

## Disaster planning for mass trauma care: implications for low income countries

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Disasters are an important public health issue with an excessive mortality, high survivor morbidity and functional limitations on daily living. According to the International Strategy for Disaster Reduction (ISDR), the total number of reported people killed between 1991 to 2005 were 960,502 [1]. The total number of reported people affected by a disaster in the same time period was 3.5 billion with economic costs totaling \$1193 billion dollars [1]. The number of disasters around the world has increased by more than four times in the last 20 years [2]. Furthermore, the increasing disaster rate has disproportionately affected poorer nations and communities [2]. This has contributed significantly to the downward spiraling effect on the economic, political and public health conditions of several developing nations.

Planning disaster preparedness and response for mass trauma is a huge undertaking for developing nations. Tight fiscal budget constraints, coupled with a lack of vision on the increasing probability of a disaster, have led governments to postpone progress on this issue to a later time. There can be no disaster management without the development of an organized, efficient and effective mass trauma care system. A failure of trauma systems development will inevitably result in a failure of disaster care. This article gives an overview and importance of trauma systems and hospital management in the event of disaster in low and middle income countries. Natural disasters like earthquake in Pakistan, 2005 and current 2010 Haiti earthquake are taken as practical examples to provide importance of a trauma system in a low income setting.

### Definitions

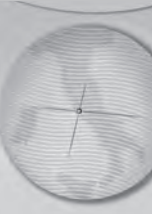
The terms *disaster* and *mass casualty* incident

are often used interchangeably but describe different entities in the same spectrum. In essence, there is a discrepancy between the number of victims and the treatment capacity of the community [3]. A *mass casualty incident* (MCI) is more limited in scope. The number of casualties in an MCI may strain the responding facilities, but resources are sufficient to cope without outside support [4]. A *disaster* is a catastrophic event that disrupts the societal or community infrastructure to such a degree that extraordinary means are necessary to cope, resulting in the need for support from the outside [5]. Joint Commission on Accreditation of Healthcare Organizations (JCAHO) defines a disaster from a responder's point of view as something that not only disrupts patient care but also increases demands upon the institution's services and disrupts the environment of care [6].

### Disaster management

Attempting to bring an organized effort to an inherently chaotic situation is a daunting task.

As a corollary to the "Damage Control Principle" that surgeons use when dealing with operative trauma on the single-patient level, the initial phase to disaster management should be a rapid assessment and containment of the inciting event with protection of the threatened population from further damage. For example, in the event of an earthquake, the threatened population should be shifted to pre-allocated staging areas away from city centers that are at risk of worsening damage from aftershocks. Rapid assessment should be categorized according to the level of a graded response. An example of this is shown in Table 1. This would run in parallel with 'search and rescue' operations in a coordinated fashion. Even



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though a detailed discussion of various federal government agency responsibilities and logistics is beyond the limits of this article, the trauma system administrator should be aware of basic disaster principles and management.

The Incident Command System (ICS) has been hailed as “best practice” and determined that it should be the standard organizational tool for all disasters worldwide [7]. The modular nature of this system for governmental agencies allows flexibility in being amenable to ramping up or down according to the size and nature of the event (Figure 1).

The effective use of the ICS in integrating and coordinating first responders and multi-jurisdictional agencies at the scene of disasters has led to the recognition that the same principles should prove equally effective when applied to an individual receiving hospital. This has

culminated in the development of the Hospital Emergency Incident Command System (HEICS) that was first envisioned in 1991 by the State of California Emergency Medical Services Authority [8] (Figure 2). By using the same terminology as the ICS, HEICS enables a more integrated and seamless response between first responders and the receiving healthcare institutions. It has been shown to reduce some of the initial confusion and chaos experienced by the hospital at the onset of a medical disaster [8]. Job-action sheets are preprinted for each functional position and are immediately distributed by the incident commander at the start of a disaster response. This informs the responding personnel what they need to do, when to do it, and who they report to. Thus, the entire process at the disaster receiving hospital is streamlined to deliver efficient mass casualty care.

Table 1. Example of disaster assessment.

Level 1 Disaster – Local Resources only required
Level 2 Disaster – Regional Resources required
Level 3 Disaster – State/Provincial Resources required
Level 4 Disaster – National/Federal Resources required
Level 5 Disaster – International Resources required

Figure 1. Incident Command System (ICS) model (accessed from www.fema.gov).

