

# “Natural catastrophes: Disaster management and implications for the acute care practitioner”

Ana G. Alzaga, Joseph Varon, Simon Nanlohy

## Abstract

The year 2004 shook the world with earthquakes, hurricanes and *Tsunamis* in a way we would never imagine. Thousands of people died, were injured, missing or became homeless. Government agencies, health-care associations and citizens in general take part in planning for emergency preparedness and action when a natural disaster strikes a geographical area in such a devastating way. International humanitarian associations also participate in offering relief to the regions most critically affected.

Hospitals and health-care organizations play an important role during these disaster and emergency situations. It is their duty to provide an efficient re-

sponse in mass-casualty situations during natural catastrophes. For this reason, hospitals invest substantial efforts in developing disaster preparedness plans and training in coordination with public health systems and government agencies.

Natural disasters impact a population in various ways. The victims' environment may be severely affected compromising their resources and immediate needs such as food, water and their homes becoming an emotionally traumatic event for them. This significant change can also result in disease outbreaks. It is a challenge for health professionals to provide the most organized emergency response to benefit of humankind.

**Keywords:** Disaster management, natural disaster, tsunami, earthquake, hurricane, emergency management strategies.

## Introduction

On December 26, 2004, two tectonic plates beneath the Indian Ocean cracked past each other forcing the sea floor upwards approximately 10 meters and displacing trillion tons of water directing it towards Asia's southeast coastline [1]. Seismologists calculated the magnitude of the earthquake as Richter scale 9 within minutes before it occurred but never imagined the immense consequent *Tsunami* [1]. The major impact was felt by India, Indonesia, the Maldives and Sri Lanka, going into history as one of the worst natural disasters in living memory [2]. This

earthquake has been the world's biggest in more than 40 years and the fourth largest since 1900, literally redrawing the map by moving some islands by up to 20 meters [1].

In the summer of 2004, the State of Florida was shook by 4 major hurricanes becoming a great challenge for citizens and for public safety, health care, emergency preparedness providers [3]. Hurricane Charley, which was the third storm of the 2004 Atlantic hurricane season, was the strongest hurricane since Hurricane Donna in 1960 with winds up to 145 miles per hour [3]. The four hospitals in Charlotte County were damaged: limited electrical supply, extensive structural damage and no air-conditioning [3].

Natural disasters, like these, affect hundreds of countries in different magnitudes every year. Health-care institutions, government agencies and other associations take part in the planning for emergency preparedness and action when a disaster strikes a geographical area. Health-care providers need to be ready for potential natural disasters.

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From the Universidad Autónoma de Tamaulipas, Tampico, Mexico (Dr. Ana G. Alzaga), The University of Texas Health Science Center, St. Luke's Episcopal Hospital, Houston, Texas, USA (Dr. Joseph Varon), and Cikini Hospital Jakarta, Indonesia (Dr. Simon Nanlohy).

### Address requests for reprints to:

Joseph Varon, MD, FACP, FCCP, FCCM, Professor, The University of Texas Health Science Center, 2219 Dorrington Street, Houston, Texas 77030, USA. Tel. +1-713-669-1670, Fax. +1-713-669-1671  
E-mail: Joseph.Varon@uth.tmc.edu

Emergency departments (ED) and Intensive Care Units (ICUs) will be the port of entry into the medical system for many of the victims of these natural disasters. This article deals with some of the basic principles of natural disasters and the immediate management and needs of the victims from a critical care standpoint.

## What are Disasters?

Disasters occur when a hazard encountered by human populations is greater than the resistance of human population to these hazards [4]. The tradeoff between hazard and vulnerabilities delimits a disaster and foreshadows future risks. Disasters can be caused by a wide range of factors. The ones caused by forces of nature usually involve large populations and can affect widespread geographic areas [3]. The effect of an event varies with the type of hazard that causes the disaster [5].

The damage of natural disasters can be of such magnitude involving a great amount of casualties in a certain moment, more than a hospital can manage [6]. This type of incidents called mass-casualty situations or “classical ambush situations” in which the demand is greater than the supplies [6]. In these situations, ED and ICUs are the areas of the hospitals that tend to become overcrowded with limited supplies.

