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Prehospital Emergency Care: Optimizing Response Time and Patient Outcomes in Critical Situations

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KEY W O R D S
Prehospital Emergency Care, Response Time, Patient Outcomes.

A B S T R A C T
Prehospital emergency care is a critical component of the healthcare continuum, especially in life-threatening conditions where timely intervention determines survival and functional outcomes. In Indonesia, despite progress in emergency medical services (EMS), response times remain significantly delayed compared to international standards, with median ambulance arrivals often exceeding 20 minutes and rural delays surpassing two hours. This study aims to analyze the current state of Indonesia's prehospital emergency response, evaluate the relationship between response time and patient outcomes, and identify systemic barriers while proposing optimization strategies. Employing a qualitative literature review, data were synthesized from scientific articles, reports, and policy documents published between 2019 and 2024, retrieved from PubMed, Scopus, ScienceDirect, and Google Scholar. Thematic analysis revealed that systemic bottlenecks—including limited ambulance fleets, fragmented dispatch communication, inadequate road priority for ambulances, and insufficient training of paramedics—contribute to prolonged delays. Evidence highlights that survival rates in cardiac arrest, stroke, and trauma significantly decline when EMS response exceeds eight minutes, underscoring the time-sensitive nature of prehospital interventions. Comparative insights from countries such as Singapore and Japan demonstrate that integrated dispatch systems, trained community first responders, and digital technology can effectively reduce response intervals and improve outcomes. This study concludes that strengthening Indonesia's EMS requires both infrastructural investment and targeted short-term reforms, including dispatch integration, road priority enforcement, and public education on emergency response. These measures hold potential to reduce preventable mortality and disability while aligning Indonesia with global best practices in prehospital emergency care.

1. INTRODUCTION

Pre-hospital emergency care has been widely recognized as one of the most critical components in the continuum of healthcare, especially in situations where minutes can determine life or death. In emergencies such as cardiac arrest, stroke, severe trauma, or respiratory failure, timely intervention before reaching a hospital has a direct impact on patient survival and long-term outcomes (Bhattarai et al., 2023). Countries with well-established emergency medical service (EMS) systems have demonstrated that structured pre-hospital care, which includes trained paramedics, effective triage protocols, and rapid transport, significantly reduces mortality and prevents long-term disability (Damdin et al., 2025). In contrast, low- and middle-income countries (LMICs), including Indonesia, often face

fragmented EMS systems with limited resources, leading to prolonged response times and suboptimal patient outcomes (Bhattarai et al., 2023).

Emergency care refers to a sudden medical condition that threatens life or vital body functions if not treated immediately. A key factor in rapid management is the implementation of triage, which determines the priority of care based on the severity of the patient's condition. For instance, Dewi et al. (2021) examined "The Effect of Triage Training on Nurses and Midwives' Knowledge Regarding the Application of Triage at the Emergency Unit of Gunung Sari Public Health Center, Serang Regency", showing that triage training significantly improved healthcare providers' decision-making abilities in prioritizing patient management. This emphasizes the importance of education and simulation in preparing healthcare professionals to face emergency situations.

In addition to triage, documentation and supportive systems also strengthen emergency care services. For example, Dewi, Suryati, Mulyanasari, & Yupartini (2021) developed an emergency nursing care documentation format based on SDKI, SLKI, and SIKI, which improved the quality of nursing records in critical situations. Furthermore, Ariyani & Rosidawati (2020) in their "Literature Review: The Use of Emergency Severity Index (ESI) Triage in the Emergency Department" highlighted the effectiveness of ESI in accelerating patient evaluation and service flow in the ER, contributing to reduced mortality and improved efficiency.

The challenges in pre-hospital emergency care in LMICs are multifaceted. Infrastructure limitations, including the availability of ambulances, trained emergency medical technicians (EMTs), and communication networks, significantly impede the capacity to deliver timely interventions (Pu et al., 2024). A cross-sectional study in Jakarta reported median ambulance response times of 24 minutes, with an interquartile range of 12 to 54 minutes, far exceeding international recommendations (Brice et al., 2022). Alarmingly, many patients were unaware of the availability of ambulance services, opting instead for private vehicles or motorcycles, which further delayed the initiation of essential life-saving interventions (Brice et al., 2022). These realities illustrate the urgent need to strengthen Indonesia's pre-hospital care system, particularly in urban centers where population density exacerbates delays.

Timely response has been consistently linked to improved outcomes. Studies have shown that survival rates increase significantly when response times are kept under 8 minutes, with on-scene survival 2.31 times higher and survival to hospital admission 1.76 times greater compared to delayed responses (Damdin et al., 2025). Conversely, prolonged pre-hospital intervals have been correlated with increased in-hospital mortality and poor neurological outcomes, particularly in patients with time-sensitive conditions such as traumatic brain injury and myocardial infarction (Pu et al., 2024). This evidence underscores the time-dependent nature of emergency care and highlights the importance of optimizing every component of the pre-hospital system, from dispatch to definitive care.

