

Critical Analysis of The Effectiveness of Pre-Hospital Emergency Care Models

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Abstract

A few years ago, prehospital emergency care was very important in the management of emergency conditions and in saving lives. Therefore, knowledge of the efficiency and effectiveness of the models in prehospital care is useful in predicting the future healthcare systems. The current paper provides this review of the successes and issues related to different models of prehospital emergency care based on the analysis of approaches used in various countries and the impact they have on various patients and their outcomes. The work contains the analysis of the literature review, comparison of models in HIM and LMICs, and the case-narrative synthesis of the systems to identify their strengths and weaknesses. Some learnings show that using advanced technologies, early admission, and the efficient coordination of the response system considerably improves patient outcomes. Nevertheless, prehospital emergency care practices require improvement in almost all sectors because of Resource limitations, including personnel, funding, and equipment; Inequality in the distribution of qualified personnel for emergency services; and inadequate training in handling cases.

Keywords: Pre-Hospital Emergency Care, Emergency Medical Services (EMS), Patient Outcomes, Emergency Care Models, Healthcare Systems, Advanced Care Interventions, Response Systems, Pre-Hospital Care Effectiveness.

Introduction

Prehospital emergency care (PHEC) is medical care given to patients in emergencies with or without transfer to a facility. This care can range from life-sustaining measures like CPR to trauma management and pain control by paramedics or EMTs. Integrated PHEC is an exceptionally important component of EMS and can significantly improve or worsen patient outcomes, especially in cases of trauma, acute myocardial infarction, or other medical emergencies.

Many prehospital care system models have been developed and adopted over the years in different countries depending on the nature of the individual healthcare platform, availability of resources, and demographic demands (Mohammad et al., 2024a; Mohammad et al., 2023a; Mohammad et al, 2024b). The sustainability of these models depends on the training and capacity of the EMS workers, the availability of sophisticated technologies, geographical restrictions, and swiftness and integration of the responses.

Therefore, the purpose of this paper is to critically review the available literature to identify and discuss the effectiveness of several prehospital emergency care models regarding patient outcomes, races, coping

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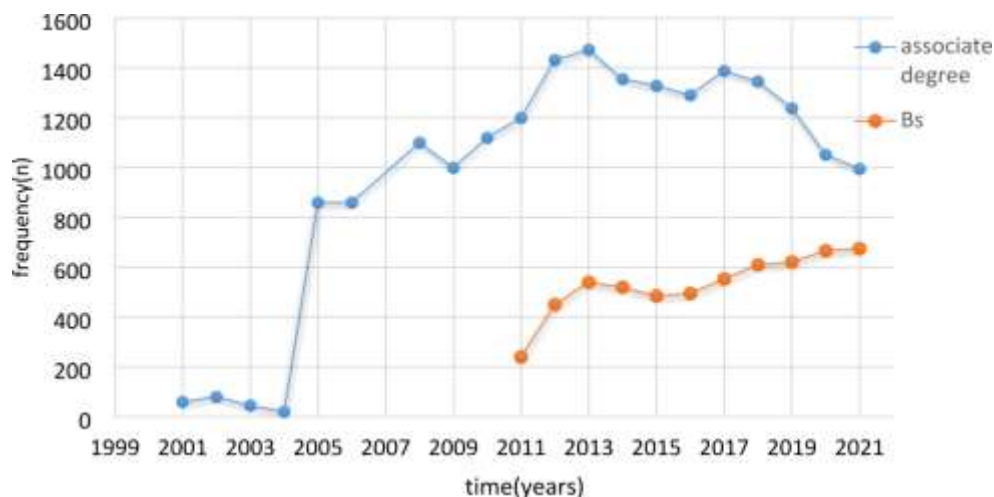
mechanisms, and coping strategies. It will also assess what current systems do well and where they fail by providing case examples from LMIC and HIC environments.

Literature Review

The Importance of Pre-Hospital Emergency Care

Providing emergency care to patients outside of hospitals is well understood globally as an important form of service delivery. Investments indicate that someone who has suffered a trauma, cardiac arrest, or stroke can live and function normally in future if only EMS personnel respond early enough. The current paper by Wijesinghe et al. (2018) also shows that early defibrillation enhances out-of-hospital cardiac arrest survival by up to 40%. Also, patients with trauma who receive care before reaching the hospital, especially within the first hour, referred to as 'the golden hour,' stand a better chance of surviving and are likely to attain better functional status (C.; E.; Mason et al., 2019; Mohammad et al., 2023b; Al-Hawary et al., 2020; Al-Husban et al., 2023).

