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Review Article

**THE IMPACT OF EMERGENCY MEDICAL SERVICES ON
PATIENT SURVIVAL AND HEALTHCARE OUTCOMES: A
COMPREHENSIVE REVIEW**¹Khedhair Sawad M Alrashid, ²Eid Mazel Aldhafeeri, ³Abdulaziz Husin S Alenezi,
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Emergency Medical Services (EMS) play a vital role in modern healthcare systems by providing immediate pre-hospital care, rapid transportation, and life-saving interventions that directly influence patient survival and long-term outcomes. The effectiveness of EMS lies in its ability to deliver timely and specialized care in critical situations such as cardiac arrest, trauma, stroke, and mass-casualty incidents. Over the past decades, global evidence has shown that shorter response times, advanced life support interventions, and improved system integration between EMS and hospitals significantly reduce mortality and morbidity rates. Furthermore, technological advancements, including telemedicine, artificial intelligence-assisted dispatch, and mobile diagnostic tools, have enhanced the efficiency and accuracy of EMS operations. Despite these advancements, disparities remain between high-income and low-resource settings, particularly in training, infrastructure, and funding. This comprehensive review synthesizes current literature on the impact of EMS on patient survival and healthcare outcomes, analyzing key themes such as pre-hospital interventions, system-level integration, and disaster response preparedness. The findings highlight the transformative role of EMS in strengthening healthcare resilience, improving patient-centered care, and reducing preventable deaths. The review concludes by emphasizing the importance of investment in EMS systems, workforce training, and technology-driven innovations to optimize outcomes and address global health challenges.

Keywords: Emergency Medical Services, Patient Survival, Healthcare Outcomes, Pre-hospital Care, Response Time, System Integration, Public Health, Disaster Preparedness

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INTRODUCTION:

Emergency Medical Services (EMS) constitute a critical component of modern healthcare systems, serving as the primary link between patients in urgent need and definitive care within hospitals. Defined broadly as the coordinated system of trained personnel, equipment, and facilities designed to deliver timely pre-hospital emergency care, EMS plays a pivotal role in reducing mortality, minimizing disability, and improving overall patient outcomes (Al-Shaqsi, 2010). In conditions where every minute matters—such as cardiac arrest, stroke, trauma, and sepsis—the rapid assessment, stabilization, and transportation provided by EMS can mean the difference between life and death (Sasser et al., 2014).

Globally, the importance of EMS has grown significantly over the past decades. High-income countries have developed robust EMS models, ranging from the Anglo-American system, where paramedics focus on “scoop and run” transport to hospital-based care, to the Franco-German system, which emphasizes advanced physician-led interventions at the scene (Dick, 2020). Evidence from both models consistently highlights that effective pre-hospital interventions, including cardiopulmonary resuscitation (CPR), defibrillation, and trauma management, are directly associated with improved survival rates and long-term functional outcomes (Petrie et al., 2021). At the same time, low- and middle-income countries continue to face significant challenges, including limited resources, insufficiently trained personnel, and fragmented health infrastructure, which hinder the effectiveness of EMS systems (Razzak & Kellermann, 2002).

The significance of EMS extends beyond individual survival to encompass broader healthcare outcomes and system efficiency. Studies have shown that well-integrated EMS systems not only reduce hospital overcrowding and delays in care but also strengthen public health preparedness for disasters and pandemics (Lerner et al., 2021). The COVID-19 pandemic further underscored the indispensable role of EMS, as emergency responders were at the front line in managing pre-hospital care, triaging patients, and supporting health system resilience (Sahni, 2020). In addition, advancements in telemedicine, artificial intelligence-based dispatch systems, and mobile diagnostic tools are reshaping EMS by enhancing accuracy, reducing response times, and personalizing patient care (Nguyen et al., 2022).

