

# Development of prehospital emergency medical services: strategies for system assessment and planning

**Abstract:** Increasing economic capacity in the Pacific Rim has led to a greater demand for integrated pre-hospital care systems. The economic and technological growth of Taiwan, South Korea, Japan, Singapore and Hong Kong has led to health system developments and growth of advanced healthcare and prehospital medical services. Changing economies and population distribution of many of the Southwestern countries and island regions in the South Pacific, as well as the geographical constraints necessitate a systematic and individually tailored planning process, while standardizing communication and quality of service with more will developed neighbors. While EMS systems in such a broad geographical region may take a variety of forms, each system contains some system components similar to those found in the United States and Southwest Pacific regions such as Australia and New Zealand. In evaluating EMS abroad, it is useful to compare the developing system type to one of five models: hospital based, municipal, private, volunteer, and complex. In so doing, the appropriate model system may be constructed to accommodate the demands of an evolving system.

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several South Asian countries require systems with evacuation and long range response capacity.

## Introduction

The changing health needs in the countries and geographical regions of the Pacific Rim have led to greater interest in developing integrated and standardized prehospital systems. Economic expansion, population migration (demographic transition) to urban areas, the increase in motor vehicle accidents and the growth of tourist industry in many less developed Pacific regions has created a greater demand for accessible and effective emergency medical systems (EMS). Similar trends preceded the development of EMS in the US, and the growth of EMS was impacted by a combination of urban growth, economic expansion, medical and technological advancements, and public demand.<sup>1</sup> Just as the US experienced the need for an organized and unified approach to prehospital care, several developing countries increasingly need a formal EMS system to address growing urban health concerns. In addition, geographically diverse regions such as Micronesia, Melanesia, Polynesia and growth, urbanization, and health care system changes

The applicability of Western systems may be limited in such economically and culturally diverse regions. Instead of transplanting a prehospital system "blueprint", it is important to recognize a number of components that are universally required in every system. The US system, while unique in many aspects, contains basic prehospital system elements that may be beneficial and can be transposed to other developing programs.

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The purpose of this paper is to describe an approach to assessment of EMS systems by addressing standard model types and essential components of any prehospital care system. In

addition, this paper provides a comparison of Western Pacific system components with the system attributes of other less developed EMS systems in the Pacific Rim.

## The growing need for EMS internationally

Global demographics and health patterns in the Pacific Rim countries have changed substantially in the last two decades, necessitating the role for prehospital care in diverse and often geographically isolated regions. The primary reasons for this are an increase in economic

## Economic growth

The health of a country's economy directly impacts the health of its people. Prehospital care and the support services which make it possible are similarly tied to a country's economic health. Some developing health sys-

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tems are unable to provide even basic health services, much less support the expense of prehospital care. In countries with tremendous economic challenges such as Thailand, Myanmar (Burma) and Vietnam require greater emphasis on preventive and public health care.

As regions have developed economically, such as seen in the rapid economic growth in Indonesia, the health system has greater capacity for expansion, and primary and tertiary health care services become more ubiquitous, particularly in urban centers. A phenomenon known as "epidemiologic transition" occurs. People live longer which results in an increase in cardiovascular illnesses, instead of dying in younger years of infectious diseases. These factors increase the need for prehospital linkage to the urban health centers and thus, the development of EMS systems.

**Urbanization**

By the year 2010, nearly 60% of the world's population will be living in urban centers. This urban shift leads to a resulting in increased population growth. Population expansion to a higher incidence of motor vehicle accidents, access prehospital services. density and urbanization response. Hong Kong, for example, has responded to motorcycles equipped with trained personnel. These ambulances can reach a cardiac victim within minutes,

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Problems are forced to address developing or revising their EMS systems may be further precipitated by a national crisis, leading to Timorese independent for restructuring of the emergency medical systems have increasing demands of urbanization or "westernization."<sup>3,4</sup>