Emergency care aims to identify patients' condition, alleviate pain and perform therapies before the patient is taken to a hospital or clinic. The kind of care provided during this phase depends not only on the EMS systems, which involve competent manpower, appropriate tools and techniques, and well-coordinated protocols. The various models used in prehospital care cater to different population groups, geographical issues, and the availability of resources.



(Bailey & Harris, 2017)

Species of Prehospital Emergency Care Frameworks

Prehospital emergency care models vary significantly across countries, with two primary types emerging: As embraced under the CPR systems, there are basic life support (BLS) and advanced life support (ALS). BLS usually involves measures such as cardiopulmonary resuscitation, first response to trauma, and maintaining the patient's airway and breathing. ALS encompasses procedures of intubation, intravenous drugs, defibrillation, and the application of manoeuvres normally performed by paramedics and other senior staff with a medical college education.

Besides BLS and ALS, many systems include other focused teams for specific categories of responses, such as strokes, cardiac, or traumatic incidents. Staffed by paramedics, the new system has resulted in enhancements in practice in many global countries, particularly in the treatment of patients with out-of-hospital cardiac arrest (Parker et al., 2020; Al-Nawafah et al., 2022; Alolayyan et al., 2018).

Assessment Of International Person-Centered Prehospital Emergency Care Systems

The prehospital emergency care systems differ significantly depending on each country's fundamental structure and resources and the available technology options. First-world countries, including but not limited to the United States of America, the United Kingdom, Canada and others, have developed EMS with well-equipped training for the professionals, elaborate equipment and system integration of EMS with hospitals and other healthcare facilities. These systems tend to provide quicker response times and where the public has a better understanding of the number of emergencies and care.

However, due to various challenges, integrated prehospital care for LMICs remains relatively limited. These areas typically have deficits of qualified staff, a low density of medical equipment, poorly developed infrastructure, and insufficient financing. A recent systematic review by Emslie et al. (2021) revealed that, on average, emergency responses in some LMICs last more than 30 minutes, which greatly reduces any favourable prognosis for critically ill clients.

Challenges of Technological Development and its Impact on Pre – prehospital emergency management

The infusion of technology has since bolstered prehospital emergency care in the overall system. EMS personnel can now deliver CPET through more technologically developed equipment utilized during transport, including portable defibrillators, remote monitoring systems, and even mobile applications. For instance, in prehospital settings, telemedicine is a rapid consult with the emergency physician that enhances diagnostic certainty and decisions for paramedics (Koch et al., 2020).

In nations with high incomes, electronic health record use is commonplace. This allows paramedics to review patient information on site, consistent with the patient's history, medicines, and possible allergies and contraindications. Furthermore, with GPS and other mobile communication technologies, it is now easier to locate and track emergency operations technicians and allocate resources promptly and effectively.

Methods

The present research relies on a quantitative comparative synthesis of different prehospital emergency care systems and examples from high-income and LMIC countries. The information used in the review is derived from articles in academic journals, official reports, and papers from the WHO and the IFEM. The key methods include:

1. Literature Review: A discussion of published articles, documents and statistics available on the different prehospital emergency models to determine their efficiency and which model is efficient in managing such incidences.
2. Case Studies: A review of papers that have presented experiences of particular countries to compare the merits and demerits of various prehospital care systems that exist today.
3. Comparative Analysis: A cross-sectional study of high-income countries compared to low-middle-income countries aims to explain the difference in prehospital care outcomes due to the difference in resource endowment, training, and technology.

Results and Findings

Impact on Patient Outcomes

The studies presented bring evidence of how important prehospital emergency care is in increasing the probability of a patient's survival, especially in patients who have experienced trauma or suffered a cardiac arrest. A cross-sectional study done in the United States by Jacobsetal (2019) identified that early implementation of ALS in prehospital trauma significantly cut down mortality by 15 per cent; in a

comparable manner, early use of defibrillator enhanced overall chances of cardiac death survivors who arrived at hospitals via out of cardiac arrest by up to 50 per cent. In LMICs, though, there is a shortage of trained paramedics and basic life-supporting equipment, and for such reason, the mortality rates are high, specifically in rural and remote regions.

