REVIEW ARTICLE
Prehospital trauma care services in developing countries

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ABSTRACT
Trauma is a leading cause of death and disability especially amongst young people. Prehospital trauma care service remains a dynamic field of medicine for care of trauma patients. The goal of prehospital emergency care system should be to match the needs of the patients to the available resources so that optimal, prompt and cost-effective care can be offered. For bridging the wide gap between the actual and expected level of care, the urgent need must be appreciated by the community, administration, medical professionals and very positive steps should be taken to meet the future challenges. The authors included a “snapshot” of current articles applicable to prehospital trauma care in developing countries. The current review aims to explore the concept of “golden hour” and objectives, controversies and existing status of prehospital trauma care service using the recent evidence based literature in developing countries.

Keywords: Prehospital trauma care service; Trauma care; Golden hour; Prehospital trauma

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INTRODUCTION
Management of trauma is a neglected field in developing nations.1 The World Health Organization (WHO) estimates that 5.8 million deaths annually are attributable to injuries, 90% of which occur in developing countries 2 with mortality rates expected to increase as these nations further develop, urbanize, and industrialize.3,4 In addition, an overwhelming proportion of these deaths occur before patients even reach the hospital.5 Two third (60.7%) of the accident victims belonged to the age range of 15 to 44 years.6 This is the economically productive age-group and major financial support for their families. Lack of medical attention attributed to 30 per cent of deaths at site and 80 per cent of the remaining patients died within an hour of injury (golden hour).7 Most of these deaths are due to airway management failure, respiratory failure or continuing haemorrhage that are preventable causes with appropriate prehospital and subsequent hospital emergency care.8 As a result, governments in developing countries have been attempting to establish and strengthen prehospital emergency medical systems that can provide patients with prehospital basic life support (BLS) and transportation to higher care.9

Unfortunately, prehospital trauma care is not available to most of the world’s population and India is no exception.

THE CONCEPT OF “GOLDEN HOUR”
One of the most well known principles in medicine is “golden hour” of trauma, which specifies that patients outcome are improved when patient is transported to a designated trauma centre within an hour of injury. Nearly all emergency medical services (EMS) providers can remember their first exposure to the concept of the “golden hour” with the idea that trauma patients have significantly better survival rates if they reach surgery within 60 minutes of their injury. The “golden hour” summarized by the 3R rule of Dr Donald Trunkey, an academic trauma surgeon, “Getting the right patient to the right place at the right time.”10 But the concept of golden hour is still questionable in most of countries.

In a 2001 literature review, Lerner EB et al.,11 determined the origin of the term “golden hour”. They cited a series of studies discussing the golden hour, but noticed that those studies often referenced one another and were not accompanied by supporting data or references to other studies. Most frequently the phrase is attributed
to Cowley, who used it in 1973 with reference to helicopter transport of injured patients in Maryland. A retrospective cohort of adult patients with severe head injuries was conducted to determine the effect of patient arrival within the golden hour on patient outcomes. Study outcomes were in-hospital mortality and survival to hospital discharge without requiring transfer for ongoing rehabilitation or nursing home care. Authors concluded that, a survival benefit exists in patients arriving earlier to hospital after severe head injury but the benefit may extend beyond the golden hour. There was evidence of improved functional outcomes in patients arriving within 60 min of injury time. Further, according to National Emergency Medical Services Education Standards; “golden period” is still listed as a guideline for teaching trauma care. Although it would seem intuitive that treating patients more rapidly results in reduced mortality and secondary injury but the evidence for the “golden hour” in general and timing of reaching hospital on patient outcomes is limited. Recently, prehospital management and outcome of polytrauma patients was compared between two countries (Scotland and Germany) with differing approaches toprehospital management. The mean time from an injury to arrival to the emergency department (73 vs. 247 minutes) was longer for the Scottish patients. Despite variation in prehospital transfer times and interventions, no significant difference was demonstrated in revised trauma score upon arrival, or for the unadjusted mortality rates. Prospective data from 146 EMS transport agencies over a 16 month period from 2005 to 2007 were analyzed for 806 trauma deaths in a pool of 3656 patients (22% mortality). After multivariate, subgroup, and instrumental analyses, no significant association was found between time and mortality for any EMS interval (activation, response, on-scene, transport, and total time) among injured patients with physiologic abnormalities. Similarly, data by Lichtveld et al confirms what was noted in a Dutch single-centre prospective study in 2007. Among other conclusions, this study also noted “the time interval between the accident and arrival at the hospital does not appear to affect the risk of death.” Further, the pressure to arrive at the hospital within the “golden hour” may increase the number of emergent transports, which have been demonstrated to increase the risk for collisions resulting in injury and fatality.