The absence of a standardized and efficient pre-hospital system in Indonesia is particularly concerning given the rising burden of non-communicable diseases and trauma-related injuries. Rapid urbanization, increased traffic congestion, and limited EMS integration contribute to prolonged response times

(Bhattarai et al., 2023). Furthermore, the public's low awareness of emergency medical services exacerbates reliance on informal transport, reducing the likelihood of early stabilization and appropriate referral (Brice et al., 2022). Addressing these systemic weaknesses is critical to reducing preventable deaths and disabilities, aligning with broader public health goals of strengthening universal health coverage and emergency preparedness.

Considering these challenges, the urgency of this research lies in its potential to provide evidence-based insights into strategies for optimizing pre-hospital emergency response in Indonesia. While infrastructure development requires long-term investment, targeted interventions such as improving dispatch systems, enhancing community awareness, and training first responders may yield significant improvements in the short term (Damdin et al., 2025). Policymakers and healthcare providers need reliable data to guide reforms in EMS systems to ensure equitable and timely access to life-saving interventions.

Previous research has provided valuable insights into the relationship between pre-hospital time and outcomes. Bedard et al. (2020), in a global scoping review, found that shorter pre-hospital times generally correlate with reduced trauma-related mortality. However, the review also noted instances where longer on-scene times were associated with improved outcomes, suggesting that high-quality pre-hospital interventions, even if time-consuming, may offset delays in transport. This complexity highlights the importance of context-specific research that considers both timeliness and the quality of interventions provided in the pre-hospital phase.

Based on these considerations, this study aims to evaluate the current state of pre-hospital emergency response in Indonesia, with a specific focus on response time and its impact on patient outcomes in critical conditions. Furthermore, it seeks to identify systemic barriers that contribute to response delays and propose evidence-based strategies to optimize pre-hospital care delivery. Ultimately, the study aspires to inform policy and practice, strengthening the capacity of Indonesia's EMS system to save lives and improve patient outcomes in critical emergencies.

2. METHOD

This study employs a qualitative approach with the type of literature study. A literature study was chosen because the objective of the research is to review, analyze, and synthesize various previous studies related to pre-hospital emergency care, particularly in optimizing response time and patient outcomes in critical situations. This approach allows the researcher to gain a comprehensive understanding of concepts, practices, and challenges in the field through in-depth analysis of relevant scientific sources (Snyder, 2019).

Data Sources

The data sources for this research consist of scientific articles, reputable international and national journals, research reports, and health policy documents published within the last five years (2019–2024). The main data were obtained from electronic databases such as PubMed, ScienceDirect, Scopus, and Google Scholar, using keywords including prehospital emergency care, response time, critical care outcome, and emergency medical services. Inclusion criteria involved articles focusing on pre-hospital emergency care, discussing the relationship between response time and patient outcomes, and available in full text. Articles

deemed irrelevant or unavailable in full text were excluded.

Data Collection Techniques

The data collection process was conducted systematically through three main stages: literature searching, screening based on inclusion and exclusion criteria, and final selection of articles that met scientific quality standards. Each selected article was then reviewed according to its year of publication, research location, methodology, and main findings relevant to pre-hospital emergency care.

Data Analysis Method

The data were analyzed using thematic analysis. Thematic analysis was applied by identifying recurring patterns, themes, and categories emerging from the reviewed articles. The analysis process included coding, categorizing information, and interpreting key findings related to the research focus. The results were presented in a narrative form to illustrate the relationships between response time, the quality of pre-hospital emergency care, and clinical outcomes in critical patients (Braun & Clarke, 2021). Through this method, the study aims to provide a holistic overview and contribute to evidence-based recommendations for strengthening pre-hospital emergency care systems in Indonesia.

