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Review

Pakistan's Emergency Medical Services (EMS) system & out-of-hospital-cardiac-arrest (OHCA): A narrative review of an EMS system of a low middle income country in context of OHCA

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Abstract

Pakistan's Emergency Medical Services (EMS) are a critical component of its healthcare system, providing pre-hospital emergency care across a nation with over 220 million people. This article explores the evolutionary journey of Pakistan's EMS, highlighting both the challenges it faces and the strides it has made, with a specific emphasis on patients experiencing out-of-hospital cardiac arrest (OHCA). To extract relevant information, we searched MEDLINE & Embase data bases using MeSH terms "Emergency Medical Services" OR "EMS" AND "Out-of-Hospital-Cardiac-Arrest" OR "OHCA" AND "Pakistan". In addition, we also retrieved information from the EMS leadership in Pakistan through e-mails. We delve into the significance of key performance indicators for OHCA, advocate for the establishment of OHCA registries to improve patient outcomes, address regional disparities in pre-hospital care, and acknowledge the gradual progress of the EMS system.

Keywords: Emergency Medical Services (EMS), Out-of-hospital-cardiac-arrest (OHCA)

Introduction

Pre-hospital emergency care, facilitated by emergency medical services (EMS) or pre-hospital emergency medical services (PEMS), is fundamental to emergency care systems. This continuum of care, from the incident scene to the emergency room, aims to rapidly assess medical emergencies, dispatch essential resources, and provide immediate care. The primary objective of pre-hospital care is multifaceted: to swiftly determine the nature of medical emergencies, effectively coordinate the deployment of essential resources such as ambulances, paramedics, and emergency medical technicians (EMTs), and equip them with life-saving medications and equipment, ensuring the delivery of immediate emergency care. Subsequently, patients are transferred to the most suitable facility to receive prompt, optimal treatment.[1]

The presence of a well-functioning EMS is paramount in improving outcomes for time-sensitive illnessess like out-of-hospital-cardiac-arrest (OHCA) and various injuries. As the outcomes of OHCA patients are dependent on the early recognition of cardiac arrest, rapid dispatch of ambulance and paramedics, and early initiation of CPR and defibrillation, the presence of a well-established and fully functional EMS significantly impacts their survival rates. However, the EMS landscape, especially in low and middle-income countries (LMICs), is often fragmented, with disparities even within the same country, posing significant challenges to timely and efficient emergency care.[2] In many low-middle-income countries (LMICs), the challenge extends beyond the scope of emergency medical services (EMS) as merely a mode of transportation; transportation itself is a significant issue, compounded by inadequate infrastructure, limited accessibility in rural and remote areas, and the scarcity of vehicles equipped for medical emergencies. Consequently, many LMICs utilize EMS primarily as a means of transport, often without the essential components such as field triage, standardized care practices, and effective communication with receiving healthcare facilities. This reliance not only hampers the timely delivery of emergency care but also exacerbates the problem by failing to address the critical needs of patients during transport. The absence

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of a functional EMS system constitutes a significant contributor to elevated morbidity and mortality rates associated with conditions like OHCA, traumatic injuries, stroke, sepsis, as well as obstetrics and gynaecological emergencies.[3–5] Bridging these gaps requires a holistic approach to EMS development, one that enhances the transportation network while integrating comprehensive emergency care services to ensure better patient outcomes.

To underscore the significance of a well-functioning EMS system, consider the findings of a multicentric study conducted in 2016 in Karachi, Pakistan—a bustling metropolitan city with an approximate population of 20 million. This study reported an alarming survival rate of 0% among OHCA patients merely two months after hospital discharge. Multiple multifactorial factors contribute to this grim outcome, including a fragmented EMS system, inadequate availability of resources and equipment, insufficient skills among emergency healthcare personnel, and a dearth of advanced life care facilities. Distinctively, the utilization of ambulances is limited in LMICs, with a meager 4.1% of patients in Pakistan opting for ambulance transport to reach emergency rooms. Most patients are transported via private or non-ambulance means.[6]

OHCA patient survival is intrinsically tied to specific prognostic factors. These include the presence of a bystander or EMS staff witnessing the cardiac arrest event, the existence of a shockable rhythm, and the achievement of on-field return of spontaneous circulation (ROSC).[7–10] Remarkably, all these factors are intricately connected to the presence of a functional EMS system. This article explores the journey of Pakistan's EMS, highlighting both the challenges it faces and the strides it has made, with a specific emphasis on patients experiencing out-of-hospital cardiac arrest (OHCA).

