Development and Implementation of a Novel Prehospital Care System in the State of Kerala, India

Heather A. Brown, MD, MPH; Katherine A. Douglass, MD, MPH; Shafi Ejas, MBBS; Venugopalan Poovathumparambil, MBBS

Abstract
Most low- and middle-income countries (LMICs) have struggled to find a system for prehospital care that can provide adequate patient care and geographical coverage while maintaining a feasible price tag. The emergency medical systems of the Western world are not necessarily relevant in developing systems, given the lack of strict legislation, the scarcity of resources, and the limited number of trained personnel. Meanwhile, most efforts to provide prehospital care in India have taken the form of adapting Western models to the Indian context with limited success. Described here is a novel approach to prehospital care designed for and implemented in the State of Kerala, India. The Active Network Group of Emergency Life Savers (ANGELS) was launched in 2011 in Calicut City, the third largest city in the Indian State of Kerala. The ANGELS integrated an existing fleet of private and state-owned ambulances into a single network utilizing Global Positioning System (GPS) technology and a single statewide call number. A total of 85 volunteer emergency medical certified technicians (EMCTs) were trained in basic first aid and trauma care principles. Public awareness campaigns accompanied all activities to raise awareness amongst community members. Funding was provided via public-private partnership, aimed to minimize costs to patients for service utilization. Over a two-year period from March 2011 to April 2013, 8,336 calls were recorded, of which 54.8% (4,569) were converted into actual ambulance run sheets. The majority of calls were for medical emergencies and most patients were transported to Medical College Hospital in Calicut. This unique public-private partnership has been responsive to the needs of the population while sustaining low operational costs. This system may provide a relevant template for Emergency Medical Services (EMS) development in other resource-limited settings.

Introductions
As a lower middle-income country, India faces the challenge of confronting a dual burden of disease, as nutritional and infectious disease persist at high levels in some areas, while chronic disease and traumatic injury are on the rise. The World Health Organization (WHO; Geneva, Switzerland) estimates that injury is responsible for 12% of all deaths in India and another 60% of deaths are attributed to non-communicable disease. The majority of the health systems in place in India are ill-equipped to handle this changing and complex burden of disease. Road traffic injuries in India have increased steadily over the past decade, and at this rate, they are projected to become the number five leading cause of death in the country by 2030. Simultaneously, cardiovascular disease is a major cause of death and disability and is predicted to be the number one cause of death in India by 2020.

Development acute care systems in a locally appropriate manner, while focusing on utilization of locally existent resources, increasingly is being recognized as a development priority and has potential for important implications in morbidity and mortality. Prehospital care is a vital linkage to the health care system for the critically ill and injured that remains underdeveloped in most parts of India. Emergency Medical Services (EMS) not only decrease time to presentation to an appropriate health care center, but also...
have been shown to decrease mortality through the provision of early and time-dependent, life-saving procedures. The WHO has called for increased research in the area of prehospital care in low- and middle-income countries (LMICs), noting that when prehospital care is poor or does not exist, preventable deaths occur, many of which could have been avoided through inexpensive interventions.

In India, the medical specialty of Emergency Medicine was recognized by the Indian Medical Council (New Delhi, India) in 2009, and physician training programs, community awareness, and hospital preparedness have been increasing since then. Despite advances, the vast majority of acute care available in India is variable at best, with limited availability particularly in rural and semi-rural areas. At this point, India’s EMS primarily has catered to those who are able to provide payment. Ambulance services in most areas consist of a multitude of privately owned, hospital-based ambulances; nongovernmental organization-operated ambulance services; and state-owned and operated systems. Each system typically has its own separate access number and they typically do not interface with each other. Most of these ambulance services provide transport to a health care facility but no prehospital treatment. Ambulances transport patients to the nearest hospital or the hospital of the patient’s choice and there is no triage system or protocols in place to transport patients to the most appropriate health care facility based on complaint. Very few ambulance services in India have any communication with the receiving facility pre-arrival, making activation of appropriate services impossible.

Higher end ambulances or mobile intensive care units (ICUs) are present in tertiary institutions and corporate hospitals. These vehicles are equipped with advanced facilities for intervention but operate primarily in the inter-hospital transfer of sick patients. They have little, if any, role in prehospital care of the acutely ill patient. Furthermore, in urban locations, a significant degree of first aid and transport is provided via an informal system of good Samaritans and police response.