Countries' needs for prehospital humanitarian crises create a unique Humanitarian emergencies

are on the increase and annually kill over 150,000 people while disrupting the lives of more than 129 million.<sup>5,6,7</sup> Disasters may be due to man-made or natural phenomena and have the common factor of overloading normal prehospital system operations.<sup>8,9</sup> One role for EMS in the international community is to prepare for and respond to crisis situations.<sup>10</sup>

Disaster relief must be a pre-planned multi disciplinary effort that has clearly defined organizational roles. Although immediate assistance is typically provided by local health personnel, multiple agencies become involved as the scope and severity of the disaster expands.<sup>11</sup> This includes participation of local, regional, national, and even international organizations. A comprehensive discussion of disaster relief is beyond the scope of this paper.

**Prehospital system models**

In order to evaluate the structure and function of an international prehospital system, it is important to determine the model-type in which a particular system may be categorized. This is helpful in determining the operational plan, political considerations and funding issues of the country being evaluated.<sup>1</sup>

**The five model types for EMS systems**

**A. Hospital based systems**

In rural areas, EMS systems often hospital based, functioning out of the central regional medical center. Hospitals hire EMS personnel, train them, and designate an administrator to oversee the efforts. In the developing systems overseas, hospital-based systems are the easiest to initiate and maintain. Medical control issues are less complicated because they primarily rest on the existing hospital or ED staff. This type of system is commonly seen in newly developed systems and in countries without national programs, and is seen in several nations in South Asia and Southeast Asia.

**B. Jurisdiction provided systems**

Jurisdiction directed systems take place at a county or municipal level. In this scenario, EMS may be linked to the fire response network that provides a structured environment for EMS system development. Medical oversight is contracted through private physicians. About half of the EMS systems in the US are jurisdiction directed.

will be living in urban centers "demographic transition", resulting in increased population density and traffic density.<sup>2</sup> These areas of explosive population growth and urbanization leads to an increase in violent crime, traumatic injuries, and a greater need for public access prehospital services. The increase in population density encumbers an effective EMS system. For example, Hong Kong was forced to respond with defibrillators, driven by the fact that mobile units can reach a cardiac victim but may wait 30-40 minutes for a prehospital transport vehicle.

**Health care system changes**

Countries affected by the population explosion and subsequent urban health problems have increased emergency care needs by developing new EMS systems. These system changes are precipitated by either developmental or crisis. The war in East Timor, for example, has led to a new health system. In China, emergency medical services have been influenced by the increasing population and outside foreign influence.

**EMS and disaster relief**

In addition to developing countries, disaster relief care, disasters and humanitarian crises create a unique environment for EMS growth.

Financial support for municipal services are typically tax or government funded. In the developing system, particularly in countries with a strong central government (i.e. China or the former Soviet States) this is common. This is also the case in most European programs where funding comes from a state-sponsored, tax-based system and the use of EMS is a medical benefit.

### C. Private systems

This is the oldest type of system, originating from the funeral home-based ambulance services. In the US, many private organizations maintain substantial influence in municipal EMS systems due to their size and payer base. Foreign systems, however, are unlikely to have well-developed private EMS programs since prehospital care is typically a state-funded medical benefit.

### D. Volunteer systems

The volunteer system has played a prominent role in EMS delivery in the rural United States and several western European regions. EMS providers form a network of volunteers who are privately trained. More densely populated areas need full time support, and eventually move to a municipal or hospital-based system.

### E. Complex systems

Complex EMS systems are composed of a "mixture" of system types and evolve secondary to resource limitations (such as trauma centers) or the need for increased coverage and providers. System components are adapted to fit the political climate, regional governmental structure, geographic area, available resources, and of course, the payer mix.

