more serious illnesses. Thus, these care-givers must be able to extend a level of care that normally would require hospital admission or the services of several physicians.

In addition, emergency care providers reduce the morbidity and mortality associated with illnesses and injuries that could result in progression to more serious or disabling conditions or death. For example, simple and inexpensive suturing of a lacerated tendon of a limb may prevent lifelong disability. Emergency careproviders also may identify patterns of environmental and social hazards (e.g., poisoning, chronic respiratory disease, burns, or violence-related injuries).

Many survivors of terrorist bombings also may have non-life-threatening injuries. Survivors often have penetrating and blunt soft-tissue injuries, many of which can be managed in an emergency department setting. Key clinical skills would include basic wound care (e.g., debridement, delayed primary closure, and tendon repair). These injuries also can be treated with the use of basic clinical laboratory analysis and plain film radiography.

Most importantly, emergency physicians often play major roles in disaster-relief operations.<sup>16</sup> As Rothman *et al* noted, "Although other specialties participate, emergency physicians are ideally suited to function as key players in disaster medical preparedness and response by virtue of their breadth of knowledge, developed critical care expertise, familiarity with working under conditions of stress and uncertainty, and their role in the development of emergency medical services."<sup>17</sup> Emergency care providers are well-suited to provide the medical care that is required after sudden onset events. The medical staff often fulfills an important role involving incident management, medical control, and caring for casualties.

### Proposed Priorities for Emergency Health

1. *Promote the development of surveillance systems for injuries and environmental illness among developing nations*

To reduce injuries in developing countries, public health

Course Content	Potential Trainees (and Future Trainers)
Emergency Operations Planning	Planning coordinator Planning committee members
Incident Management Systems	Planning coordinator Planning committee members
General Principles of Disaster Management	Emergency medical care providers Fire department staff Public safety / Law enforcement staff Search & rescue personnel
Disaster Communications	Ministry of Health operational staff Planning coordinator Emergency medical care providers Physicians & nurses Search & rescue personnel
Mass Casualty Management	Ministry of Health operational staff Planning coordinator Fire department staff Emergency medical care providers
Hazardous Materials Emergency Response	

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**Table 5**—Recommendations for emergency health and medical curriculum content

officials must collect and analyze data to identify the extent and nature of the most significant injury problems and to set prevention priorities. In addition, risk factors involving the host, agent, and environment should be assessed to identify effective interventions.<sup>11</sup> These assessments are needed to identify hazards and to evaluate the vulnerabilities of the population. Surveillance and trauma registries are needed to track trends over time and to measure the effectiveness of any subsequent interventions. On the basis of findings delineated previously about injuries in Sub-Saharan Africa, groups at risk and particular high hazard environments can be chosen as sites for initial intervention. Cross-sectoral working and reference groups should be established with private (e.g., industry) and public (e.g., government) sources.

### 2. *Improve access to decentralized emergency medical services at the community-level*

The basic principles of emergency and disaster medical care often are time-dependent, with the most lives saved by early intervention that may be available only when provided by the community itself. Community-based intervention also takes advantage of the many important resources available at that level. It also promotes buy-in and acceptance of governmental planning initiatives.

Community-based intervention should maintain the basic structure of health-care system as much as possible. It may include a cadre of local volunteers trained to provide basic first aid, in addition to the existing resource of traditional or modern healers. It should follow a normal medical referral process utilizing the services of existing primary care workers, dispensaries, and super-dispensaries. It also should seek to utilize other community assets such as local facilities that may include churches, schools, and private homes.

This level of planning should involve community standards and societal norms. It should seek to identify authentic community leadership and to enlist their support and guidance. It should involve a broad base of community assets including neighborhood and village volunteers.

These persons may be mobilized and organized in the form of community brigades under the direction of local, authentic leadership.

The chain of emergency health begins in the individual home and extends up to the national Ministry of Health. In order for a service and plan to be used effectively by the community, it first must be communicated effectively to the community. Communication also should occur in both directions. Health-care planners should enlist and incorporate community input into the disaster plan and exercises.

Community-based emergency response first-aid teams or brigades also may serve as effective extensions of the national health planning apparatus. They may be appointed for each village, and would serve as a first responder to assist their neighbors in times of emergency. These brigades may assist in the organization of community-level planning as well as emergency response to involve essential job elements such as the following:

- Direction and Control
- Communications
- Warning and Emergency Public Information
- Evacuation and Mass Shelter
- Health and Medical
- Emergency Census and Search and Rescue
- Resource Management
- Damage Assessment

Also, disasters frequently damage or destroy existing means of communication. This common phenomenon may lead to the relative isolation of some communities from the assessment, reporting, and coordination efforts at the national level. These resources for communication, assessment, and reporting should be integrated formally into the national and ministry level organizational efforts.