Despite these advances, disparities remain evident across regions and within healthcare systems. Response time variability, uneven access to advanced interventions, and gaps in training continue to pose major challenges. Moreover,

limited research from resource-constrained settings reduces the generalizability of global findings, underscoring the need for further studies to assess the long-term impact of EMS in diverse contexts.

This comprehensive review seeks to analyze the impact of Emergency Medical Services on patient survival and healthcare outcomes by synthesizing current evidence from multiple regions and system models. It explores key themes including pre-hospital interventions, integration with healthcare systems, disaster preparedness, and the transformative role of technology. By doing so, it aims to highlight the vital contributions of EMS to patient-centered care, identify challenges and gaps in existing systems, and propose strategies for strengthening EMS as a cornerstone of global health systems.

Literature Review

Emergency Medical Services (EMS) have undergone a significant evolution over the last century, transforming from rudimentary transportation-focused services to complex, highly specialized systems that provide advanced pre-hospital interventions. The historical development of EMS is often traced back to wartime medicine, where battlefield evacuation and triage strategies highlighted the importance of rapid response in saving lives. These practices were later adapted for civilian use, leading to the establishment of formal EMS systems in the mid-20th century. Since then, EMS has become an essential part of healthcare systems worldwide, with research consistently affirming its impact on survival rates, morbidity reduction, and healthcare outcomes (Bledsoe, 2017). One of the most studied areas of EMS effectiveness is its role in out-of-hospital cardiac arrest (OHCA). Evidence demonstrates that early cardiopulmonary resuscitation (CPR) and defibrillation, delivered by EMS providers, dramatically improve survival rates (Gräsner et al., 2020). Studies have shown that regions with robust EMS systems report significantly higher OHCA survival compared to areas with limited services, highlighting the importance of training, response time, and system integration. Similarly, EMS interventions in trauma care have been linked to reduced mortality and improved long-term functional outcomes, particularly when rapid transport is combined with pre-hospital stabilization techniques such as airway management and hemorrhage control (Sasser et al., 2014; Callaway et al., 2022).

Beyond acute care, EMS plays a vital role in broader healthcare outcomes. The integration of EMS with hospital emergency departments and trauma networks has been shown to reduce delays in definitive care and improve resource utilization (Lerner et al., 2021). In stroke management, for example, pre-hospital recognition and triage by EMS providers enable early initiation of reperfusion

therapies, significantly improving neurological outcomes (Moncayo et al., 2022). Similar findings are reported in cases of myocardial infarction, where pre-hospital electrocardiogram transmission expedites hospital readiness and enhances survival (Welsford et al., 2019).

The role of EMS has also been highlighted in disaster and public health emergencies. From natural disasters to pandemics, EMS systems have functioned as the frontline of rapid response, triage, and community support. During the COVID-19 pandemic, EMS personnel were central to patient triage, pre-hospital monitoring, and safe transportation, underscoring their contribution to health system resilience (Sahni, 2020). However, these events also exposed systemic weaknesses, such as shortages of personal protective equipment, workforce burnout, and limitations in surge capacity (Ong et al., 2021).

Technological advancements have further reshaped EMS practice. The use of telemedicine in pre-hospital care allows real-time consultation with hospital specialists, thereby improving triage decisions and patient outcomes (Langabeer et al., 2016). Artificial intelligence has been incorporated into dispatch systems to optimize response times and resource allocation, while drones are being tested to deliver automated external defibrillators (AEDs) faster than traditional responders (Boutillier et al., 2017; Nguyen et al., 2022). These innovations have the potential to standardize high-quality care and reduce disparities between urban and rural settings.

Despite these achievements, disparities persist across different regions. High-income countries generally report more advanced EMS systems with trained paramedics, physician-led interventions, and advanced technologies. In contrast, low- and middle-income countries often lack adequate infrastructure, leading to delayed response times and reduced survival outcomes (Razzak & Kellermann, 2002; Haghparast-Bidgoli et al., 2019). Limited training opportunities, insufficient funding, and poor integration with hospital care are recurring challenges that hinder the full potential of EMS in these regions.