Currently in India, there is no formal licensing required to run an ambulance service and no minimal educational standards for prehospital personnel. Higher end ambulances or mobile intensive care units (ICUs) are present in tertiary institutions and corporate hospitals. These vehicles are equipped with advanced facilities for intervention but operate primarily in the inter-hospital transfer of sick patients. They have little, if any, role in prehospital care of the acutely ill patient. Furthermore, in urban locations, a significant degree of first aid and transport is provided via an informal system of good Samaritans and police response.

Variable state-by-state efforts have taken place in India to develop more affordable models of EMS care. For example, the Emergency Management and Research Institute (EMRI) was launched in 2005 in Hyderabad with funding from the GVK Foundation (Telangana, India). The EMRI created a single access number for all police, medical, and fire emergencies. The EMRI system currently is active in 12 Indian states and functions through partnerships at the state level. The Centralized Accident and Trauma System (CATS) launched in Delhi in 1991 was the first prehospital system of its kind in India, providing on-site emergency first aid and transport to the closest appropriate health care facility. The Centralized Accident and Trauma System is run by the central government of Delhi in coordination with the All India Institute of Medical Sciences (AIIMS; New Delhi, India) hospital, but despite government lead, CATS has not gained enough momentum to become the sole ambulance service for the city. Numerous challenges remain within these systems, including regionalization of care, standardization of training, and financial constraints.

Report
In order to address the gaping need for effective, yet inexpensive, prehospital care in Kerala, India, the Active Network Group of Emergency Life Savers (ANGELS; Kozhikode, India) was launched in 2011. The ANGELS is a registered Indian nonprofit charitable foundation conceptualized by a group of senior physicians, administrative officials, and non-medical personnel of various backgrounds committed to creating an economically viable, self-sustaining EMS system. In the initial phase, the Calicut District was mapped extensively by locating the roads, highways, railways, hospitals, bus stations, fire stations, and accident-prone areas with help from the Calicut district administration. Hospitals in and around Calicut also were mapped and graded as “A” (hospitals with tertiary care facilities, including fully equipped emergency departments, around-the-clock imaging facilities, cardiac catheterization, stroke teams, and surgical capability), “B” (hospitals with up to 100 beds and facilities for operative intervention), and “C” (hospitals with 20 beds or fewer). The steps to implementing the ANGELS prehospital care system are shown in Figure 1.

To maintain an economically viable system, resources were mobilized from the community and pre-existing systems were integrated into a single network instead of making new purchases and creating a separate competing service. Through early engagement with state government, local officials, and local hospital administrators, ANGELS succeeded in enrolling nearly every existing ambulance in Calicut into the ANGELS network, many of which previously had served as a transport vehicle or mobile ICU but never had functioned in providing prehospital care. Both privately owned and state-owned ambulances in Calicut were evaluated and grouped into Basic Life Support (BLS) ambulances (with facilities for airway intervention, monitoring, and ambulance assistant) and Advanced Life Support (ALS) ambulances (with facilities for airway intervention, monitoring, defibrillation, and pulse oximetry). Ambulances that did not meet at least BLS standards were upgraded and Global Positioning System (GPS) technology was placed in each ambulance.
The most common mechanisms of injury were calls were for medical emergencies as opposed to traumatic injury. Over a two-year period from March 2011 to April 2013, 8,336 ANGELS Bike Emergency Rescue Team (ABERT), to augment mission and has trained more than 1,400 community members as to other states in India. The ANGELS has expanded plans to expand operations to two more districts of Kerala as well forward, ANGELS extended their reach to two more districts in Kerala. The curriculum included weekly didactic sessions as well as in-field training and covered basic topics including hemorrhage control, c-spine precautions, basic airway management, and BLS. The EMCTs volunteered to enroll in the free training program with an understanding that they would staff the ANGELS ambulances as uncompensated volunteers after the training program was completed.

