



Mass Casualties Management in Low-Income Countries

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15.1 Disasters in Low-Income Countries

The terms *disaster* and *mass casualty incident* (MCI) are often used as synonyms, but they describe different entities in terms of discrepancy between the number of victims and the treatment capacity of the community [1]. In MCI, the number of casualties may strain the responding facilities, but resources are sufficient to cope without outside support. A disaster is a catastrophic event which disrupts the social and community infrastructures and extraordinary means are necessary to cope it, resulting in the need for support from the outside [1].

Average mortality for all types of natural disasters increased to 69,800 per years in the decade 2006–2015, up from 64,900 between 1996 and 2005. Average deaths per disaster also rose, up to 194 from 187. These increases reflect the impacts of two megadisasters in the most recent decade (Cyclone Nargis in 2008 and the 2010 Haitian earthquake) up from one megadisaster in 1996–2005 (the 2004 Indian Ocean Tsunami) [2]. The increasing disaster rate has disproportionately affected poorer nations and communities contributing to the downward spiraling effect on the economic, political, and public health conditions of several developing nations [1]. According to an analysis of the US Geological Survey data, since 1976 there have been 99 earthquakes of magnitude 7.0 or greater, 26 of them caused more than 1000 deaths, but only five of these disasters occurred in rich or middle-income countries [3]. Furthermore since 2001, while just 19% of violent earthquakes

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worldwide have resulted in more than 1000 deaths, nearly 90% of them have been in poor countries [3, 4].

The Centre for Research on the Epidemiology of Disasters (CRED) created an Emergency Events Database (EM-DAT) that shows that also the severity of the impacts of natural hazards are directly related to income and development levels (Fig. 15.1). This is particularly evident for disaster mortality. The poorer the country, the higher the number of disaster deaths there are likely to be. Of the 1.35 million people killed by natural hazard over the past 20 years (more than half in earthquakes, with the remainder due to weather- and climate-related hazards), the overwhelming majority was in low- and middle-income countries, that have the highest numbers killed per disaster and per 100,000 population [2]. On average 327 people died per disaster in low-income countries in the past 20 years, almost five times more than the average toll in high-income countries (Fig. 15.2). Furthermore, none of the high-income countries which appear on the 2015 top ten list for economic losses from disaster appear among the countries suffering the highest disaster mortality [2]. Finally, the nonprofit GeoHazards International says that over the past few decades, rich countries have reduced mortality from earthquakes at a rate of ten times faster than poor countries [3].

Today some 613 million people live in 31 low-income countries. Many of these countries are either in post-conflict or conflict situations and lack the resources to account adequately for their disaster losses or to reduce their vulnerability to



Fig. 15.1 The 20 most deadly disasters of the last 20 years (1996–2015). From *Poverty and death: disaster mortality 1996–2015* by the Centre for Research on the Epidemiology of Disasters (CRED) [2]

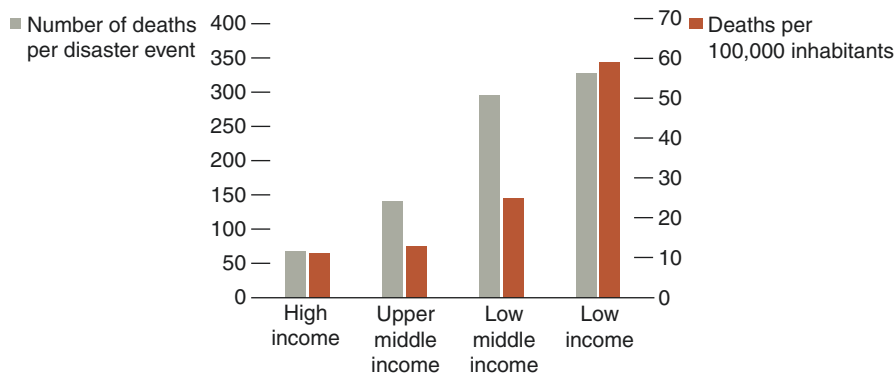


Fig. 15.2 Number of deaths per disaster event compared to the number of deaths per 100,000 inhabitants per income group, 1996–2015. From *Poverty and death: disaster mortality 1996–2015* by the Centre for Research on the Epidemiology of Disasters (CRED) [2]

disasters. Thus disaster mortality in low-income countries is probably even higher than indicated in the EM-DAT [2].

15.2 Trauma Care in Low-Income Countries

Planning disaster preparedness and response for mass trauma is a huge undertaking for developing countries, because they often lack of an organized, efficient and effective trauma system. A trauma system is a regional coordination system that delivers the full range of care to all injured patients and it is integrated with the local public health system, making efficient use of health-care resources [1]. An efficient trauma system includes injury prevention, prehospital care, acute care facilities, and posthospital care. In low-income countries, there is gross disparity between trauma services in various portions of the country, there is no dedicated national lead agency to coordinate various components of trauma system, no mechanism for accreditation of trauma center exists, and there is an inappropriate resource allocation [1]. In fact, 90% of the world's trauma deaths occur in low- and middle-income countries (LMICs) [3].