Methods

Search strategy

To ensure a comprehensive literature review, we employed a structured search strategy. Our primary data sources were MEDLINE and Embase, two widely recognized databases that collectively offer extensive coverage of medical and healthcare research.

The search was conducted using a combination of Medical Subject Headings (MeSH) terms and text words to capture the broadest possible range of relevant studies. The MeSH terms used were "Emergency Medical Services" OR "EMS" AND "Out-of-Hospital-Cardiac-Arrest" OR "OHCA" AND "Pakistan". This combination was chosen to specifically target studies that discuss EMS's involvement with OHCA cases within the geographic context of Pakistan.

We included peer-reviewed studies published in English that detailed EMS response to OHCAs, the protocols used, outcomes, challenges, and improvements within the context of Pakistan.

Retrieval of additional information

Recognizing the lack of relevant data or insights not covered in the academic literature, we also reached out directly to EMS leadership in Pakistan. This was achieved through a series of targeted emails to key individuals in EMS organizations, requesting information on their experiences, organizational structure, challenges, and outcomes related to OHCA. These communications were aimed at gathering qualitative data to supplement the narrative review with practical, current insights from the field.

The synthesis of this data involved a narrative approach, integrating findings from the literature with insights from EMS leadership to provide a comprehensive overview of the current state of EMS with emphasis on OHCA in Pakistan.

Study settings

Demographics of Pakistan

Pakistan, a South Asian country, has a population exceeding 220 million, ranking as the fifth most populous nation globally. According to World Bank data, 62% of its population lives in rural areas.[11] Spanning over 880,000 km^2, it is the world's 33rd largest country by area and the second largest in South Asia. Pakistan's diverse landscape includes coastal plains, glaciated mountains, hills, deserts, forests, and plateaus.

The country is divided into five provinces: Sindh, Punjab, Khyber Pakhtunkhwa (KP), Baluchistan, Gilgit-Baltistan, and the state of Azad Kashmir. Administratively, each province is further segmented into divisions, districts, tehsils, and union councils, with the union council serving as the fundamental administrative unit.

Pakistan's healthcare system encompasses primary and secondary facilities in rural and peri-urban areas, alongside large tertiary institutions, including teaching hospitals in urban centers. The system is managed by the provincial governments.

EMS evolution in Pakistan

To appreciate the current state of Pakistan's EMS, we must revisit its evolution. The pre-hospital emergency care in Pakistan is fragmented, with EMS and ambulance services operating independently. The EMS system is governed by the provincial governments whereas the ambulance services are operated by a mixture of private, not-for-profit and philanthropic organizations. The formal EMS system as we recognize it today was only established in 2006. Prior to this pivotal development, pre-hospital care was predominantly delivered through non-EMS-based ambulance services, mainly operated by philanthropic organizations and a few private entities. These services often served as transportation means and lacked essential components such as triage, medical care, and effective communication.

The establishment of professional emergency services in Pakistan was necessitated after the failure of repeated attempts to revitalize and modernize the Civil Defense Organization and Municipal Fire Brigades. Factors such as lack of trained emergency personnel, dedicated training institutes & resources and apprehension about the autonomy been taken away from these organizations were the major barriers in establishing a dedicated emergency response service in Pakistan.

The pressing need for dedicated rescue and emergency medical services in Pakistan became glaringly evident during the devastating earthquake that struck the northern areas of Pakistan in October 2005, causing massive destruction and loss of lives. The disaster also highlighted the lack of a structured emergency service, which often resulted in an inadequate response to emergencies and disasters, leading to unnecessary loss of lives and property. This catastrophic event underscored the necessity for a comprehensive EMS system in the country. Consequently, in 2006, an emergency service, the Punjab Emergency Services, Rescue 1122 (PES, Rescue 1122) was inaugurated in the province of Punjab, falling under the purview of the Punjab Emergency Services Department. This transformative initiative was not confined to emergency medical services alone; it also encompassed fire and water rescue services and disaster