Complex systems exist in large cities which necessitate independent central dispatch, communication, and complex medical control. They base EMS personnel in major medical institutions or as a part of the municipal fire services. A combination often seen in developing countries is coexisting private and municipal systems. Problems may arise if they are working in competition rather than in a planned system. Complex models also include civilian and military coordination which occurs in many countries during times of war and may remain as a joint effort in times of relative peace, as seen in Indonesia in the Maluku Islands, or in East Timor, where only around 20 East Timorese doctors remain in the country to serve a population of approximately 800,000 people.<sup>12</sup>

## Comparing common EMS systems components

Evaluation of a foreign EMS system can be both confusing and complicated even for one familiar with EMS at home. In order to evaluate the effectiveness and complete a needs assessment of a foreign EMS system, the basic system components must first be identified. Many developing countries assimilate system components from numerous outside foreign systems. At times a confusing combination between American and European systems can be seen. This blending of systems can be seen in the People's Republic of China EMS system where influences from the US, Italy, and Germany can be seen when comparing hospitals within a city or between cities. A review of both types of western systems prior to identifying another country's existing components is helpful. An underlying difference can be seen by understanding that European systems initial premise is to "bring the doctor to the patient" while the US "brings the patient to the doctor."<sup>13</sup> The European systems typically have higher level field care, and less reliance on receiving hospital emergency care facilities. Conversely, the Anglo-American system has greater acceptance of specialized prehospital care providers and more reliance upon the expertise of hospital based emergency care providers.<sup>14</sup>

A starting point for evaluating the prehospital system capacity is to identify the 15 Essential EMS components outlined in the Emergency Medical Service System Act.<sup>1</sup> However, it must be recognized that one or several components may be nonexistent in the developing setting or exist in a completely different form. Some components such as Review and Evaluation, Mutual Aid, Consumer Participation, and Public Safety Agencies may be completely unknown entities to a foreign hospital-based system. It must be remembered that the US formed a cohesive and comprehensive prehospital system which integrated many competing components only after legislation and a large amount of funding helped it to do so. Therefore, a system assessment must be approached with maximal flexibility and minimal ethnocentrism.

Despite regional differences, many of these components are present, to a certain degree, in many of the existing Asian prehospital programs. Burkle et al described the comparative aspects of the US system contrasted to the EMS system in mainland China and concluded that similar structural commonalties exist despite profound cultural differences.<sup>15</sup> In addition to describing our system, the 15 Essential EMS components can be used to assist in analyzing the developing EMS system. System components in Western countries may be compared to their counterparts in the Pacific region. (table 2)<sup>14,15,16</sup>

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## Approach to system development

Developing an EMS system in a country that either has an incomplete system or where EMS services are nonexistent can be approached in phases. These phases include analysis, planning, and implementation.

### Phase I: Analysis

To assist in EMS system development, one must be familiar with the current resources. The components of the system that are present should be contrasted with the perceived needs as identified by local health care leaders. A good starting point is identification of existing components.

**System Identification:** Nearly all countries have some method of transporting their sick or injured to health care facilities, even if this is as primitive as carrying a child in their arms to the local health facilities. A familiarity with the public perception of EMS is necessary to begin integration into the current system.

Identification of the health care facilities participating in the new system should be made. Factors such as the bed-capacity, patient acuity, personnel, level of training, surgical capability, radiology and laboratory support will impact the patient outcome and alter destination goals.

**Transportation:** The existing transportation methods should be incorporated into the overall EMS plan. Transportation modes should be those that the public is familiar with and most likely to use. Methods such as hand-carried stretchers, canoes, rickshaws, donkey carts, baskets, and taxis are all utilized for medical transport in developing countries. The road and/or water system should be analyzed and their use maximized. New forms of transportation can be introduced as funding permits.

**Destination:** Knowledge regarding the transport destinations to the local health care facilities is essential when developing EMS. Most developing systems except for the true public system operate on a strictly fee-for-service basis. So issues such as the closest facility for acutely ill patients become complicated.

**Personnel:** Information about the number of local health care providers, level of training, and current integration in the prehospital system may be incorporated into the planning.