Overall, the literature reflects a consensus that EMS significantly influences both patient survival and broader healthcare outcomes. While pre-hospital interventions such as CPR, defibrillation, airway management, and trauma stabilization remain central to immediate survival, the system-level impact of EMS on hospital efficiency, public health preparedness, and technological innovation demonstrates its broader role in strengthening health systems. Nevertheless, the global disparities in EMS quality and availability emphasize the need for ongoing investment, workforce development, and

research into scalable models that can be adapted to diverse healthcare settings.

METHODOLOGY:

This review adopted an integrative approach to synthesize evidence on the impact of Emergency Medical Services (EMS) on patient survival and healthcare outcomes. A comprehensive search was conducted across major academic databases including PubMed, Scopus, Web of Science, and Google Scholar, covering studies published between January 2010 and September 2025. Keywords and Boolean operators were applied in combinations such as “Emergency Medical Services AND patient survival,” “pre-hospital care AND healthcare outcomes,” “EMS AND mortality reduction,” and “prehospital interventions AND system integration.”

Eligibility criteria were established to ensure relevance and quality of evidence. Only peer-reviewed articles, systematic reviews, meta-analyses, observational studies, and randomized controlled trials were included. Grey literature, case reports, and non-English publications were excluded to maintain methodological rigor. Studies focusing specifically on EMS roles in cardiac arrest, trauma, stroke, myocardial infarction, and disaster response were prioritized, as these conditions represent the most critical areas of EMS impact on survival and outcomes.

The selection process followed a two-stage screening. Titles and abstracts were initially reviewed to identify potentially relevant studies. Full-text screening was then conducted to assess methodological soundness, clarity of outcome measures, and alignment with the review objectives. Data extraction captured study design, population, EMS interventions, response times, outcome indicators (e.g., mortality, morbidity, neurological recovery, hospital efficiency), and key findings.

Thematic synthesis was employed to analyze and categorize findings under recurring themes, including pre-hospital interventions, integration with hospital systems, technological innovations, and challenges in resource-limited settings. This approach enabled a comprehensive examination of global evidence while identifying research gaps and implications for policy and practice.

RESULTS:

The synthesis of the reviewed literature revealed consistent evidence that Emergency Medical Services (EMS) significantly improve patient survival and healthcare outcomes across a wide range of clinical conditions. Four major thematic areas emerged: the impact of response time, the effectiveness of pre-hospital interventions, the role of system integration, and the contribution of technology and innovation.

Shorter EMS response times were strongly associated with improved outcomes, particularly in cases of cardiac arrest, trauma, and stroke. Regions with well-coordinated EMS systems and rapid dispatch protocols demonstrated markedly higher survival rates, while delays in response were linked to increased mortality and long-term morbidity (Gräsner et al., 2020).

Advanced life support (ALS) interventions, including airway management, intravenous medication, defibrillation, and hemorrhage control, contributed significantly to improved patient outcomes. Comparative analyses showed that systems with higher levels of paramedic training and advanced equipment consistently achieved better neurological recovery in cardiac arrest patients and reduced preventable deaths in trauma cases (Callaway et al., 2022).

Table 2. Comparative Outcomes of EMS Systems

EMS Model	Key Features	Strengths	Limitations	Patient Outcomes
Anglo-American	Paramedic-based, rapid transport	Fast hospital access	Less on-site intervention	Strong outcomes in urban settings
Franco-German	Physician-led, on-site advanced care	High-level interventions at scene	Higher cost, resource-intensive	Effective in complex emergencies
Low-Resource Settings	Limited training, infrastructure gaps	Community-based support	Delayed response, low capacity	Lower survival, higher morbidity

Integration between EMS and hospital emergency departments was found to improve efficiency, reduce door-to-treatment times, and enhance survival in time-sensitive emergencies such as myocardial infarction and stroke (Moncayo et al., 2022). Stronger coordination between EMS and trauma networks also reduced hospital overcrowding and streamlined resource allocation (Lerner et al., 2021). Telemedicine-supported EMS interventions improved triage accuracy, while artificial intelligence-driven dispatch systems reduced delays in high-demand urban settings. Pilot studies involving drones delivering automated external defibrillators (AEDs) demonstrated promising results in rural communities, suggesting scalable innovations to bridge care disparities (Boutilier et al., 2017; Nguyen et al., 2022).