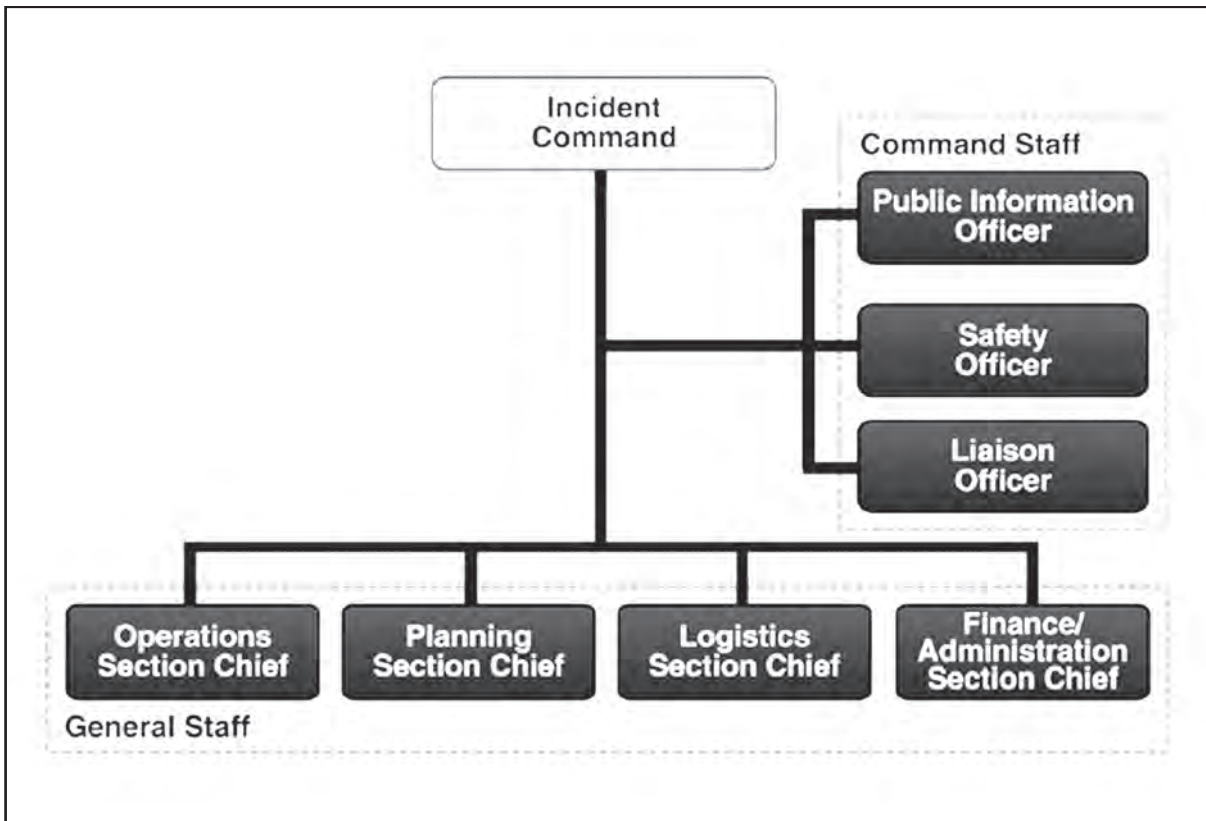
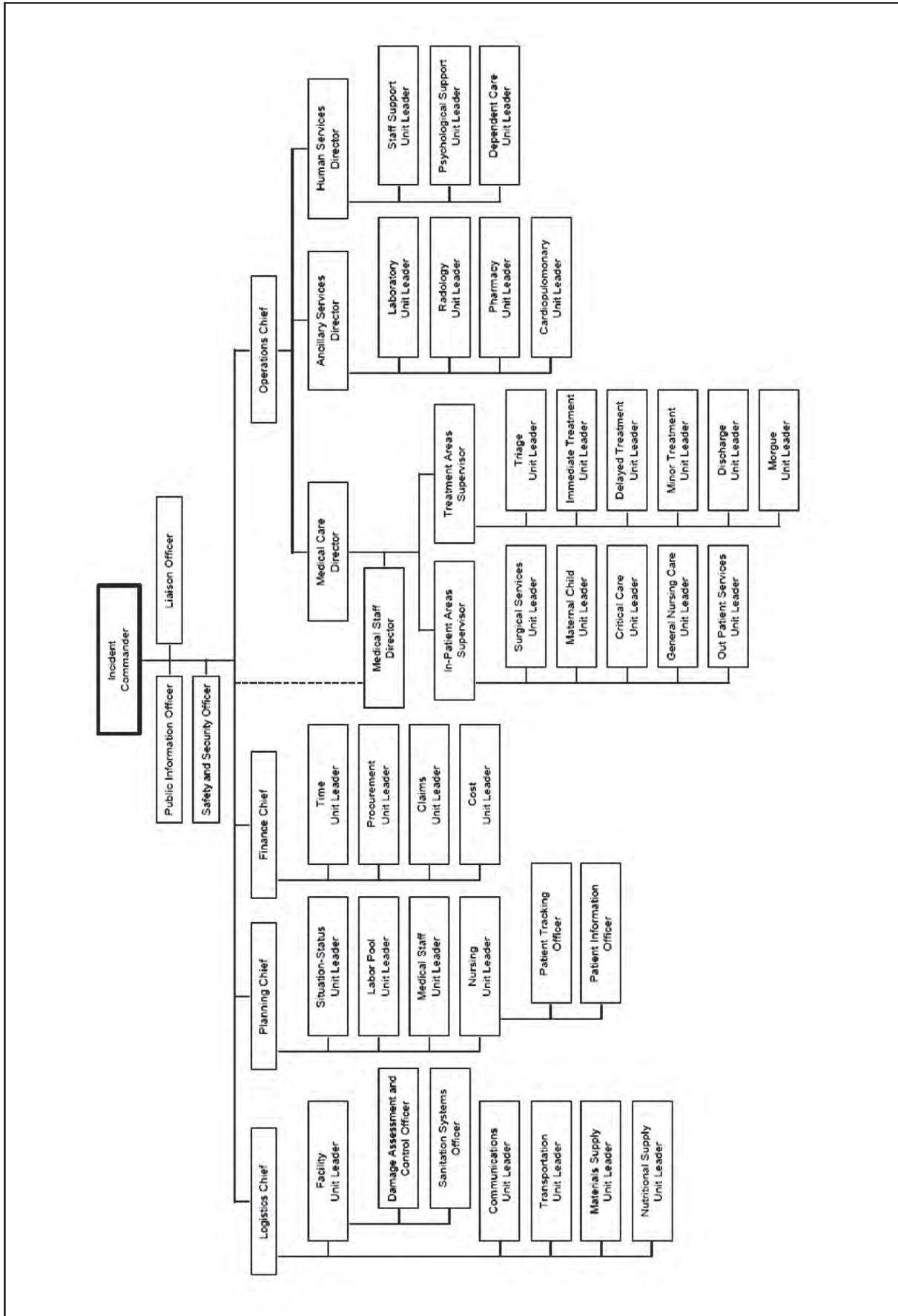
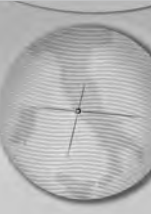