response teams. Currently the Punjab Emergency Services (PES, Rescue 1122) is providing emergency services in the province of more than 127 million people, with over 15,000 emergency services personnel, 847 ambulances, 2,281 rescue motorbikes, 283 fire vehicles, 86 rescue vehicles and 202,942 community responders. The organizational staffing system of the Punjab Emergency Services Department is structured as a hierarchical staffing model (Fig. 1). The Provincial Monitoring Cell oversees the entire operations of the Emergency Services Department which is the central operational unit. Directly under the department, there are two branches. On one side, there is the Emergency Services Academy, which is responsible for training and education and on the other side, there is a tiered system of emergency officers, including 09 Divisional Emergency Officers, 36 District Emergency Officers and 146 Tehsil Rescue & Safety Officers, who oversee emergency services at the division, district and tehsil level respectively.

The Emergency Services Academy has now become the national centre for training for all the provinces in Pakistan. The staff go through a vigorous training program including basic and specialized courses in EMS, fire & water rescue, collapsed structure search & rescue and disaster response.

Since 2006, the EMS & Rescue services have gradually evolved across Pakistan (Table 1) and is governed by the respective provincial governments.

National impact

Over time, Pakistan's EMS system has achieved significant milestones and has extended its reach to all provinces of the country. In the province of Punjab, the EMS has cast a wide net, extending its coverage to every district and tehsil within the province. What sets Punjab apart is its remarkable ability to provide high-quality rescue services and pre-hospital emergency care while adhering to rigorous standards. The Punjab Emergency Services is the first United Nations International Search & Rescue Advisory Group (INSARAG) certified rescue service in South Asia, reflecting its capacity to deliver top-tier rescue services. The impact of this Emergency Rescue Service is nothing short of remarkable, with more than 12 million accident and disaster victims saved through timely and efficient responses. Notably, the Punjab Emergency Services has confronted Pakistan's unique challenges, such as congested urban localities and traffic jams, by pioneering a Rescue Motorbike Service with paramedical staff. This innovative service boasts an impressive average response time of 4 minutes and has responded to over 1.3 million emergencies to date.

In the quest for enhanced pre-hospital patient care, the Punjab Emergency Service has embarked on various initiatives. One notable effort focuses on cultivating socially responsible, safe, and resilient communities through the establishment of Community Emergency Response Teams (CERTs) and Rescue Scouts.[12] Other provinces have also progressed over the years. In 2014, the Emergency Medical Services (EMS) in the province of Sindh was honored with the prestigious "Institutional Award" by the Asian Emergency Council, now known as the Asian Association for Emergency Medical Services (AAEMS). This accolade serves as a powerful acknowledgment of Sindh's EMS's commitment to excellence and innovation in the field. The AAEMS plays a pivotal role in advocating for EMS across various Asian communities, tackling critical issues such as EMS training standards and accreditation. Initially, the EMS in Sindh was governed by a not-for-profit private organization, with services extending to only a few districts. Despite facing significant challenges, including sustainability, the system has seen remarkable expansion throughout the entire province and has transitioned to governance by the provincial government. This expansion underscores the system's resilience and ability to innovate in the face of obstacles. Further bolstering the province's emergency response capabilities, the Sindh Emergency Service Rescue 1122 (SES Rescue 1122) was launched in June 2022. This dedicated rescue service spans across the divisional headquarters of the province, seamlessly integrating rescue operations, emergency medical services, and firefighting.[13,14] This comprehensive approach not only enhances the province's emergency response infrastructure but also stands as a testament to the enduring impact of the 2014 AAEMS award, symbolizing the system's ongoing commitment to elevating emergency