## Basics of Disaster Management

Disaster management involves the range of activities designed to maintain control over disaster and emergency situations, and to provide a framework for helping at-risk persons to avoid or recover from the impact of the disaster [7,8]. Hospitals are part of the essential facilities necessary for disaster response on behalf of the community [9]. Hospitals and other health-care organizations are mandated to prepare for mass-casualty events and disasters by assessing risks, reviewing emergency management plans, assessing resources and training personnel [10].

Public health and medical planning occurs, at first, at a local level. As the planning evolves the activities are integrated with the County, States and Federal efforts [11]. Local associations such as law enforcement, fire department, environmental protection departments and the local medical community are involved in dealing with a natural disaster [11]. If the natural disaster damages a large area and the amount of victims continues, federal assistance and international humanitarian relief agencies provide support [12,13].

In a hospital setting, there have been proposed several strategies and protocols with guidelines with a common goal: delivering an “acceptable” quality of care to preserve as many lives as possible in mass-casualty disasters and to prevent complications of the victims [6]. Hospitals invest substantial efforts in developing disaster preparedness plans and training in coordination with public health systems and government agencies [14-16].

Hospitals activate a useful organizational tool for the command and coordination of emergency response [17]. Such tool is called Hospital Emergency Incident Command System (HEICS) which provides a predictable chain of command, clear lines of communication, prioritized actions, accountability of performance, and harmonized nomenclature [17]. Before the arrival of the victims, the ED must be cleared of as many patients as possible as well as the hospital capacity in other units such as ICUs [17]. A triage area setup at the entrance of the ED should be lead by experienced emergency physicians, critical care physicians and mid-level surgeons [17]. The emergency department’s resuscitation must be prepared to receive the most critical patients with equipment and medications readied [17]. A much larger area for minor treatment must be organized for the victims with minor injuries apart from the main ED [17]. A third area for discharge should also be assigned for patients who are waiting for transportation to return home [17]. A designated senior trauma surgeon will make the disposition decisions to prioritize and coordinate patients to the OR or ICUs [17]. An ED command and control post is mandatory for the overall perspective of the patient load capacities of the units receiving patients from the ED [17]. This subdivision of the emergency department into large care areas with clear chains of command and lines of communication is quite helpful in the better emergency response and avoids flooding of the scene with people and equipment in a disorganized manner [17,18].

Yet, hospitals are vulnerable facilities since their occupants have a greater need for help than occupants in other buildings [9]. Therefore, every hospital must have a plan to support immobile patients in case of evacuation [19]. Natural disasters are not the main cause of evacuation but pose particularly difficult problems, such as incapacitating several hospitals of the same region simultaneously [9]. Therefore, hospitals in areas subject to hurricanes or earthquakes should invest in extraordinary planning to remain operational [9]. Mutual-aid between hospitals across different regions should be established to enable a long-distance patient and staff transfer during emergencies [9]. The Joint Commission on Accreditation of Healthcare Organizations has set standards for a cooperative disaster planning “among health-care orga-

nizations that together provide services to geographical area” [14,20].

When local hospital facilities are unavailable or unusable in the United States of America, the National Disaster Medical System (NDMS) is activated [12,21]. This system aids in managing and coordinating the federal medical response to major emergencies and federally declared disasters [3]. The disaster medical assistance teams (DMATs) are an operational mobile emergency department comprised by physicians, nurses, paramedics, physician assistants and pharmacists [3].

## Vulnerable populations

The population groups who are compromised in their ability to prepare for, respond to, and to recover from a disaster are children and elderly [22, 23]. They require special planning when establishing emergency management strategies and it is a responsibility of emergency managers, health-care providers, emergency responders, agencies dedicated to the health and well-being of children and elderly [22,23].

The basic anatomic and physiological difference between adults and children make the latter more vulnerable and become symptomatic earlier when exposed to disaster situations [23]. There may be culture or language barriers that could delay or compromise medical care. Children rarely carry a source of personal identification or of medical issues. The prevalence of children with special health care needs is higher compared to the general population [23].

For these reasons, a new algorithm pediatric triage has been proposed which includes four priority categories: I-immediate care/shock room, II-urgent care/emergency department, III-delayed care, IV-unsalvageable [24]. The most important aim of triage is to rapidly identify the patients in category I [24].

The Pediatric Disaster Life Support (PDLS) was created at the University of Massachusetts Medical School with the objective of training health-care providers in a 2-day course the multiple aspects related to disaster care in children [25]. Federal, state and local organizations have formed the Emergency Medical Services of Children (EMS-C) as an effort to reduce death and disability for children [25].