### 3. *Promote the development of community-based injury prevention and disaster mitigation strategies*

The most cost-efficient use of health-care resources is to prevent or lessen the effects of an emergency before it happens. This may be accomplished through methods that also

have been employed for prevention of other causes of adverse human health effects. These methods also are applicable to emergency prevention and control measures, and include engineering controls, educational controls, and legislative controls.

*Engineering controls*—Facilities, homes, and communities may be designed or located within areas that may minimize or lessen vulnerability and risk. Examples of these measures include safe highways, seismic, flood, or high wind hazard-specific architectural designs, flood plain management engineering projects, counter-terrorist security measures, and fire-resistant structures. Land also may be developed and maintained in a manner that will minimize risk for seismic activity, landslide, lahars, or flood.

*Education controls*—Public education can promote general hazard awareness, and can guide individual management of risk. It can serve to identify hazards, prioritize risk, offer prevention strategies, discourage development within high hazard areas, and promote safe conduct. Student education within the school system also offers a unique opportunity for instilling a lifelong awareness of emergency and disaster prevention measures.

*Legislative controls*—Legislative controls restrict and encourage behavior served to prevent disasters among vulnerable populations. These include controls involving industrial, commercial, and construction practices that may prevent technological disasters, such as hazardous material spills, building collapse, dam failure, or boat and plane crashes. Legislative controls also may be applied to guide behavior of vulnerable populations on an individual basis. It may discourage counter-productive measures such as home building within flood plains, ravines, and hillsides prone to landslide or deforestation.

#### 4. Promote the education and training of emergency responders

In order to respond effectively to the challenges that face the community, the emergency and disaster response workforce requires additional training and education. Local institutions assisted by others with extensive experience in emergency health, medical services, and disaster management, best provide this training.

The training itself should be simple. It should include the most likely first responders to everyday emergency responders (e.g., daladala and matatu bus drivers, police, fire, ambulance, nurses, and doctors). A train-the-trainers system also would allow developing nations to create a sustainable capacity for self-sufficiency and facilitate the legacy of this gain for future generations. The length of the training sessions also should be brief, so as not to cause disruption of the

attendees' ongoing work and public service. Table 5 lists recommendations for a training curriculum content according to the potential target audience.

Steps for development should be prioritized and sequential. It should be noted that no recommendations are implied for a first step of improving the existing ambulance systems in most of Kenya and Tanzania. In these nations, the financial imbursement scheme for most ambulance services is based upon a fee paid in advance of service rendered, and few can afford ambulance transport. Most hospital emergency patients are self-transported or carried by family members, private vehicle, or public transportation. In developing countries where the hospitals have inadequate equipment, diagnostics, specialty consultants, and intensive care, the action of improving formal ambulance systems may not be the most cost-effective first step. First, the infrastructure must be modified so that the victims have adequate care upon reaching their destination. A study done in Kuala Lumpur, Malaysia found that extensive prehospital systems are expensive and resources would be better spent on occupational safety, schools, or better roadways. According to their estimations, there was no significant increase in survival rates from improvement of the prehospital care system.<sup>19</sup> The University of New Mexico Division of Emergency Medicine attempted to help develop an EMS system in Costa Rica in 1990. Their conclusion was that this was an overly optimistic goal due to the lack of an effective infrastructure.<sup>20</sup>

In comparison, even experienced and developed EMS systems often are overwhelmed during disasters. Most recently, in an event similar to the embassy bombings, the Murrah Building bombing reportedly overwhelmed the Oklahoma City emergency medical services. Hogan *et al* reported little to no documentation of on-scene triage of casualties, and in fact, on-scene documentation of EMS treatment was minimal. Of the known arrival modes, only 33% of patients arrived at hospitals transported by EMS; and EMS was used largely for transport and not for providing clinical interventions.<sup>21</sup>

#### Conclusions

The recent US Embassy bombings have illustrated some of the vulnerabilities shared by the people of Tanzania and Kenya. Injuries comprise a key vulnerability and thus far, have been neglected. Injuries result from combinations of adverse environmental conditions, equipment, behavior, and personal risk factors; many of which can be modified. Ultimately, any intervention to lessen human suffering should reduce hazards, enhance local response resources, and have the desired effect of sustainability. A proactive and evidence-based approach for the prevention and control of sudden-onset, health emergencies among developing nations is proposed.

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