**OBJECTIVES OF PREHOSPITAL TRAUMA CARE**

The prehospital trauma care process consists of six key steps: detection, reporting, response, on-scene care, care in transit and transfer to definitive care inspired from the EMS-symbol or so-called ‘Star of Life’ symbol created by the US National Highway Traffic Safety Administration which presents six EMS functions. Objectives of prehospital trauma care involve prompt communication and activation of the system, proper actions at the scene of the crash by first responders, and the prompt response of the system or simply offer fastest possible basic life support includes, airway, breathing, control of bleeding, and transportation of the right patient to the right place at right time. This includes all the appropriate personnel safety precaution, assessment, and treatment of the injured people at the scene, and transport to trauma care facilities while delivering the necessary medical care before arrival at the hospital. Widespread first-aid training is the most important aspect of successful prehospital care. Level of care, offered at the site, varies according to the facilities available in a given situation.

**First responder care:** Motivated volunteers from community, fire-fighters, police, and laypersons trained to provide initial first aid can only offer fastest possible care. For best possible prehospital trauma care expected actions from trained bystanders are: getting involved, call for help, assessing the safety of the scene, assessing the victim, capable of appreciating seriousness of emergency and extend initial care, all will fail if bystanders are not getting involved.

**Basic prehospital trauma care:** This care is provided by the community members exposed to formal training in prhospital BLS, scene management, rescue, stabilisation and transportation of injured persons to the definite facility safely without causing further harm. Appropriate training had been advocated for skill enhancement to ensure control of external haemorrhage by direct or indirect pressure, protection of spine, provision of artificial respiration, circulatory support, oxygen therapy and extrication.

**Advanced prehospital trauma care:** Advanced life support at prehospital level is resource intensive and is expected to be provided by highly skilled medical professionals or paramedical staff. The ATLS care recommendation includes intravenous fluid therapy, endotracheal intubation, and highly invasive interventions such as needle decompression or cricothyroidotomy. Despite the enormous cost involved, this kind of care has not been proved to be beneficial except for small subset of very critically ill patients. Cost benefit analysis, therefore, is necessary before planning to introduce such facility.
CONTROVERSIAL INTERVENTIONS
“Stay and play” versus the “scoop and run”
Main potential benefit of “scoop and run” is minimise delay to definitive care, other potential benefit depend on mechanism of injury, specific prehospital interventions and transport distance. However, the question of attempted “Stay and play” versus “scoop and run” approach in the management of trauma has no clear-cut answer. In real life situation a balance is necessary based on the transport distance, pre-hospital resources, and mechanisms of injury (blunt vs. penetrating trauma). Decision should be taken by the healthcare provider accordingly at the site of incidence.

Airway management
Airway management had been advocated in patients with traumatic brain injury, cervical spine, or thoracic trauma before evacuation unless the same can be performed easily en route. Despite the claimed advantages, prehospital endotracheal intubation (ETI) and rapid-sequence induction performed by less experienced paramedical staff leads to higher mortality and poorer neurologic outcomes. Studies on prehospital ETI showing survival benefit in severe head injury, harm in haemorrhagic state and no difference over bag-valve-mask ventilation. Use of ETI in the prehospital care environment remains controversial. Well-designed randomized trials are necessary to assess the efficacy and risks associated with prehospital ETI. Alternatives to endotracheal intubation including, Laryngeal mask Airway, Combitube, Easy tube and Laryngeal tube are easier to insert when compared to endotracheal intubation by providers after minimal training.