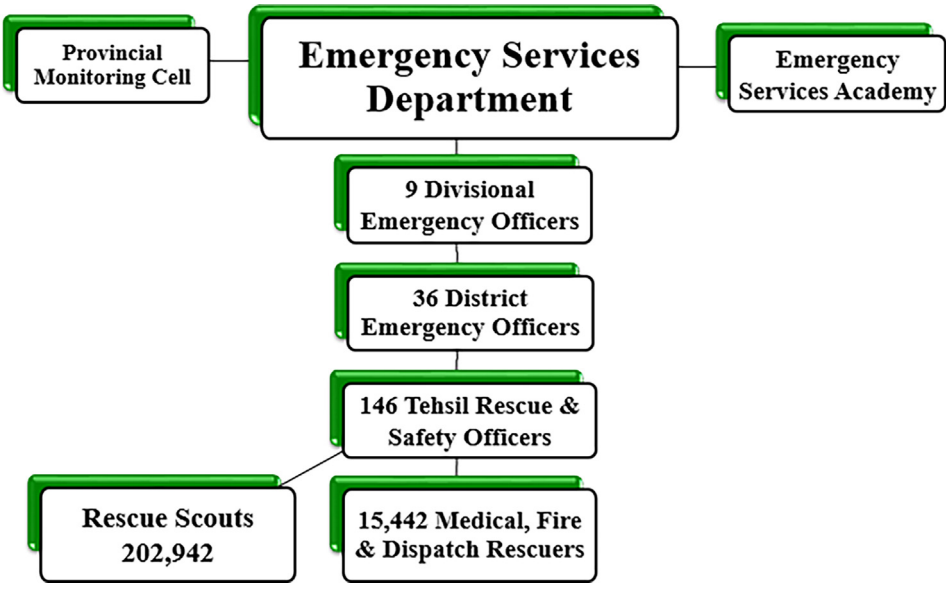

Fig. 1 – Staffing System of the Punjab Emergency Services Department.

Table 1 – EMS Evolution in Pakistan.

2006	Start of Emergency Services Academy.
2007–2008	Emergency Services establishment in 12 major cities of Punjab province.
2009	EMS establishment in Karachi, the provincial capital of Sindh.
2010	Assistance and Training of Emergency Services in Azad Kashmir.
2010	Emergency Services establishment in the province of Khyber Pakhtunkhwa (KP).
2012	Assistance and Training of Emergency Services in the province of Gilgit Baltistan.
2015	Assistance and Training of Emergency Services in the province of Baluchistan.
2015–2017	Completion of expansion of Emergency Services in all the districts and tehsils in the province of Punjab.

medical care standards across the region. The EMS systems in the provinces of Khyber Pakhtunkhwa (KP), Baluchistan, Gilgit Baltistan (GB), and in the state of Azad Kashmir are also actively progressing and improving (Table 2).

OHCA & Pakistan's EMS systems

The development of Pakistan's EMS system has been a gradual process, facing significant challenges in delivering efficient outcomes, especially for out-of-hospital cardiac arrest (OHCA) patients. A multicentric study in Karachi revealed that 92% of OHCA patients did not receive resuscitation, leading to a 0% survival rate two months post-hospital discharge. Despite 92% of cardiac arrests being witnessed, only 2.3% of patients received bystander CPR, and merely three cases involved dispatch-assisted CPR.[6] These inadequate resuscitation attempts may stem from an insufficient EMS system that only partly covers a city of over 20 million, the lack of a unified emergency response number, the absence of public-access automated external defibrillators (AEDs), and community unawareness regarding OHCA response. The 'chain of survival'—a concept emphasizing the need for immediate medical intervention through coordinated efforts among bystanders, emergency dispatchers, and paramedics—is crucial for improving OHCA outcomes.[15] Effective collaboration among these groups is essential; the absence of any link can break this chain, leading to suboptimal results. Therefore, establishing a robust and efficient pre-hospital emergency medical service is paramount. Such a service should be capable of not just swift response but also of initiating crucial medical care even before EMS personnel arrive at the scene. Regions with more robust and well-organized EMS systems tend to report better outcomes for OHCA patients.[16,17]

Given the constraints in resource-limited settings like Pakistan, the International Liaison Committee on Resuscitation (ILCOR) recently introduced the concept of a 'chainmail of survival' to address the challenges in managing OHCA patients.[18] This model features multiple interconnected supports rather than a singular chain, enhancing the system's resilience even when some components are compromised, considering the available resources. To bridge these gaps, Pakistan has launched community-based initiatives such as the Pakistan Life Savers Programme (PLSP), aimed at teaching life-saving skills like CPR to its citizens. Such efforts are designed to improve pre-hospital resuscitation rates and, consequently, the outcomes for OHCA patients in Pakistan.[19]