**Communication:** Communication means used to summon medical aid have included the Roman foot

messenger, the English horseman, and the hill-top callers currently in use in Papua New Guinea. Use of all communication forms available should be integrated into the developing system.

**Needs Assessment:** Implementing or upgrading EMS in a community is expensive and depends on relatively advanced technology and resources. In developing countries with limited financial resources, choices must be made regarding the benefit of EMS versus other health services. A cost benefit analysis of a community's needs is an important early step, and should be carefully thought out as resources are considered for the development and maintenance of a prehospital system. In order to contribute appropriate advice to developing countries a careful assessment of national resources, government structure, population demographics, culture, and health care needs is necessary.<sup>17</sup> The evaluation of the health infrastructure must be coupled with the consideration for health education and preventive health measures.

An EMS feasibility study in Kuala Lumpur, Malaysia showed that implementation of a system to deliver defibrillation to 85% of cardiac arrests in 6 minutes would cost 2.5 million per year saving 7 lives, 3 of which would be marred by significant neurologic injury. This study concluded that developing countries may need to consider alternatives to the North American EMS model.<sup>18</sup> Examples like this illustrate the necessity for successful planning.

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**System Analysis:** System components must be identified in order to understand

the existing system and address issues of support and integration. Comparing a foreign EMS system to US counterparts is problematic and direct comparisons are difficult. A reasonable starting point is to address the fifteen EMS components which will assist planners in a comprehensive review of accompanying services. Any use of foreign consultants should be tightly controlled. The role of a foreign consultant is not to impose our system on other countries but to help develop a system that works for and is appropriate to their needs.<sup>19</sup> It is helpful to obtain and review copies of any available local, state or national EMS documents or regulations and to meet with local physicians to understand local practice and current standards of care.

**Technical Analysis:** Analysis of the technical capacity of the prospective system are also very important. From vehicles to radio communication, from data collection to dispatch, there are a number of important technical features in an EMS system which need to be addressed. In many settings, the most cost-effective resource is

personnel training rather than large equipment investments.

A difficulty experienced when designing a system tailored to a specific regions circumstances is that of "technology hunger." One consultant assisting an international municipal EMS service recommended that funds be spent on basic and advanced airway equipment followed by a defibrillator. On a return visit it was noted that all existing funds had instead been spent on a portable ventilator although basic airway equipment was still unavailable.

**Political Considerations:** The integration of any new health program into a community or country must be explicitly supported by the local, regional, and national authorities. This is important from the onset since issues of funding, manpower, training, and health system integration are essential to program success. Any foreign consultation must be coupled with a strong program for local leadership development and be consistent with local political considerations.

**Factors Influencing EMS Advancement:** System oversight, budget control, and political interrelationships between local, regional, and national leaders must be carefully delineated. While altruism is present in all cultures, the driving force behind the development of a more advanced EMS system may be financial or political. It is essential to address such concerns to ensure effective planning and implementation.

## Phase II: Planning the essential components

Essential components need to be in place prior to implementing a prehospital care delivery system. The fifteen components of EMS may represent a starting point but may not correlate directly to other countries resources and culture. A valuable question to ask is "what components are absolutely essential and which are desirable to the daily function of the EMS system?" With severe financial considerations and prohibitive start-up costs a basic planning approach is important. On a basic level, EMS should provide two crucial components of medical care. The first is access to a medical system that will rapidly evaluate the urgency of the patient complaint and match it to appropriate community resources. The second is to transport the patient to the health care delivery site.<sup>23</sup>

One approach is to implement essential components with a graduated plan for other necessary components. Attention to initial issues must be accomplished (table 3). Components for gradual implementation may then be

added as resources become available.

For example, during development of a hospital-based ambulance in Hangzhou, China, a complete EMS program was designed in the planning phase with a basic set of essential components implemented initially and graduated implementation of other components such as a quality improvement plan. All components should be addressed in the planning phase so that a system tailored to regional circumstances may be implemented successfully.