Fluid replacement
Prehospital fluid resuscitation for major trauma is controversial. The harm associated with prehospital intravenous (IV) fluid administration is significant for victims of trauma. The routine use of prehospital IV fluid administration for all trauma patients should be discouraged. Current trends are for limited crystalloid resuscitation and early use of blood and blood products before haemorrhage control in prehospital setting for both blunt and penetrating injury. Maximum attention should be on preventing the lethal triad of trauma: hypothermia, acidosis, and coagulopathy.

Spine Immobilization in Penetrating Trauma
Spine immobilization, like IV fluid administration, ETI and field stabilization has the potential to delay the transport of trauma patients. It is often part of the current prehospital treatment for patients with penetrating injuries to the head, neck, or torso, although there are no definitive studies that demonstrate its benefit. Some authorities have instituted selective immobilization protocols based on injury mechanism. However, many prehospital protocols advise for spine immobilization whenever there is potential for spinal cord injury. In contrast, prehospital trauma life support (PHTLS) course and textbook state that spine immobilization is not indicated in patients with penetrating trauma to the head, neck, or torso without neurologic deficit or complaint. Also supported by retrospective analysis of penetrating trauma patients in the National Trauma Data Bank, in which patients were compared with and without prehospital spine immobilization. Authors concluded that, prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.

PREHOSPITAL TRAUMA STATUS IN INDIA
Centralised Accident & Trauma Services (CATS), an autonomous body formed in 1991 by the Delhi government was probably the first comprehensive initiative to improve pre-hospital trauma service. Emergency Management and Research Institute (EMRI), Hyderabad, Ambulance Access for All (AAA), Foundation and Emergency and Accident Relief Centre (EARC) are other service providers in Andhra Pradesh, Maharashtra and Tamil Nadu respectively. For faster response Ambulance Motorbike and Rescue Service (AMARS) was initiated in March 2003 by Christian Medical College, Ludhiana to offer support in Punjab, Himachal Pradesh, Jammu and Delhi. National Rural Health Mission (NRHM) access started through 108. Recently, Active Network Group of Emergency Life Savers (ANGELS) access through 102 has been started. Trained paramedical staffs had been involved by all the above agencies for offering pre-hospital emergency care. Despite increased awareness of the global impact of injury and existing system, it has been highlighted that the field of trauma care and emergency medicine has not progressed uniformly in the country and it is still at a primitive stage. Assessment of prehospital care is essential in order to guide future efforts to strengthen the overall systems. Nielsen et al attempted to understand the methods of transport to the hospital, training and certification of EMS providers, organization and funding of EMS systems, public access to prehospital care, and barriers to further prehospital care development in thirteen wide ranges of low- and middle income countries (LMICs). A standardized 32-question was derived from needs assessment forms originally created by WHO, based on the prehospital
that, expansion of prehospital care to currently legislation setting standards (18%). Authors concluded of leadership within the system (18%) and lack of administration and leadership a more desirable career path. The next most commonly cited barriers were lack of leadership within the system (18%) and lack of legislation setting standards (18%). Authors concluded that, expansion of prehospital care to currently underserved or unserved areas, especially in rural areas, could make use of the already-existing networks of first responders, such as commercial drivers and laypersons. Also, added that efforts to increase their effectiveness, such as more widespread training accordingly, and better encompassing their efforts within formal EMS, are justified. There is a need for increased and more regular funding, integration and coordination among existing services, and improved organization and leadership, as could be accomplished by making EMS administration and leadership a more desirable career path.

Later on isolated study appeared form different countries to provide some useful ideas on prehospital solution. Waseem et al5 presented a model of prehospital emergency services which fulfilled the guidelines of WHO, called Rescue 1122. Authors has described the process of establishment of the service, the organisational structure, the scope of services and the role it was playing in the healthcare services of the designated region. The system was well supported by government funding. Authors agreed that, Rescue 1122 has managed to set up a low cost, effective system of prehospital care which can be replicated in other developing countries with little or no modification. However, prospective and retrospective clinical trials are needed to verify the efficacy of the system and its role in the healthcare sector.