However, the path to achieving an optimized EMS system is complex and marked by variations that are not just international but also intra-national. These variations are deeply rooted in a myriad of factors, including organizational and systemic disparities. Within the same country, differences in EMS can manifest through divergent infrastructure, service delivery methods, protocols, certifications, governance structures, oversight mechanisms, communication systems, coordination efforts, and legal frameworks. These disparities underscore the multifaceted nature of the challenge, highlighting the need for a targeted, context-specific approach to refine and harmonize EMS systems, thereby enhancing the chain of survival for OHCA patients and improving healthcare outcomes on a broader scale.

Table 2 – EMS comparison between different provinces in Pakistan.

	Punjab	Sindh	KP	Baluchistan	Gilgit Baltistan	Azad Kashmir
EMS Delivery Model	Emergency Rescue & Medical Services	Emergency Rescue & Medical Services	Emergency Rescue & Medical Services	Emergency Rescue & Medical Services	Emergency Rescue & Medical Services	Emergency Rescue & Medical Services
Coverage	37 Districts (Estimated population covered:127 million/127 million people- 100%)	30 Districts (Estimated population covered: 16 million/55 million people- 29%)	35 Districts (Estimated population covered: 15 million/41 million people-36%)	25 Highways (Estimated population covered: Not known)	08 Districts (Estimated population covered: Not known)	Estimated population covered: Not known
Access/ Regional Toll-Free Number	Yes	Yes	Yes	Yes	Yes	Yes

Based on our review, we suggest the "Emergency Care Integration Framework" as a holistic strategy to enhance OHCA care in Pakistan. This strategy involves integrating public, private, and philanthropic emergency care providers, supported by a single emergency response number (Fig. 2). The framework advocates for policy reform and improved governance structures, promotes the adoption of innovative practices and technologies tailored to the socio-cultural norms, needs, and resources available in Pakistan, and aims to expand service reach to ensure accessibility across all regions. It also emphasizes capacity building for EMS staff, adherence to high-quality care standards, and the implementation of a robust monitoring and evaluation system to continuously assess and enhance the emergency care response to OHCA.

Diverse population, diverse needs

Pakistan, with a population exceeding 220 million people, ranks as the 5th most populous nation globally.[20] Its diverse demographic regions encompass the plateaus of Punjab, the coastal areas and deserts of Sindh and Baluchistan, and the mountainous terrain of Khyber Pakhtunkhwa (KP), Gilgit Baltistan, and the State of Azad Kashmir. Within these regions, the population is further divided between urban and rural areas. These diversities in Pakistan are compounded by factors such as inadequate infrastructure, including roads and telecommunications, which hinder access to certain populations, and socio-cultural practices, like areas where female patients prefer care solely from female emergency providers, posing challenges to pre-hospital emergency care. Disparities in pre-hospital care are evident not only across regions but also within the country, as evidenced in Table 2. The EMS system is often fragmented, with ambulances primarily serving as transport vehicles lacking standardized care protocols, communication, and coordination with healthcare facilities.

Effective pre-hospital care across Pakistan's diverse landscapes requires robust infrastructure, ample resources, and specialized expertise, supported by strategic planning to meet societal needs. However, current resuscitation guidelines are tailored to high-resource settings and do not fully address the challenges in low- and middle-income countries like Pakistan.[18] Adapting strategies to community needs, such as training local members as first responders, employing motorcycles or alternative transportation where ambulances are impractical, integrating women into EMS roles, and launching educational and awareness programs through schools, colleges, and religious institutions, alongside promoting Good Samaritan laws, could mitigate some of these challenges in pre-hospital emergency care.