**Establishing Objectives:** When general goals have been agreed upon and the initial assessment completed, specific objectives for the development of the system should be outlined. The feasibility of the objectives must be addressed both in terms of finances and institutional sustainability. Ideas for long term planning should not be limited by financial constraints; explore all potential avenues for future development. The lack of detailed early assessment will impede the ability for organizers to develop specific achievable objectives, increasing the likelihood of failure.

## Financial planning

**Financial Assessment:** EMS systems are expensive relative to primary health and community-based services. Prehospital care is manpower and equipment intensive and requires the acquisition and maintenance of sophisticated machinery. Developing programs may seriously underestimate the amount of financial support a prehospital system demands, and may be reluctant to make the initial investment. In addition to starting costs, the ongoing cost of maintaining and upgrading the system components is substantial. Outside contributions may assist in set-up, but project maintenance remains a major financial consideration.

**Personnel:** Ongoing project costs also include the payment of administrative personnel to promote, develop, and oversee operations. In addition, technical providers and trainers must also be paid.

**Project Administration:** Local and expatriate leadership must be identified and developed throughout project implementation. Leadership within the government structure is very important for the successful development and subsequent integration of the system.

## Phase III: Implementation

**Legislation and governmental commitment:** Formal governmental recognition of the project is ideal to

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solidify the government's commitment to the program. Although official legislation may be desirable, it is often difficult to obtain and may cause excessive delays in implementation. Agreements between nongovernment organizations (NGO's) are also important to avoid conflicts between potentially competing agencies.

**Development of local leadership:** Local providers and administrators who were crucial to the information gathering process should be involved in the planning process. They will be invaluable to helping to develop a focus of where initial efforts should be directed and obtaining community buy-in. Leaders must be developed concurrently with program implementation since leadership support is the driving force behind continued program development and ultimately, the future of the project. A mentor approach is useful to link local leaders with expatriate personnel throughout the program's development. A steering committee is helpful to troubleshoot and maintain program momentum.

**Participatory approaches:** It is essential to build in local leadership and participation from the very first stages of project development. Early planning and participation with attention to leadership development and investment of individuals and institutions is more difficult, but extremely important in sustainable development.

**Funding for International EMS Development:** The development of EMS systems abroad usually requires financial investment from both the host country and outside developmental agencies. Agencies who have contributed to the development of EMS abroad include the AusAID (Australian Government Agency for International Development), USAID (United States Agency for International Development) and the European Community Humanitarian Organization (ECHO).

### **Future EMS needs: where to look for opportunities**

Given the prior discussion on the factors which precede EMS system development, the most likely candidates for requiring systems are those countries which are experiencing economic growth, such as tourist locations, such as American Samoa, Cook Islands, Fiji, Kiribati, New Caledonia, Niue, Samoa, Solomon Islands, Tahiti, Tonga, Tuvalu, Vanuatu and those contending with increased urbanization, such as Indonesia, Malaysia, and the Philippines.

Opportunities for physicians and health workers interested in promoting EMS abroad include consulting options for program development in selected developing regions. In addition, specific system component expertise and opportunities for bringing technology and materials are needed. Resuscitation education such as ACLS, APLS, PALS, ATLS etc. are often valuable in initiating education exchange programs.

### **Conclusion**

The changing economies and population distribution of many developing countries have increased the need for prehospital care systems. While EMS systems overseas may take a variety of forms, they usually contain system components in common with those found in the United States. For countries or regions seeking to improve prehospital care, it is important to perform adequate assessments and to set appropriate targets for improvement that are economically sustainable. Most developing countries are incapable of supporting western-style EMS systems, and inappropriate technology may divert necessary resources. It is important to remember that EMS system development in another country requires a substantial investment of time and resources to see the project to its successful completion.

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It isn't the thing you do  
 It's the thing you leave undone  
 which gives you a bit of heartache  
 At the setting of the sun  
**er from the poem 'The Sin of Omission'**

**M E Sangst**