In order to augment the capacity to provide trauma care in LMICs, in 2004, the World Health Organization (WHO) issued the Guidelines for Essential Trauma Care. The Guidelines outlines 11 essential trauma care services that should be available to every injured person around the world regardless of their country's income status (Table 15.1). These guidelines have been implemented in a number of countries and studies have shown some benefit in terms of trauma capacity [3]. However, to make improvements in trauma care in LMICs, health-care facilities had to be assessed in order to identify areas for targeted intervention. Then in 2007 the WHO's Global Initiative for Emergency and Essential Surgical Care developed the Tool for Situational Analysis to Assess Emergency and Essential Surgical Care (TSAEESC)

Table 15.1 Essential trauma services

Obstructed airways are opened and maintained before hypoxia leads to death or permanent disability
Impaired breathing is supported until the injured person is able to breath adequately without assistance
Pneumothorax and hemothorax are promptly recognized and relieved
Bleeding (external or internal) is promptly stopped
Shock is recognized and treated with intravenous (IV) fluid replacement before irreversible consequences occur
The consequences of traumatic brain injury are lessened by timely decompression of space occupying lesions and by prevention of secondary brain injury
Intestinal and other abdominal injuries are promptly recognized and repaired
Potentially disabling extremity injuries are corrected
Potentially unstable spinal cord injuries are recognized and managed appropriately, including early immobilization
The consequences to the individual of injuries that result in physical impairment are minimized by appropriate rehabilitative services
Medications for the above services and for the minimization of pain are readily available when needed

to evaluate surgical capabilities of facilities in LMICs. The survey contains four section: infrastructures, human resources, interventions, emergency equipment and supplies. In response to the need for a more streamlined tool to evaluate surgical care, Surgeons Overseas modified TSAAEESC to create the simplified Personnel, Infrastructures, Procedures, Equipment and Supplies (PIPES). Afterwards, the need for a more specifically focused tool on emergency and critical care led to the development of the Emergency and Critical Care (EaCC) tool, which cover eight domains: infrastructures, human resources, training, drugs, equipment, routines, guidelines, support services [3]. These survey tools represent snapshots of workforce and hospital-based resources required to provide surgical care and, as trauma care relies on a subset of these resources, these assessments also provide information on components required for adequate trauma care [3].

Because substantial evidence exists in higher-income settings that the establishment of trauma system significantly decreases injury-related mortality, and some evidence suggests that this holds true in lower-resources setting, several studies tried to identify the more critical weaknesses in trauma systems of LMICs through the use of these tools [3]. Targeted corrective action addresses system weakness through initiatives that maximize benefit while minimizing costs [5]. In this setting, future efforts to improve trauma outcomes in these countries should address the following areas:

- *Prehospital care.* Prehospital trauma systems are rudimentary in many LMICs and currently an important proportion of prehospital care and transport is provided by layperson bystanders and commercial drivers. In fact, 80% of all trauma-related death in LMICs occurs in the prehospital setting [5]. It would be

necessary to implement training programs for laypersons as first responders and to allocate material resources to them. Point-of-care interventions may have important survival benefits and hospital care may be futile without proper stabilization on the field [3]. The training for first responders should include external hemorrhage control, airway management, splinting, spinal immobilization, basic patient triage, and patient extrication [6]. The development of certified courses and of standardized treatment protocols is useful to improve standards of care. Because of the low level of literacy and health knowledge of layperson in LMICs, local physicians and health-care providers should teach courses in laypersons' native language to reduce language barriers [6]. One method to disseminating training materials and increasing basic first aid knowledge among laypersons is also by leveraging technology [6].

- *Primary care facilities availability in district hospital.* In LMICs, policy makers are rationally allocating their limited resources to higher-level referral centers. Surgical and trauma capacity is most limited in personnel, infrastructure, and procedures at rural and district facilities. In these settings, an ICU often consists of pressurized air or oxygen, but rarely mechanical ventilation or renal replacement therapy is present. Fifty percent of the patients have no monitors, necessary disposable material (EEG stickers, tubing), or electricity [7, 8]. Strengthening district hospitals, at list to a point of patient stabilization for transport to a referral center, is necessary [3]. Interventions should focus on increasing the number of surgical and anesthesia resources and personnel on rural areas [5].
- *Improvement in training of physicians and development of established protocol or checklist for the management of major trauma.* A trial in Trinidad and Tobago demonstrated a 50% decrease in injury mortality at a local tertiary care hospital after physicians attended the Advanced Trauma Life Support course. Similarly a project that trained paramedics in basic life support skills in Iraq and Cambodia dropped local trauma mortality rates from 22.6 to 13.7% in 2 years [2].
- *Posthospital care.* Rehabilitation services should also be addressed as trauma-associated morbidity remains significant and is likely to increase when mortality decreases [3].
- *Prevention programs.*

One potential pitfall in the improvement of trauma systems in LMICs is to attempt to replicate systems that have been successful in high-income countries. LMICs suffer from severe constraints of available resources, both in structural and human fields, and in these settings initiatives to improve trauma systems should be developed within the context of the resource limitations of the targeted region to decrease financial stress and inefficient resource allocation [9]. However, an estimated two million lives annually could be saved if injury mortality rates in LMICs were the same as that of high-income countries. The economic benefit from such a reduction in mortality and morbidity would be substantial, as road traffic injuries alone cost countries between 1 and 5% of their gross national product annually [3].