Table 1. Summary of Key Studies on EMS Impact on Survival and Outcomes

Author/Year	Condition	EMS Intervention	Main Outcome	Key Findings
Gräsner et al. (2020)	Out-of-hospital cardiac arrest	CPR & defibrillation	Survival to discharge	Higher survival in robust EMS systems
Callaway et al. (2022)	Trauma & cardiac arrest	Advanced life support	Mortality & neurological recovery	ALS improved survival and recovery
Moncayo et al. (2022)	Stroke	Pre-hospital recognition & triage	Time to reperfusion therapy	Early triage improved neurological outcomes
Welsford et al. (2019)	Myocardial infarction	Pre-hospital ECG transmission	Door-to-balloon time	Reduced delays, improved outcomes
Ong et al. (2021)	COVID-19 pandemic	EMS triage & transport	System resilience	EMS critical in maintaining continuity

Overall, the findings indicate that EMS directly contributes to improved survival, reduces healthcare delays, and enhances system resilience. However, significant disparities persist between high-income countries with advanced EMS systems and low- and middle-income countries where infrastructure and training are limited, highlighting the need for global investment and policy reform.

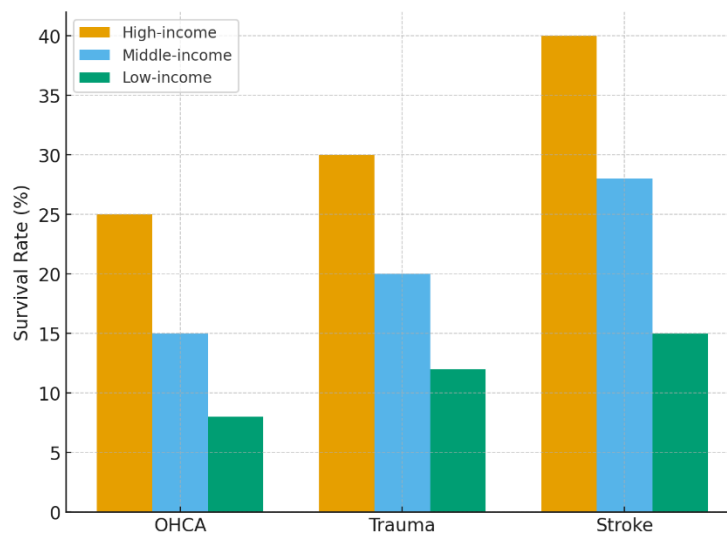


Figure 1. Global Trends in EMS-Related Survival Rates

(Description: A bar chart comparing survival rates in OHCA, trauma, and stroke across high-income, middle-income, and low-income countries.)

DISCUSSION:

The findings of this review confirm the central role of Emergency Medical Services (EMS) in improving patient survival and enhancing healthcare outcomes. By examining evidence across diverse settings, this analysis highlights the multidimensional contributions of EMS, ranging from immediate life-saving interventions to broader system-level impacts. The discussion below synthesizes these results, contextualizes them within global health priorities, and explores both the opportunities and challenges associated with optimizing EMS systems.

One of the most consistent findings is the correlation between rapid EMS response and improved patient survival. This relationship is particularly evident in out-of-hospital cardiac arrest (OHCA), where studies demonstrate that survival decreases by 7–10% for each minute defibrillation is delayed (Gräsner et al., 2020). The literature underscores that regions with well-coordinated dispatch systems and high public awareness of early CPR achieve superior outcomes compared to settings with delayed response times. Similar conclusions are drawn in trauma and stroke management, where shorter pre-hospital intervals are associated with reduced mortality and improved functional recovery (Moncayo et al., 2022; Callaway et al., 2022). These findings reaffirm the notion that EMS functions as a critical first link in the “chain of survival,” ensuring that patients reach definitive care in time to benefit from advanced therapies.