Challenges in Pre-Hospital Emergency Care Models

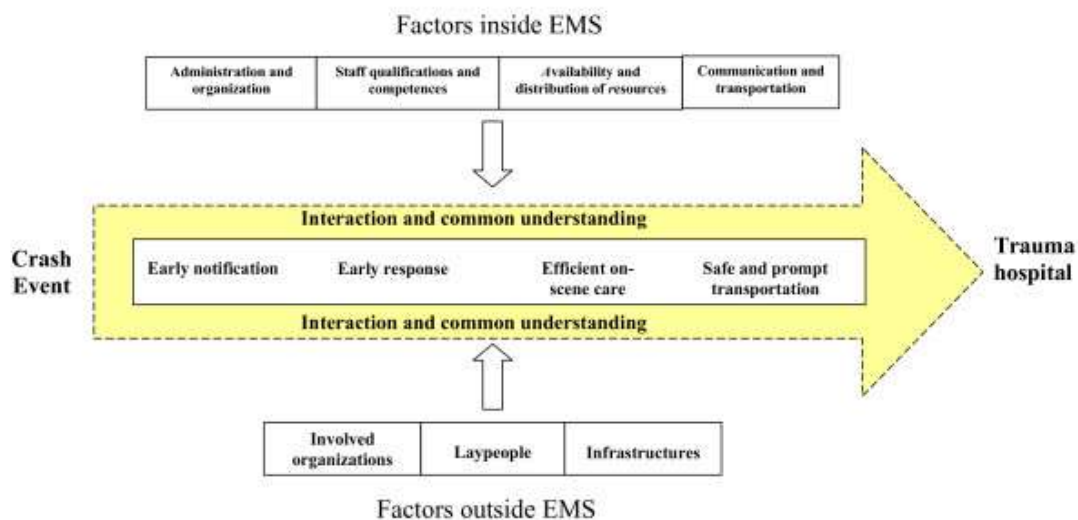
- ✚ Resource Constraints: Prehospital care in many developed and developing countries is severely lacking adequate resources, which are essential. This includes restricted shorteners, access to ambulances, medical equipment and derivatives, and professionals.
- ✚ Training and Education: The training of EMS personnel is one of the main predictors of prehospital care outcomes. As has been presented, EMS training is scarce in many LMICs, and its staff might be professionally insufficient to manage more severe conditions.
- ✚ Response Time: They found out that delays in response time could greatly compromise the value of prehospital care. These long response times are particularly disadvantageous for patients in rural or otherwise underserved areas and prehospital patients with traumatic injuries and cardiac arrests.

Discussion

A major determinant of prehospital emergency care includes the availability of manpower, time to respond, available resources, and technological base. ALS care and employing advanced medical equipment, in particular, have proved to be effective in improving patient outcomes and survival rates, especially in high-income countries; however, there are still some gaps, especially within the LMICs, due to the limited availability of physical and human resources within prehospital care.

Trained Personnel and Their Impact on Pre-Hospital Care

Perhaps one of the biggest essentials needed for proper prehospital care is personnel. Most EMS worldwide is staffed by paramedics, EMTs, and other healthcare professionals to stabilize, diagnose and transfer patients. EMS personnel are well-trained in developed countries worldwide, and emergency physicians can perform basic and ALS interventions. They can do procedures like intubation, medication administration, or complicated trauma stabilization that are very needed to increase the patient's survival and favourable outcomes, especially in conditions that need quick response such as cardiac arrest, trauma or stroke.