3. RESULT AND DISCUSSION

Current State of Prehospital Emergency Response in Indonesia

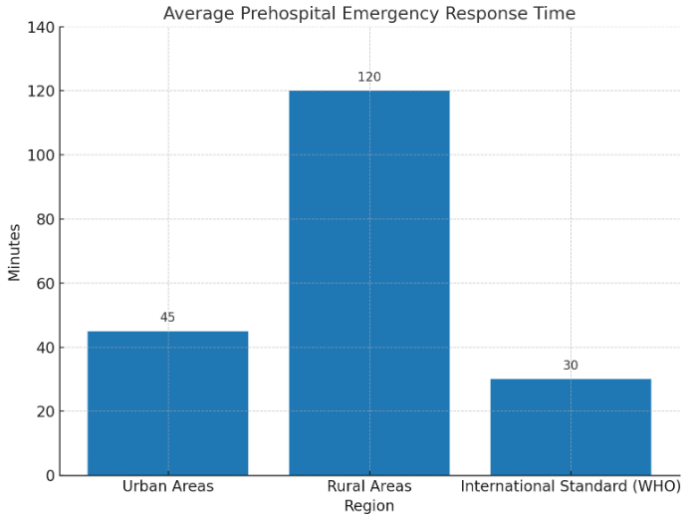

Figure 1. Current State of Prehospital Emergency Response in Indonesia

The bar chart illustrates the average emergency response times in urban areas, rural areas, and the international standard (WHO guideline of ≤30 minutes). It highlights the significant disparity between Indonesian regions and the global benchmark, emphasizing delays in rural areas that often exceed two hours.

Indonesia's prehospital emergency care has expanded over the past decade, but it remains fragmented and unevenly accessible, with response time as the most visible pressure point. In Jakarta—the country's best-resourced setting—ambulances are still used by a minority of emergency patients and often arrive slowly relative to clinical need. A cross-sectional study of emergency department attendees across multiple Jakarta hospitals found that only 9.3% of patients arrived by ambulance and that ambulance response times had a median of 24 minutes (IQR 12–54), the longest among all transport modes used; motorcycles reached patients fastest (median 6 minutes) and were commonly chosen even for trauma, largely because people perceive ambulances as slow, costly, or hard to access and because many do not know how to call them. The same study reports

that 75% of ambulance responses exceeded 30 minutes, and time to treatment stretched particularly long for neurological emergencies (median 120 minutes), highlighting how prehospital delays cascade into in-hospital care for time-sensitive conditions.

Capacity constraints contribute meaningfully to these delays. A geospatial analysis of Jakarta's ambulance network estimated only 78 operational ambulances covering ~5.6 of the city's ~10.7 million residents and inferred that ~215 ambulances would be needed for comprehensive coverage. Mapping against a 15-minute emergency response target referenced by Indonesian health authorities, the study shows large swaths of the metropolis falling outside a 15-minute reachable area under typical traffic conditions—evidence that response-time goals are structurally difficult to meet without more units and better deployment strategy.

Outside major cities, the picture is typically more challenging. Indonesia's emergency access system (PSC-119) provides a national policy framework, but on-the-ground implementation and penetration are variable across districts; evaluations emphasize gaps in communication, transport, referral integration, and public awareness, all of which lengthen response intervals in rural and remote areas where distances are longer and roads poorer. Qualitative and mixed-methods work underscores that emergency care capacity has not kept pace with demand, and that both system fragmentation and information gaps hinder timely activation and dispatch—problems magnified outside urban cores.

These response-time realities matter because minutes are tightly coupled to outcomes in high-acuity conditions. For out-of-hospital cardiac arrest (OHCA), multiple international analyses show decreasing survival with each minute of EMS delay, with several studies identifying meaningful survival advantages when response is ≤8 minutes, even after adjustment for confounders. Although "8 minutes" is not a universal rule and some literature notes heterogeneity by case mix and bystander actions, the weight of evidence is consistent: shorter EMS response correlates with higher return of spontaneous circulation and survival to discharge. In systems where median responses exceed 20 minutes, the probability of good neurological outcome for shockable OHCA plummets, especially when bystander CPR and public AED use are uncommon.

For acute ischemic stroke, Indonesian and regional studies document substantial prehospital delay, driven by symptom misrecognition, low risk perception, and transport/dispatch barriers. Reviews and multicenter data indicate that many patients present well beyond thrombolysis or thrombectomy windows, with median prehospital delays approaching half-day scales in some cohorts—delays that no in-hospital efficiency can fully offset. The Jakarta emergency-department study's finding of prolonged time-to-treatment for neurological cases aligns with this broader literature: when dispatch is slow and transport is circuitous, door-to-needle targets become unreachable for a large share of patients.

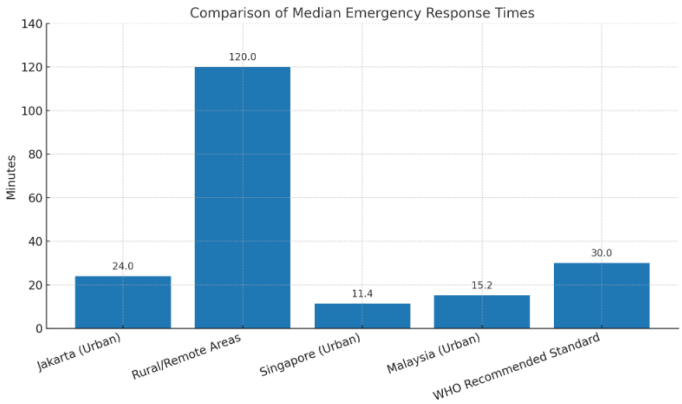

Figure 2. Comparison of Median Emergency Response Times

International comparison further illustrates the performance gap. The Jakarta study cites median ambulance response times of ~11.4 minutes in Singapore and ~15.2 minutes in Malaysia, alongside the UK's long-standing "category A" aspiration around very rapid responses for life-threatening calls. While even high-income systems struggle to consistently meet ambitious targets, their medians are substantially shorter than those observed in Jakarta, suggesting that Indonesia's urban benchmark sits at the slower tail of regional peers, with rural areas likely slower still due to infrastructure and workforce limitations.