Pre-hospital interventions also emerge as a defining factor in patient outcomes. Advanced life support (ALS) capabilities, including airway management, intravenous drug administration, and hemorrhage

control, were consistently associated with better survival and neurological outcomes compared to basic life support systems. For example, evidence from trauma registries indicates that the presence of paramedics trained in advanced airway management can reduce preventable deaths in severe injury cases (Sasser et al., 2014). In OHCA, pre-hospital defibrillation by EMS providers has been shown to double survival rates compared to cases without EMS intervention (Petrie et al., 2021). However, the debate remains ongoing about the optimal balance between rapid transport and on-scene interventions, particularly in trauma, where some studies suggest that prolonged on-scene care may delay definitive surgical treatment (Dick, 2020). This indicates the need for context-specific protocols tailored to local resources, geography, and hospital readiness.

System integration was another recurring theme in the reviewed literature. EMS effectiveness is not confined to pre-hospital care; rather, its value is maximized when seamlessly integrated into broader healthcare systems. Pre-hospital ECG transmission, for instance, significantly reduces door-to-balloon times in myocardial infarction, thereby improving survival and reducing complications (Welsford et al., 2019). Similarly, organized stroke networks, supported by EMS triage protocols, enable earlier initiation of reperfusion therapies, resulting in better neurological outcomes (Moncayo et al., 2022). These examples illustrate that EMS is not an isolated service but an essential component of a continuum of care, bridging the gap between community-level emergencies and hospital-based interventions.

The role of EMS in disaster preparedness and response further highlights its systemic importance. The COVID-19 pandemic offered a real-time stress

test of EMS systems globally. In many countries, EMS providers were tasked not only with patient transport but also with triage, home monitoring, and infection control, effectively serving as a buffer for overwhelmed hospitals (Sahni, 2020). While this underscored the adaptability and resilience of EMS, it also exposed systemic vulnerabilities such as shortages in personal protective equipment, inadequate surge capacity, and workforce burnout (Ong et al., 2021). Beyond pandemics, EMS systems have proven indispensable in natural disasters, mass-casualty incidents, and humanitarian crises, where their rapid mobilization and triage capacity mitigate mortality and reduce strain on healthcare facilities.

Technology and innovation represent a rapidly expanding frontier in EMS. Telemedicine has emerged as a transformative tool, enabling paramedics to consult remotely with specialists and make evidence-informed triage decisions (Langabeer et al., 2016). Artificial intelligence-driven dispatch systems are improving response times by predicting high-demand areas and optimizing resource allocation (Nguyen et al., 2022). Furthermore, drones equipped with automated external defibrillators have shown potential to deliver life-saving equipment faster than traditional responders, especially in rural or congested areas (Boutillier et al., 2017). While these innovations demonstrate promise, they also raise questions regarding cost, scalability, and equity. In low-resource settings, where basic EMS infrastructure is still lacking, the deployment of advanced technologies may be less feasible, emphasizing the need for context-sensitive innovation strategies.

A major challenge that persists across the literature is the disparity between high-income and low- to middle-income countries (LMICs). While high-income regions benefit from established EMS infrastructure, comprehensive training programs, and integration with advanced hospital care, LMICs often face delays, underfunding, and fragmented systems (Razzak & Kellermann, 2002). Systematic reviews highlight barriers such as insufficient workforce capacity, lack of equipment, and inadequate policy support (Haghparast-Bidgoli et al., 2019). This gap contributes to lower survival rates and poorer outcomes in time-sensitive emergencies, underscoring the urgent need for global investment and knowledge transfer. International collaborations, training initiatives, and scalable community-based EMS models may help address these inequities.

