

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

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Conflicts of interest: none

Keywords: ambulances; developing nations; Emergency Medical Services; India; paramedics; prehospital emergency care

Abbreviations:

ANGELS: Active Network Group of Emergency Life Savers
ABERT: ANGELS Bike Emergency Rescue Team
ALS: Advanced Life Support
BLS: Basic Life Support
CATS: Centralized Accident and Trauma Services
EMCT: emergency medical care technician
EMRI: Emergency Management and Research Institute
EMS: Emergency Medical Services
GPS: Global Positioning System
ICU: intensive care unit
LMIC: low- and middle-income countries
WHO: World Health Organization

Received: January 23, 2016

Accepted: May 1, 2016

Online publication: September 22, 2016

doi:10.1017/S1049023X16000960

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 economic 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.

Brown HA, Douglass KA, Ejas S, Poovathumparambil V. Development and implementation of a novel prehospital care system in the State of Kerala, India. *Prehosp Disaster Med.* 2016;31(6):663-666.

Introduction

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.¹ 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 2030.² 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 2020.³

Developing 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.⁴⁻⁶ 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.⁷⁻¹¹ Emergency Medical Services (EMS) not only decrease time to presentation to an appropriate health care center, but also

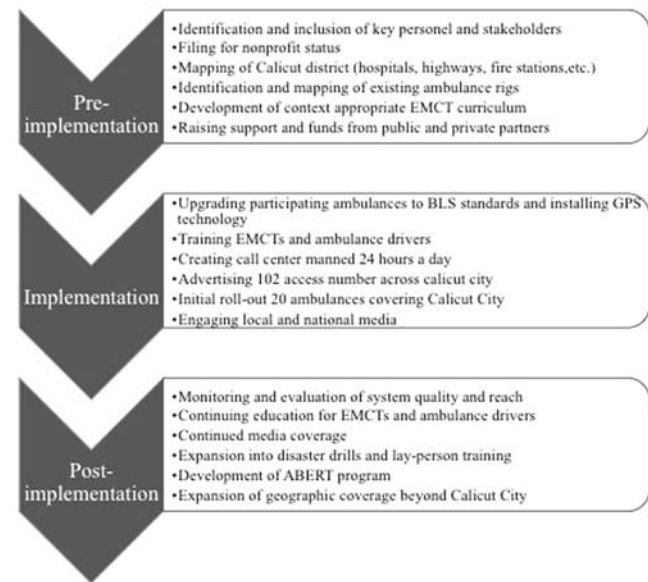
have been shown to decrease mortality through the provision of early and time-dependent, life-saving procedures.⁶ The WHO has called for increased research in the area of prehospital care in low- and middle-income countries (LMICs), noting that when prehospital care is poor or does not exist, preventable deaths occur, many of which could have been avoided through inexpensive interventions.^{6,12}

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 that time.¹³ 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.⁸ 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.¹⁴ Currently in India, there is no formal licensing required to run an ambulance service and no minimal educational standards for prehospital personnel.⁸

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 partnership at the state level.⁷ 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.¹⁵ 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



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Figure 1. Steps in Implementing the ANGELS Prehospital Care System.

Abbreviations: ANGELS, Active Network Group of Emergency Life Savers; ABERT, ANGELS Bike Emergency Rescue Team; EMCT, emergency medical care technician; GPS, Global Positioning System.

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 city 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 city were evaluated and grouped into Basic Life Support (BLS) ambulances (with oxygen, suction, and staffed by a driver 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.

Parallel to administrative and concept implementation, ANGELS developed a communications system which aimed to integrate and channel all calls through a single access number to a centralized call center. The call center was established at the Institute of Palliative Care in Calicut, which is manned around-the-clock by trained dispatchers. All incoming calls are directed to the ambulance in the nearest vicinity based on the GPS location of the ambulance at the time of the call. The number 102 was chosen as the single access number, and a robust media campaign was run in conjunction with the development of the ANGELS network. The media was present for each ANGELS milestone, and billboards were placed throughout the greater Calicut area boasting a new faster EMS system under the 102 access number.

Ambulance drivers were enrolled in a first responder course that covered basic resuscitation and trauma care. Area physicians with emergency or critical care experience volunteered to teach the course. Simultaneously, the first class of emergency medical care technicians (EMCTs) was recruited for a one-year training program. Some of the participants had background experience as ambulance assistants, while others had no previous experience in the medical field. The EMCT curriculum was a novel curriculum created by Indian physicians tailored to the current prehospital scenario 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 forward, ANGELS extended their reach to two more districts in Kerala State, Wayanad and Malappuram, in June of 2011. Simultaneously, the number of ambulances enrolled in Calicut was upgraded to 50.

To date, ANGELS has trained 120 EMCTs, responded to more than 9,000 calls, and is operational in five districts in Kerala. 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 by the EMCTs. Over 90% (4,217) of calls were for medical emergencies as opposed to traumatic injury. The most common mechanisms of injury were "other" (23.2%), "motorbike versus car" (20.1%), "autorickshaw versus car" (17.6%), and "pedestrian versus car" (17.3%). These results are shown in Table 1. The average time for an ambulance to reach the scene was 15.65 minutes and the majority of patients were transported to the main government hospital in Calicut, Medical College Hospital.

One hundred forty-six ambulances are now registered with ANGELS across the five districts, and the foundation has plans to expand operations to two more districts of Kerala as well as to other states in India. The ANGELS has expanded their operations to include education and training as a primary mission and has trained more than 1,400 community members in BLS skills, conducted two regional disaster drills, while maintaining a significant public presence in outreach events. A novel motorcycle rescue service has been established, the ANGELS Bike Emergency Rescue Team (ABERT), to augment the available ambulance transport system. This is important,

Mechanism of Injury	n (%)
Motorbike versus Car	71 (20.1%)
Autorickshaw versus Car	62 (17.6%)
Pedestrian Struck	61 (17.3%)
Car versus Lorry	29 (8.2%)
Fall from Height	32 (9.0%)
Assault	15 (4.2%)
Other	82 (23.2%)

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

Abbreviation: ANGELS, Active Network Group of Emergency Life Savers.

especially considering the significant traffic challenges faced in Kerala State, similar to many other locations in the world, where the potential response time for a motorcycle is significantly less than for a larger vehicle.

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

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