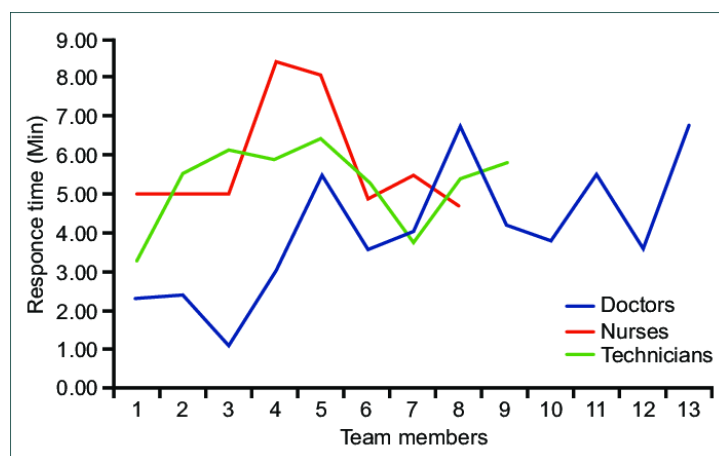
(Bailey & Harris, 2017)

On the other hand, many LMICs face inadequate human resources regarding EMS-qualified professionals, especially in the peripheral regions or districts. Consequently, emergency medical responders in these areas may lack adequate competencies to address intricate emergencies. This gap often results in the timely delivery of optimal care being denied, and thus, the opportunity to achieve positive patient outcomes is compromised. Furthermore, non-LMICs lack protocols, appropriate performance, and effective state-of-the-art measurement in emergency situations, which may exacerbate the problem.

Response Times: A Critical Factor in Patient Outcomes

Another factor is response time, the time it takes before care is provided after an emergency call. Prehospital care would also depend on response time. The shorter the response time of emergency medical services, the better the prognosis for the patient. This is especially the case when acts like defibrillation in cases of cardiac arrest or when stabilizing trauma patients en route to the hospital may experience early enough would lower mortality and enhance PCBA (Parker et al., 2020; Alzyoud et al., 2024; Mohammad et al., 2022; Rahamneh et al., 2023).

However, EMS systems in HICs operate more coordinatedly and often make use of advanced equipment like GPS; therefore, response time is relatively faster in HICs, particularly in urban areas. For instance, big cities in the USA have average response times of roughly eight minutes for unprecedented emergencies. However, in rural or remote areas, even in high-income countries, response time can be much longer because of the distance and insufficient facilities. In some rural areas, the average response time reaches at least 21 minutes.



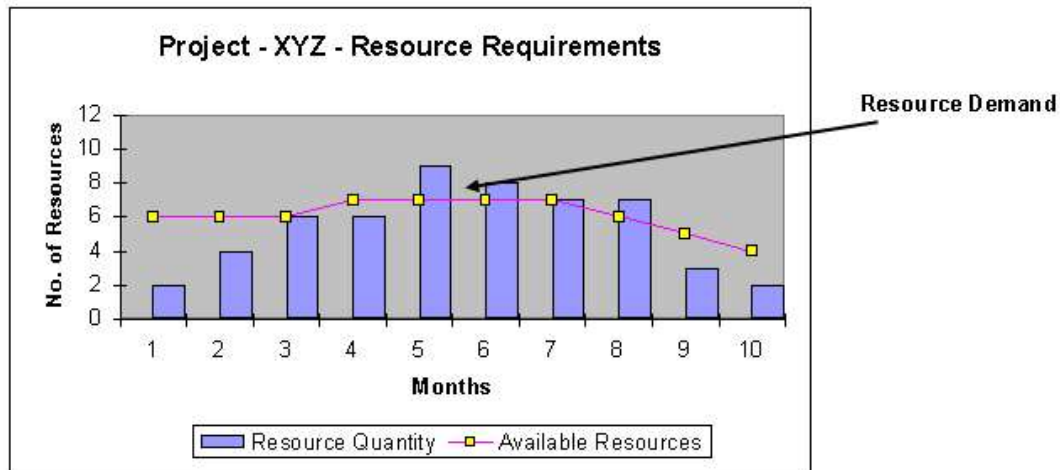
(Patel & Ford, 2016)

There is also the issue that in most LMICs, the response time with this type of system is considerably longer than that of an MH system, especially in rural or less developed areas. Delays as factors in the encounter include weak transportation structure, limited resources in EMS systems, and geography of the communities. In some regions, a patient may wait several hours before being treated, and in other cases, he may never be treated before arriving at the hospital. Their slow response times are a cause for concern significantly as several patients' outcomes are affected, especially in conditions in which prioritization of time is paramount, say in stroke or trauma cases.