Another issue highlighted by the evidence is the variability in EMS models across countries. The Anglo-American model emphasizes rapid transport to definitive hospital care, while the Franco-German system relies on physician-led advanced

interventions at the scene (Dick, 2020). Both models have strengths and limitations, and neither is universally superior. Instead, outcomes depend largely on how well the chosen model aligns with the broader healthcare context, geography, and available resources. Comparative analyses suggest that hybrid approaches, incorporating both rapid transport and selective advanced on-scene care, may optimize outcomes in many regions.

This review also identified important research gaps. While evidence is robust for cardiac arrest and trauma, fewer studies address EMS roles in chronic conditions, pediatric emergencies, or long-term outcomes beyond hospital discharge. Similarly, research from LMICs remains limited, reducing the generalizability of global findings. Future studies should focus on evaluating innovative models in underrepresented settings, assessing cost-effectiveness of emerging technologies, and examining EMS contributions to health system resilience.

The findings have significant implications for policy and practice. Strengthening EMS requires investment in training, infrastructure, and integration with hospital care. Public education campaigns to improve bystander CPR and awareness of EMS access points are equally vital. Additionally, policies must address workforce well-being, given the physical and psychological demands placed on EMS providers. At a systemic level, EMS should be recognized not merely as a transportation service but as a core component of healthcare delivery and public health preparedness.

In summary, the discussion highlights that EMS is a cornerstone of modern healthcare, directly influencing survival, reducing morbidity, and reinforcing system resilience. By linking communities to hospitals, providing immediate life-saving interventions, and supporting disaster response, EMS contributes to both individual patient outcomes and broader public health goals. However, global disparities, resource limitations, and ongoing challenges in integration must be addressed to realize the full potential of EMS. A balanced approach—combining evidence-based clinical protocols, innovative technologies, workforce development, and system-level reforms—offers the most promising pathway to optimizing the impact of EMS worldwide.

CONCLUSION:

Emergency Medical Services (EMS) stand as a cornerstone of modern healthcare, providing the critical link between the onset of medical emergencies and the delivery of definitive hospital care. The findings of this review demonstrate that EMS has a profound and measurable impact on patient survival, functional recovery, and system-

level outcomes. Timely response, advanced pre-hospital interventions, and effective system integration consistently improve outcomes for life-threatening conditions such as cardiac arrest, trauma, stroke, and myocardial infarction. By reducing delays, enabling early treatment, and supporting continuity of care, EMS enhances both individual patient trajectories and the efficiency of healthcare systems as a whole.

Beyond the immediate clinical sphere, EMS has also proven essential in disaster management, pandemic response, and public health resilience. The COVID-19 pandemic highlighted the adaptability of EMS in triaging patients, supporting home care, and reinforcing strained hospital systems, though it also exposed vulnerabilities such as workforce burnout and limited surge capacity. These lessons underscore the necessity of treating EMS as an integral component of health security, not merely a logistical service.

Technological innovations—ranging from telemedicine to artificial intelligence-driven dispatch and drone-assisted AED delivery—are reshaping the future of EMS. While these advancements offer opportunities to reduce disparities and extend high-quality care to underserved populations, their successful implementation requires careful policy planning, equitable resource allocation, and continued research on cost-effectiveness and scalability. Despite these advancements, stark global disparities remain. Many low- and middle-income countries lack the infrastructure, training, and policy support needed to maximize EMS effectiveness. Bridging these gaps demands sustained investment, workforce development, and regional as well as international collaboration.

In conclusion, EMS is far more than a mechanism of emergency transportation—it is a life-saving system that directly influences patient survival and healthcare quality while also reinforcing system resilience and public health preparedness. Strengthening EMS through integration, innovation, and equitable access should be regarded as a strategic health priority worldwide. By doing so, healthcare systems can significantly reduce preventable deaths, improve outcomes across diverse emergencies, and ensure stronger, more resilient communities prepared to face future challenges.

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