Figure 2. Hospital Emergency Incident Command System (HEICS) model (accessed from www.heics.com).





### Trauma System

A trauma system is an organized, coordinated effort in a defined geographic area that delivers the full range of care to all injured patients and is integrated with the local public health system [9]. Trauma systems are regionalized, making efficient use of health care resources [9]. They must emphasize the prevention of injuries in the context of community health. At the center of this system are four essential elements that include injury prevention, pre-hospital care, acute care facilities, and post-hospital care. Ultimately, the nationwide development of a trauma system would allow for seamless and effective care across a nation with the ability to expand to meet the medical needs of a community from a man-made or natural disaster.

The best organizational structure for a trauma system in disaster situation should be a tiered approach. This would allow the transfer of the sickest patients to close proximity hospitals for triage, initial stabilization and live-saving procedures with subsequent pre-arranged agreements for transfer to the next tier. This is in parallel to the concept of “split forward surgical teams”, as developed by the US army for dealing with mass casualties, that resulted in much better outcomes than previous models [10]. Although transferring the sickest patients to the least-equipped, more abundant hospitals might seem like a paradox, the concept of tri-modal death distribution – as advanced by the ATLS Program of the American College of Surgeons Committee on Trauma – would dictate that early deaths could be salvaged due to reduction of time to initial stabilization [11]. The tiered approach would also prevent the best institutions from being overwhelmed with a chaotic influx of patients resulting in fragmented, inefficient care. For such tiered approach to function effectively, disaster planning should allow for a system of hospital designation according to proximity and level of care. Advanced level of care hospitals with intensive care units should have mass critical care contingency planning to accommodate a patient census to at least three times usual and for at least 10 days without external assistance [12].

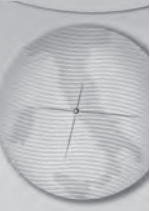
### Mass casualty care in low income countries

In envisioning a trauma system for low income countries, their current models should be taken into account. Low income countries like India, Pakistan, Indonesia, and Haiti (especially in the wake of its recent disastrous earthquake) do not have a comprehensive trauma system. There is gross disparity between trauma services in

various portions of these countries. There is no dedicated national lead agency to coordinate various components of a trauma system [13]. No mechanism for accreditation of trauma centres and professionals exists resulting in a lack of quality improvement measures. Disaster drills are not conducted and hospitals are ill-equipped to deal with a surge of patients.