15.3 Mass Casualties in Low-Income Countries

The lack of a structured trauma system in low-income countries is reflected on the scarce ability to face a MCI or a disaster. During the Pakistan 2005 earthquake, approximately 75,000 people were killed and 70,000 were injured. In this occasion, lacking an integrated trauma system and a mass casualty preparedness, a “cluster approach” was adopted with several criticisms: failure to prioritize cross-cutting issues, weak information management, weak inter-cluster coordination, lack of centralized command, and inappropriate resource allocation (out of the 1698 patients air-ambulated to Military Hospital Rawalpindi, only 50% actually required hospitalization, the rest either did not require inpatient care or were dead on arrival) [1]. Similarly during the earthquake that struck Haiti in 2010, the initial emergency response was delayed. The most important reason was that the earthquake destroyed the location of Haitian government offices and the main Haitian Hospital (University Hospital in Port-au-Prince). Many agencies around the world participated to improving resources, but this “clustered” medical teams had no way of knowing which hospitals had space or equipment, and communication between centers was absent for the first few days [1].

An analysis of the features of the early response to these and other disasters in low-income countries allowed to identify many criticisms [1, 8, 10]:

- Lack of national agency for disaster management
- Inadequate prehospital care, due to the lack of an efficient trauma system
- Lack of national high level trauma care facilities
- Lack of facility standard accreditations
- Lack of a pre-defined disaster management plan
- No disaster drills/simulations

Tight fiscal budget constraints, coupled with a lack of vision of the increasing probability of a disaster, have led governments to postpone progress on this issues to a later time. However, governments should consider that preparedness funding routinely returns five dollars for every dollar spent [3].

The Third UN World Conference on Disaster Risk Reduction, held in Sendai, Japan in 2015, resulted in the adoption of the Sendai Framework for Disaster Risk reduction 2015–2030. It identified four priorities for action for governments around the world [2]:

1. Understanding disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics, and the environment
2. Strengthening disaster risk governance at the national, regional, and global levels to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation, and reconstruction

The actions necessary to implement MCIs management are often corollaries of the previously exposed actions necessary to develop an efficient trauma system. An effective trauma system may potentially manage mass casualty incident better [4]. However, an approach that works well in one country may work less well in another, and not all approaches are equally acceptable to all governments [9].

The Resource-Poor Setting panel of the Task Force for Mass Critical Care in 2014 outlined suggestions for capacity building and mitigation, preparedness, response, reconstruction, and recovery in MCIs in LMICs. Many of the capability building and mitigation suggestions are relevant to policy maker and health administration, whereas preparedness and response primarily relate to clinicians. The suggestions include capacity building in public health, education for families, community health-care workers and clinicians in addition to infrastructure support such as transportation and communication system. In order to mitigate the need for critical care, they suggest the development of simple triage tools, protocols, and care guidelines modified to resource limitations that can be used by health workers with limited clinical backgrounds. Furthermore, they stress the importance of the education and training of resuscitation, evacuation and transport of critically ill, expanding prehospital support in the community through education of medical and non-medical laypersons. They confirm the need of a minimal level of critical care at district or regional hospital facilities. Furthermore, local authorities should establish formal relationship with coalitions of academic medical centers, professional societies, governmental organization, and NGOs prior to an actual event in order to develop and maintain effective communication with the goal of assessing the need for assistance and of developing planning and preparation for potential disaster event [9, 11–15].

15.4 Take Home Message

- Low-income countries are the most exposed to disasters, because they have both the highest rate of disasters and the highest numbers killed per disaster and per 100,000 population.
- Low-income countries often lack an organized, efficient and effective trauma system and this is reflected on the scarce ability to face a MCI or a disaster.
- To make improvements in trauma care in LMICs, health-care facilities had to be assessed in order to identify areas for targeted intervention and initiatives that maximize benefit while minimizing costs.
- To make improvements in trauma care in LMICs, it would be necessary to implement training programs for laypersons as first responders, to allocate material resources to them, to improve in training of physicians, and to develop established protocol for the management of major trauma.
- Strengthening district hospitals, at list to a point of patient stabilization for transport to a referral center, is necessary.
- The actions necessary to implement MCIs management are often corollaries of the actions necessary to develop an efficient trauma system.

- The Resource-Poor Setting panel of the Task Force for Mass Critical Care in 2014 outlined suggestions for capacity building and mitigation, preparedness, response, reconstruction, and recovery in MCIs in LMICs. They involve both clinicians and policy maker.
- Governments of low-income country should invest in trauma-focused education and in disaster preparedness as the economic benefit from a reduction in mortality and morbidity would be substantial.

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