Data collection & registries

EMS services worldwide focus on key performance indicators to enhance their performance and subsequently improve OHCA patient survival rates. These indicators encompass the time taken to recognize cardiac arrest, the time required for CPR instructions, the time to initiate chest compressions, and emergency response times. While EMS agencies in Pakistan do collect data regarding medical and traumatic emergencies, the scope of this data collection is relatively narrow, primarily focusing on a limited set of variables. There is a noticeable lack of emphasis on collecting comprehensive data related to out-of-hospital cardiac arrest (OHCA) incidents. This aligns with findings from a scoping review aimed at evaluating clinical outcomes for OHCA patients in low-resource settings, identifying gaps, and suggesting improvements and research directions. The absence of standardized Utstein-style reporting, which details key OHCA metrics, has led to diverse and incomplete data. This highlights the critical need for a comprehensive EMS data system that can accurately gather and convey pertinent information, thereby facilitating the development of lasting solutions.[21] This gap is significant as OHCA-related indicators, such as response times, bystander CPR rates, defibrillation application before EMS arrival, and detailed patient outcomes, are critical for evaluating the effectiveness of the EMS system and improving the chain of survival. Without a robust dataset encompassing these specific indicators, it becomes challenging to perform a thorough analysis of the situation, identify areas needing improvement, or benchmark against international standards. Consequently, the potential for informed policy-making and targeted interventions to enhance OHCA outcomes remains largely untapped.

Expanding the data collection framework to include these OHCA-related indicators is not just a theoretical enhancement but a practical necessity, as evidenced by recent research outcomes in the field. This approach could significantly contribute to a more nuanced understanding of emergency medical services' operational dynamics and pave the way for substantial improvements in patient care and survival rates. In support of this notion, a study conducted in Karachi, Pakistan, serves as a stark illustration of the current challenges and

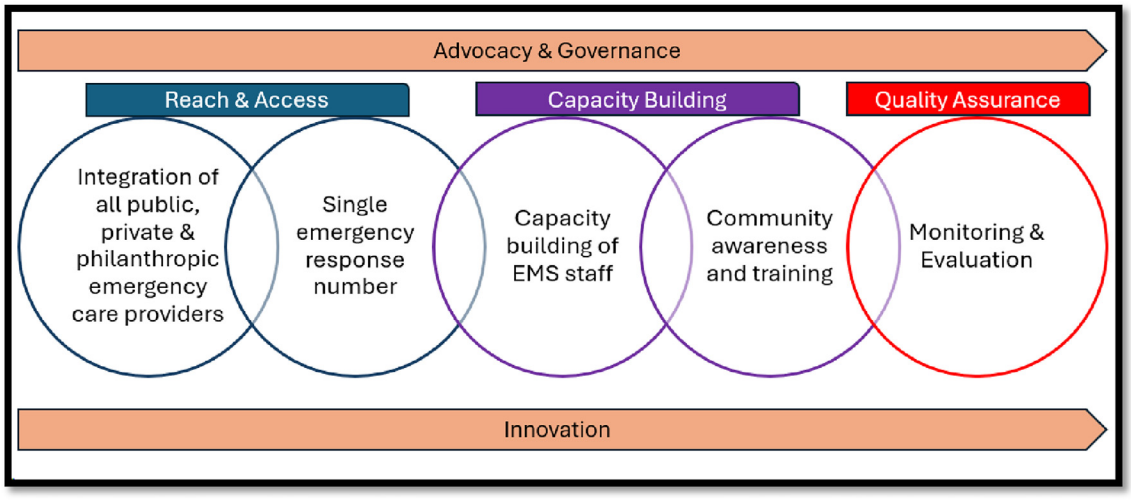

Fig. 2 – The Emergency Care Integration Framework.

underscores the urgency of reform. The study revealed critical delays at various stages of the emergency response. For instance, it was found that the mean time taken for an EMS telecommunicator to recognize the need for CPR was 4 minutes and 59 seconds, markedly exceeding the recommended target of less than 2 minutes. Similarly, the mean time to commence CPR instruction was 5 minutes and 28 seconds, significantly overshooting the minimal acceptable target of less than 2 minutes. Furthermore, the study highlighted that the mean time to initiate chest compressions was 6 minutes and 4 seconds, surpassing the minimal acceptable target of less than 3 minutes.[22,23]. These findings not only illuminate the current gaps in the EMS response times in Pakistan but also strongly advocate for the inclusion of these specific OHCA-related indicators in data collection efforts. By doing so, EMS agencies can obtain actionable insights, enabling them to pinpoint inefficiencies, implement targeted training and protocols, and ultimately, improve the timeliness and quality of care for OHCA patients.