Let us take the example of the Pakistan 2005 earthquake. In the context of a low income country, mass trauma management of the October 2005 earthquake clearly had a lot of problems. The earthquake killed approximately 75,000 people, injured another 70,000, and left an estimated 3.5 million people homeless [14]. As no disaster response organization existed to respond to major natural disasters, it was not surprising that the army took charge initially of relief operations [14]. There was significant involvement of US and NATO forces in the response 36 hrs later to provide needed logistical support for rescue and relief operations. However, a “cluster approach” was adopted with sectoral or thematic clusters e.g. health cluster, food & nutrition, water & sanitation. This approach has several criticisms to it: failure to prioritize cross-cutting issues, weak information management, weak inter-cluster coordination and lack of centralized command [14]. Lack of a trauma system resulted in inappropriate resource allocation. For example, out of the 1698 patients air-ambulated to Military Hospital Rawalpindi, Pakistan, only 50% of these patients, actually required hospitalization. The rest either did not require inpatient care or were dead on arrival [15].

The earthquake that struck Haiti on Jan 12, 2010 caused even more damage and destruction than the Pakistan earthquake noted previously. An estimated 230,000 people had been identified as dead, an estimated 300,000 injured, and an estimated 1,000,000 homeless with these numbers still rising [16]. Majority of injuries were orthopedic in nature consisting of fractures, soft tissue injuries and growing problems of extremity sepsis. Even though it is premature to fully analyze a situation in its early recovery phase, there are some salient aspects of the disaster response that can be commented on. First of all, the initial emergency response was delayed. The most important reason for delay was the location of Haitian government offices and international organizations in the capital city, near the earthquake’s epicenter. The result was that Haiti lost a lot of the very resources that could have been used to marshal a more



effective initial response. In addition, many of those resources weren't very developed to begin with. The country lacked accessibility to health care even before the disaster struck. Health care was provided in large part to rural Haiti by the non-governmental organization known as Partners in Health (a Boston-based group that has been working in Haiti for 20yrs) [16]. Urban Haiti depended largely on one hospital: University Hospital in Port-au-Prince and three quarters of the facility was destroyed in the earthquake [16]. Health care practitioners and many agencies around the world (e.g. World Health Organization, International Federation of Red Cross & Red Crescent, CDC, etc.) participated greatly in providing resources, field hospitals, medications, food, water and sanitation services. However, these "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 [17]. The result was an ad hoc collection of medical facilities ranging from military ships and semi-functioning hospitals to tiny makeshift clinics in the streets running without coordination and effective allocation of resources [17]. A summary of some features of the early response to the Haitian earthquake disaster and some recommendations are listed in Table 2.

**Implications and recommendations**

Disasters are a big problem in the world today. Adequate preparedness and planning is needed. We should consider the following steps to ensure

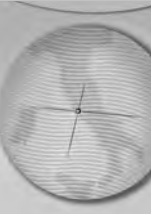
that communities are better prepared for a mass-casualty event:

- Ask local law enforcement and emergency managers to brief the medical community so that physicians understand the magnitude of the threat in the area.
- Develop a plan of action by identifying capabilities, actions required, gaps, and budget requirements.
- Equip, train, exercise, and revise disaster plans for both the community and the family.
- Protect the workforce and make sure it will show up in the event of an emergency; plan and discuss what protective actions will be in place for them.
- Make sure everyone understands their roles and responsibilities under the Incident Command System.
- Develop a legal framework to support disaster care, including credentials and privileges where you might not have them, and changing standards of care in an austere environment when demand exceeds supply.
- Manage nationally while preparing at the local level.

Although certain aspects of disaster management are federal in nature, preparedness is local. Ultimately, local responders and the local population must deal with and experience the consequences of a disaster. Physicians, law enforcement personnel, emergency management teams, emergency medical services, and others must have a plan for working together.

**Table 2. Haiti emergency response features & recommendations.**

<b>Emergency Response System Features</b>	<b>Recommendations</b>
Lacks national agency for disaster management	Establishment of national agency for disaster management (with location away from disaster prone areas)
Prehospital care inadequate	Investment in a low cost ambulances and rapid communication system
Lacks national high level trauma care facility	Development of nationally acclaimed high level trauma facilities
Lacks facility standards accreditation	Establishment of committee for oversight of hospital capabilities and accreditation
No disaster drills/simulation	Equip, train and review hospital staff for disaster drills



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