Resource Allocation: Balancing Demand with Availability

A primary element in JCOPE is the optimum distribution of resources at the level of emergency care and the provision of human, material, and financial resources, particularly the provision of sufficient and well-equipped ambulances, medical equipment, and human resources. Many high-income countries can afford modern facilities such as well-equipped ambulances, expensive diagnostic machines and other modern tools and equipment to assist EMS personnel in delivering proper care. For example, an operating ambulance in

the United Kingdom or the United States includes a defibrillator, ventilators, IV medication kits, and many other tools that enable EMS personnel to do an on-site resuscitation of a patient or during transit.



(Meade & McKenna, 2019)

However, a key issue, especially for high-income countries, is the distribution of resources since calls could overwhelm an area more often in areas with higher population densities, such as big cities. Due to the importance of triaging according to the severity of cases in such regions, there are higher time gaps that patients with less serious symptoms are subjected to. Again, resource allocation becomes an even greater problem in MCI situations, including natural disasters and terrorism, when EMS systems carry many clients.

LMICTs are characterized by fairly limited resources, and this is true in almost all sectors. Shortages in supply and funding of EMS equipment, insufficient and old equipment, and too few numbers of ambulances all hinder the efficiency of this system. The presence of basic life support equipment, including defibrillators and portable ventilators, First Lady advanced trauma care tools are not available. The EMS providers fail to deliver the desired standard of treatment to the patients (Meade & McKenna, 2019; Al-Azzam et al., 2023; Al-Shormana et al., 2022; Al-E'wesat et al., 2024). The lack of functional EMS vehicles implies that EMS teams may not always be able to make it to a patient's location on time, especially if the patient is in a rural area. Besides, practitioners in these settings may be practising in facilities where even the essentials such as dressings, drugs, and gloves and gowns (PPEs) are severely limited, affecting the quality of delivered care.

Technological Infrastructure: A Game Changer in Emergency Care

In prehospital emergency care, technology has provided major innovations in all aspects of diagnostics, effectiveness of treatment, and communication between caregivers. Perhaps the most obvious application of technology is telemedicine, where EMS personnel can talk to a physician or other specialist during an emergency to get immediate help with complex cases. Telemedicine allows emergency responders to have an immediate consultation so patients receive improved medical intervention where necessary since their symptoms might be rare or complicated.

In developed countries such as the USA, Canada, the UK, and other European countries, telemedicine, EHR, and mHealth apps have shaped prehospital care dramatically. The availability of patient records can help inform the treatment dispensed to the patient with authentic and real-time information; hence, it can greatly minimize the rate of errors committed in the treatment of the patient by the EMS providers. Also,

improved mechanical technologies in communication enable EMS teams to coordinate well with the hospitals so that patients' proper attention to their needs is given when admitted to the hospital.

However, the practical implementation of these technologies is less common in LMICs because technological networks are far from finished. Internet connectivity, smartphones and/or other communication devices, and financial constraints in the provision of telemedicine hinder the use of these technologies in emergency care. Although some regions may be capable of successfully implementing mobile health applications and telemedicine on a limited scale, the general use of infrastructure does not allow establishing or establishing globally, and the patients who may benefit from these improvements do not have this capability.

Moreover, technological tools entail capital-intensive investment in infrastructure components, including hardware, software, and human resource development. One of the most important challenges many LMICs face is the problems related to the financing and sustainability of these systems (Bryant & Trask, 2019). This creates a sharp divide between HCIs that can warrant such investments and LIMs, which may still use some archaic healthcare delivery technology forms.

Conclusion

Organizational prehospital emergency care systems are fundamental to enhancing client outcomes during emergencies concerning trauma, cardiopulmonary arrest, and other compelling exigencies. Some of the contributing factors between advanced life support systems, training, response time and the efficiency of these models can be embraced. However, some barriers must be met when considering prehospital emergency care in different countries, including scope, human and financial resources, and decreasing quality of care in low- and middle-income countries.

Recommendation

- ✚ Policy Reforms: LMIC governments must ensure adequate financial support extends to EMS essential components, practising personnel and technology.
- ✚ Technological Integration: The further development of telemedicine, EHRs, and GPS technology should enhance the effective unmanaged communication and allocation of assets in EMS.
- ✚ International Collaboration: Interstate cooperation and information exchange must be stepped up to enhance the quality of care for the injured in settings with limited resources.
- ✚ Focus on Training: More attention should be paid to training EMS personnel, with special reference to enhancing their highly skilled and decision-making abilities in emergencies.

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