Recognizing that systems that do not measure cannot effectively improve, there exists a pressing need to gather data on these crucial indicators and establish OHCA registries. By identifying gaps through these indicators, interventions can be devised to enhance response times and ultimately improve outcomes for OHCA patients.

Conclusion

Pakistan's EMS system has come a long way since its inception in 2006. The gradual progress made in establishing a more robust and comprehensive EMS system across all provinces is commendable. Yet, challenges remain, particularly in ensuring the best possible outcomes for patients experiencing out-of-hospital cardiac arrest (OHCA).

It is imperative for Pakistan to prioritize the collection of OHCA-related data and establish registries to track and improve key performance indicators. Furthermore, addressing disparities in pre-hospital care, both between regions and concerning OHCA specifically, is crucial. Standardizing protocols, enhancing communication, and extending EMS coverage to underserved areas are essential steps in this direction.

By focusing on data-driven improvements and equitable access to pre-hospital care, Pakistan can not only enhance the outcomes of OHCA patients and continue to advance its EMS system, but also become a model of excellence in pre-hospital emergency care.

CRediT authorship contribution statement

Mirza Noor Ali Baig: Project administration, Data curation, Conceptualization, Writing – original draft. **Nadeemullah Khan:** Writing – review & editing, Supervision. **Rizwan Naseer:** Writing – review & editing. **Shahnaz Akhter:** Writing – review & editing. **Abid Jalaluddin Shaikh:** Writing – review & editing. **Junaid Abdul Razzak:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

1. Mehmood A, Rowther AA, Kobusingye O, Hyder AA. Assessment of pre-hospital emergency medical services in low-income settings using a health systems approach. Int J Emerg Med 2018;11:53. https://doi.org/10.1186/s12245-018-0207-6. PMID: 31179939; PMCID: PMC6326122.
2. Bhattarai HK, Bhusal S, Barone-Adesi F, Hubloue I. Prehospital emergency care in low- and middle-income countries: a systematic review. Prehosp Disaster Med 2023;38:495–512. https://doi.org/10.1017/S1049023X23006088. PMID: 37492946; PMCID: PMC10445116.
3. Mock CN, Jurkovich GJ, nii-Amon-Kotei D, Arreola-Risa C, Maier RV. Trauma mortality patterns in three nations at different economic levels: implications for global trauma system development. J Trauma. 1998;44:804–12; discussion 812-4. https://doi.org/10.1097/00005373-199805000-00011. PMID: 9603081.
4. Kobusingye OC, Guwatudde D, Owor G, Lett RR. Citywide trauma experience in Kampala, Uganda: a call for intervention. Inj Prev 2002;8:133–6. https://doi.org/10.1136/ip.8.2.133. PMID: 12120832; PMCID: PMC1730841.
5. Moosajee US, Saleem SG, Iftikhar S, Samad L. Outcomes following cardiopulmonary resuscitation in an emergency department of a low- and middle-income country. Int J Emerg Med 2018;11:40. https://doi.org/10.1186/s12245-018-0200-0. PMID: 31179917; PMCID: PMC6326149.
6. Mawani M, Kadir MM, Azam I, et al. Epidemiology and outcomes of out-of-hospital cardiac arrest in a developing country-a multicenter cohort study. BMC Emerg Med 2016;16:28. https://doi.org/10.1186/s12873-016-0093-2. PMID: 27465304; PMCID: PMC4963996.
7. Ho AFW, Hao Y, Pek PP, et al.; PAROS Clinical Research Network. Outcomes and modifiable resuscitative characteristics amongst pan-Asian out-of-hospital cardiac arrest occurring at night. Medicine (Baltimore). 2019;98:e14611. https://doi.org/10.1097/MD.0000000000014611. PMID: 30855446; PMCID: PMC6417559.
8. Mathiesen WT, Bjørshol CA, Kvaløy JT, Søreide E. Effects of modifiable prehospital factors on survival after out-of-hospital cardiac arrest in rural versus urban areas. Crit Care 2018;22:99. https://doi.org/10.1186/s13054-018-2017-x. PMID: 29669574; PMCID: PMC5907488.
9. Hamilton A, Steinmetz J, Wissenberg M, et al. Association between prehospital physician involvement and survival after out-of-hospital cardiac arrest: a Danish nationwide observational study. Resuscitation 2016;108:95–101. https://doi.org/10.1016/j.resuscitation.2016.08.007. PMID: 27565859.
10. Koyama S, Gibo K, Yamaguchi Y, Okubo M. Variation in survival after out-of-hospital cardiac arrest between receiving hospitals in Japan: an observational study. BMJ Open 2019;9:e033919. https://doi.org/10.1136/bmjopen-2019-033919. PMID: 31767599; PMCID: PMC6887081.
11. World Bank. Rural population (% of total population) - Pakistan. Available from: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=PK [Accessed on 2nd March 2024].