Study by Murad et al44 evaluated a prehospital trauma system model, to which extent a low-cost trauma system reduces trauma deaths where prehospital transit times are long, and to identify specific life support interventions that contributed to survival. Ten year study period from 1997 to 2006; included 2,788 patients injured by land mines, war, and traffic accidents were managed by a chain-of-survival trauma system where non-graduate paramedics were the key care providers. The results of study show that, 37% of the study patients had serious injuries with Injury Severity Score ≥ 9. The mean prehospital transport time was 2.5 hours. Trauma mortality was reduced from 17% to 4%, survival especially improving in major trauma victims. In most patients with airway problems, chest injured, and external haemorrhage, simple life support measures were sufficient to improve physiological severity indicators. It was concluded that, in case of long prehospital transit times simple life support measures by paramedics and lay first responders reduce trauma mortality in major injuries. Assigning life-saving skills to paramedics and lay people is a key factor for efficient prehospital trauma systems in low-resource communities.

Henry et al46 conducted a systematic review and meta-analysis to assess the effectiveness of prehospital trauma systems in developing countries. Multiple database and bibliography searches were conducted to identify articles assessing the effectiveness of prehospital trauma systems in developing countries. The primary outcome was mortality. Secondary outcomes were physiologic severity score; Injury Severity Score, and prehospital time, appropriate statistical analysis was done. Out of fourteen studies, eight representing seven countries (n = 5,607) were included in the meta-analysis. Their pooled estimated results show a 25% decreased risk of dying from trauma in areas that have prehospital trauma systems. In-field response time was reduced in both rural and urban settings. Authors concluded that, prehospital trauma systems in developing countries, particularly middle-income countries, reduce mortality.

Recently, Sun et al46 conducted the study, by using a prehospital care system and implementation strategy that was more appropriate for a range of conditions in South Africa. This model utilizes a core emergency first aid responders (EFAR) system model that can be locally adapted, along with an implementation strategy that could be done in a graduated fashion within an area’s means. Motivated local community members were trained to become EFAR who can provide immediate, on-site care until a transporter can take the patient to the definite hospital. Management of the system was done through local community based organizations, which can adapt the model to their communities. Within a community, the system was implemented in a graduated manner based on available resources, and was designed to not rely on the whole system being implemented first to provide partial function. Authors
concluded that, strategy was a versatile prehospital emergency care model with emergency need, and shows great promise in making prehospital emergency care more accessible in under-developed areas of South Africa. Interestingly, The University of Cape Town’s Division of Emergency Medicine and the Western Cape’s provincial METRO EMS intend to follow this model, along with sharing it with other South African provinces.

As developing countries begin to urbanize and grow, so do their health care needs. The current system does not meet the needs of increased mortality from trauma. Various factors identified those hinder or facilitate an effective prehospital trauma care process: administration and organization, staff qualifications and competences, availability and distribution of resources and communication and transportation are inside the EMS and involvement of other organizations, laypeople and the general infrastructure are outside the EMS. The core factor is interaction and common understanding in the medical and non-medical sector.42,47

**CONCLUSION**

A prehospital trauma care service remains a dynamic field of medicine for care of trauma patients. Therefore, improvements in the field of trauma services are required to ensure “golden hour” compliance for all trauma victims as an achievable goal by coordinating activities between prehospital care and specialized hospital care services. One technical aspect of prehospital trauma care is to improve access and to establish a uniform emergency access telephone number. Due to great heterogeneity in the literature, firm conclusions cannot be drawn. However, present literature review provides useful information about the current status of prehospital trauma care in developing countries that will assist in strengthening and expansion of prehospital trauma care. A specific and unique model system should be developed to address the needs of the trauma patient. The goal should be to get ‘the right patient, to the right place, at the right time, to receive the right care’ following trauma.

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