Twenty ambulances were enrolled in the network for the initial rollout, and the system was made accessible to the general public on March 9, 2011. Community support and acceptance of the ANGELS network was nearly immediate as the network’s success stories were reported in the media. With new donors coming on March 9, 2011. Community support and acceptance of the ANGELS substantially increased their reach by providing free training in BLS prehospital services, as opposed to trauma training and equipment increasing cost while minimally affecting morbidity and mortality.5,12,16

Table 1. Mechanism of Traumatically Injured Patients Transported by ANGELS Between March 2011 and April 2013

<table>
<thead>
<tr>
<th>Mechanism of Injury</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>Motorbike versus Car</td>
<td>71 (20.1%)</td>
</tr>
<tr>
<td>Autorickshaw versus Car</td>
<td>62 (17.6%)</td>
</tr>
<tr>
<td>Pedestrian Struck</td>
<td>61 (17.3%)</td>
</tr>
<tr>
<td>Car versus Lorry</td>
<td>29 (8.2%)</td>
</tr>
<tr>
<td>Fall from Height</td>
<td>32 (9.0%)</td>
</tr>
<tr>
<td>Assault</td>
<td>15 (4.2%)</td>
</tr>
<tr>
<td>Other</td>
<td>82 (23.2%)</td>
</tr>
</tbody>
</table>

Discussion

The success of the ANGELS system in Kerala, and now other Indian states, suggests this model of prehospital care could successfully be implemented in other LMICs. Inadequate funding has been cited as the most common barrier to implementing adequate EMS in LMICs.5 The ANGELS’ grassroots approach has maintained low operating costs and engaged local stakeholders. By reorganizing existing services, minimal startup costs are required, saving on initial equipment purchases, human resources, and minimizing upheaval in administrative processes. In addition, ANGELS has remained cost-effective by retaining focus on providing BLS prehospital services, as opposed to expanding services to provide ALS. Several studies have shown BLS services to be cost-effective in the prehospital setting with ALS training and equipment increasing cost while minimally affecting morbidity and mortality.5,12,16

The ANGELS is not just a prehospital care system, but instead represents a community-based network for improving health outcomes. The ANGELS substantially increased their reach by providing free training in first aid and BLS in surrounding communities. Lay person training in first aid and BLS particularly is effective in countries like India where the majority of emergent patients presenting to a health care facility are brought by private vehicle.14 Similar programs based on lay person training have been implemented successfully in other LMICs.17

There are some notable limitations in implementing the ANGELS prehospital care model in other LMICs. Kerala’s infrastructure is relatively good compared to many rural parts of India and other LMICs.18 Road infrastructure in particular can limit the success of a prehospital care system due to unacceptably long response times. The ANGELS had addressed this to some extent with their ABERT program, which provides motorcycle response, although the motorcycle response groups do not have capacity to actually transport patients. Therefore, an EMS provider can reach the patients, but the traffic constraints still limit...
the transport time to definitive care. In general, poor infrastructure is challenging as both a driving factor and limiting factor for systems development.

Furthermore, ANGELS was formed as a concerted effort by a group of motivated physicians at a critical time when the importance of Emergency Medicine development was being recognized on a national level. Countries that have not recognized Emergency Medicine as a formal specialty frequently lack physicians with the knowledge and motivation to implement effective prehospital care services. In addition, prehospital care services are not useful if the receiving health care facility lacks the ability to care for the acutely ill or injured in a timely and appropriate manner, which is often the case where Emergency Medicine has not been developed as a formal specialty. This highlights the importance of performing a detailed needs assessment prior to implementing a prehospital care system and developing a broader acute care system in conjunction with prehospital care.6,19

Conclusions
At least one-half of the world’s population still lacks access to adequate EMS.5 Improving access to prehospital care in LMICs will require low-cost, innovative systems tailored to the community’s needs and available resources. Although India has made great strides in the last decade in recognizing the importance of Emergency Medicine and prehospital care, 80% of traumatically injured patients in India cannot access medical care within the first hour of being injured.11 Success of the ANGELS model of prehospital care in Kerala is due to a multitude of factors, particularly the group of highly motivated and dedicated founding members, organizing at a time when the worth of emergency and prehospital care was becoming realized in India. The ANGELS model also incorporated a thorough pre-implementation needs assessment, context appropriate design, system-wide coordination, and ongoing quality evaluation and improvement; all of which are distinctive features of successful EMS systems in LMICs.17

References