12. Punjab Emergency Service Department. Available from: Punjab Emergency Service Department (rescue.gov.pk) [Accessed on 24th January 2024].
13. Sindh integrated Emergency & Health Services. Available from: SINDH INTEGRATED EMERGENCY & HEALTH SERVICES (siehs.org) [Accessed on 24th January 2024].
14. Sindh Emergency Rescue Service. Available from: SINDH EMERGENCY RESCUE SERVICE – SERS [Accessed on 24th January 2024].
15. Berg KM, Cheng A, Panchal AR, et al. Adult Basic and Advanced Life Support, Pediatric Basic and Advanced Life Support, Neonatal Life Support, and Resuscitation Education Science Writing Groups. Part 7: Systems of Care: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2020;142:S580–604. https://doi.org/10.1161/CIR.0000000000000899. PMID: 33081524.
16. Garcia RA, Girotra S, Jones PG, McNally B, Spertus JA, Chan PS; CARES Surveillance Group. Variation in Out-of-Hospital Cardiac Arrest Survival Across Emergency Medical Service Agencies. Circ Cardiovasc Qual Outcomes. 2022;15:e008755. https://doi.org/10.1161/CIRCOUTCOMES.121.008755. PMID: 35698973; PMCID: PMC9233095.
17. Tjelmeland IBM, Masterson S, Herlitz J, et al.; GL2020 Epidemiology group and participating countries. Description of Emergency Medical Services, treatment of cardiac arrest patients and cardiac arrest registries in Europe. Scand J Trauma Resusc Emerg Med 2020;28:103. https://doi.org/10.1186/s13049-020-00798-7. PMID: 33076942; PMCID: PMC7569761.
18. Schnaubelt S, Garg R, Atiq H, et al.; Cardiopulmonary Resuscitation in Low-Resource Settings Group. Cardiopulmonary resuscitation in low-resource settings: a statement by the International Liaison Committee on Resuscitation, supported by the AFEM, EUSEM, IFEM, and IFRC. Lancet Glob Health. 2023;11:e1444–e1453. https://doi.org/10.1016/S2214-109X(23)00302-9. PMID: 37591590.
19. The Pakistan Life Savers Programme. Available from: Home | Pakistan Life Savers Programme (plsp.org.pk) [Accessed on 5th March 2024].
20. United Nations- Pakistan: Annual Report 2021. Available from: One UN Pakistan: Annual Report 2021|United Nations in Pakistan [Accessed on 2nd March 2024].
21. Schnaubelt S, Monsieurs KG, Semeraro F, et al. International Liaison Committee on Resuscitation Education, Implementation, Teams Task Force. Clinical outcomes from out-of-hospital cardiac arrest in low-resource settings - A scoping review. Resuscitation 2020;156:137–45. https://doi.org/10.1016/j.resuscitation.2020.08.126. PMID: 32920113.
22. Ahmed F, Khan UR, Soomar SM, et al. Acceptability of telephone-cardiopulmonary resuscitation (T-CPR) practice in a resource-limited country- a cross-sectional study. BMC Emerg Med 2022;22:139. https://doi.org/10.1186/s12873-022-00690-w. PMID: 35918647; PMCID: PMC9347158.
23. Kurz MC, Bobrow BJ, Buckingham J, et al.; American Heart Association Advocacy Coordinating Committee. Telecommunicator cardiopulmonary resuscitation: a policy statement from the American Heart Association. Circulation. 2020;141:e686–e700. https://doi.org/10.1161/CIR.0000000000000744. PMID: 32088981.