Elderly who are house-bound, socially isolated, with impaired mobility and dependant on medications, medical treatments or nursing care are the most vulnerable [22]. Especially if the health-care conditions limit the individual’s independence and increase the need for assistance and dependency. The disasters that can impact

the elderly population range from hurricanes, floods, tornados, earthquakes, and heat and cold waves.

## Infectious Diseases

There is a strong correlation between disasters and infectious diseases [26]. Disasters produce compromised living conditions and cause populations to evacuate their surroundings [26]. This significant change in their environment can act as a precursor to an infectious disease outbreak overwhelming the surge capacity of the health-care system and allowing the disease to spread.

Millions of people from the countries bordering the Indian Ocean affected by the *Tsunami* are now under serious threat of disease outbreaks as result of damaged water and sanitation systems, sea water contamination and congested conditions of the people displaced according to the World Health Organization [2]. There is an immediate risk for waterborne disease such as cholera, typhoid fever, shigellosis, and hepatitis [2]. The most important preventive measure is to provide of safe drinking water. These areas are usually endemic for tuberculosis and malaria as well as intestinal parasite infestation [27].

Clinicians must be alert for even simple injuries as potential sources of infection in natural disaster conditions. The proper treatment of fracture, simple soft tissue injuries and lacerations should not be dismissed since the infection of such wounds can lead the patients to sepsis and septic shock if not treated on time [27].

## Economical and social impact

There is a tight relationship between disasters and development [5]. Disasters can impede the effectiveness of development resource allocation [28]. The damage can be evaluated and classified in 4 different categories: resource loss; program interruption and prioritizing crucial resources to other, shorter-term needs; negative impacts upon investment; and/or disruption of the local businesses [28].

The victims of severe natural disasters face inevitable changes in their environment such as reduced access to food, water, fuel; uninhabitable homes; among others [29]. There are significant differences in rural and urban environments. There is usually a greater ability to manage a chronic ailment in the urban environment [29].

The Sumatran earthquake took over 146,000 deaths, 525,000 people were injured, over 20,000 missing, 1.6 million displaced and over a million homeless [2]. This earthquake and consequent *Tsunami* destroyed billions

of dollar's worth of properties in December of 2004 [30]. The *Tsunami* ravaged the Bay of Bengal reminding the world the terrible cost of ignorance [30]. Countries such as India have committed to collaborate with Indonesia, Thailand and Myanmar to eventually build a reliable *Tsunami* warning network in the region [30].

## Psychological issues

There is a wide spectrum of psychological reactions which will impact the management of a natural disaster [31]. Normal people experience a variety of behaviors under abnormal circumstances that will either help or hinder efforts [31]. Emergency medical workers with managerial responsibilities must be aware of these factors and should train to handle them effectively [31].

An inevitable disaster is emotionally traumatic for everybody involved and can later stage for psychiatric illnesses. For this reason, mental health providers recommend early psychological intervention for victims of disasters to reduce distress through a cognitive behavioral therapy. This therapy decreases the incidence, duration, and severity of acute stress disorder, post-traumatic stress disorder and depression in survivors of disasters. The psychological first aid and triage will reduce the potential for significant psychological morbidity associated with a mass disaster [31].

## Ethical issues

Disasters pose a perceptible challenge to the integrity of both emergency response systems and health professionals [32].

Emergency health care providers encounter the opportunity to reaffirm their commitment to their profession and to their patients through the adoption of a virtue-based ethic. Virtue honors the fundamental humanity of all patients, the respect due to colleagues, and the noble mission of safeguarding public health in times of disaster [32].

## New technology in disaster management

The effective response of out-of-hospital disasters requires systems to share relevant information that will enable responders to rapidly collect, process, and distribute information [33]. Information technology has increasingly been acquiring a more important role in sharing information, especially in out-of-hospital response.

Wireless peer networks offer a promising solution to many of the technical challenges of using information technology through ad hoc wireless routing networks and peer-to-peer application architectures [33].

## Conclusions

Natural catastrophes will continue to shake the world whether if we are prepared or not. It is our duty, as health professionals to be prepared for these types of emergencies through disaster response plans and training in coordination with public health systems and government agencies. There are several helpful tools that provide predictable chains of command, clear lines of communication, prioritized actions in order to offer the best quality of service to the large amount of victims affected in these disasters with the supplies available.

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