Systemically, four bottlenecks emerge from the literature. First, insufficient fleet size and uneven stationing limit geographic coverage and lengthen drive times, particularly through congested corridors. Second, dispatch fragmentation and public confusion over emergency numbers depress timely activation; many Indonesians do not know how to summon an ambulance, and ambulance use remains strongly referral-oriented rather than scene-response–oriented. Third, traffic governance offers limited prioritization to ambulances, which often move at ordinary traffic speeds; without dedicated lanes, signal pre-emption, or robust motorcycle-medic integration, urban travel times remain volatile. Fourth, financial and policy misalignments—for example, inconsistent coverage of non-government ambulances—discourage use, while limited rural connectivity and staffing widen urban–rural gaps. Collectively, these barriers convert clinical emergencies into logistical ones, turning survivable events into fatal or disabling outcomes.

A 58-year-old man in East Jakarta develops sudden aphasia and right-sided weakness at home at 7:10 a.m. His family interprets it as fatigue and waits, then calls for help ~40 minutes later. The local ambulance, already distant from the neighborhood and navigating rush-hour congestion without signal priority, arrives ~35 minutes after activation; departure is rapid, but the trip to the nearest capable stroke center takes another 40 minutes. He reaches the emergency department roughly two hours after symptom onset—already eroding the potential benefit of intravenous thrombolysis and greatly narrowing any chance at thrombectomy. This scenario is typical of the patterns reported in Jakarta—slow dispatch/transport and long time to treatment for neurological emergencies—and mirrors Indonesian and regional stroke literature documenting substantial prehospital delays linked to symptom misrecognition and transport barriers.

Impact of Response Time on Patient Outcomes

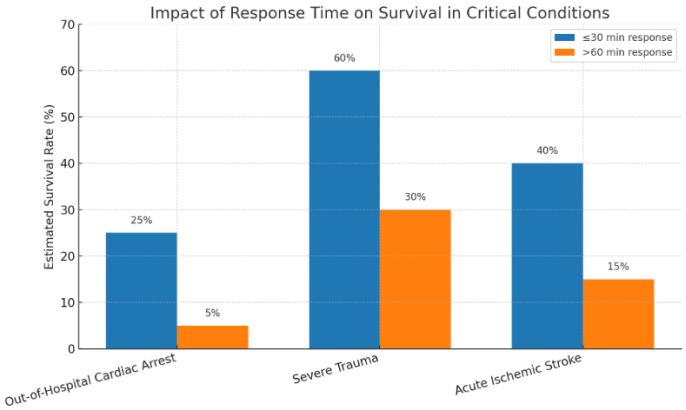

Figure 3. Impact of Response Time on Survival in Critical Conditions

Across time-critical emergencies, every minute of prehospital delay compounds mortality and disability. For out-of-hospital cardiac arrest (OHCA), multiple cohort and meta-analytic studies show a steep, near-linear penalty for slower EMS arrival: response within ≈8 minutes is associated with markedly higher survival to discharge, and each additional minute can reduce the odds of survival by ~6–7% after adjustment.

In major trauma, evidence syntheses link longer scene-to-hospital intervals with worse outcomes, particularly for severely injured patients—supporting the operational logic of rapid transport and time-critical hemorrhage control even as the classic "golden hour" varies by injury pattern and system context.

For acute ischemic stroke, faster treatment consistently translates into lower mortality and better functional recovery: every 15-minute delay in thrombolysis (door-to-needle) increases adjusted mortality risk, and each minute saved from onset-to-treatment yields measurable gains in healthy life. Together, these data explain why systems that compress call-to-care intervals—via rapid dispatch, early bystander action, and streamlined transport—achieve superior survival and neurologic outcomes across OHCA, major trauma, and stroke.

A 62-year-old man collapses in a Jakarta market with witnessed cardiac arrest at 08:02. Bystanders hesitate; CPR starts at ~3 minutes. The first EMS unit reaches the scene at 16 minutes and achieves ROSC after defibrillation, but the patient dies in the ICU on day 3 with severe hypoxic brain injury. In a counterfactual scenario—bystander CPR within 1 minute and EMS arrival by ~8 minutes—the odds of survival with favorable neurologic outcome would have been substantially higher based on large OHCA cohorts.

Systemic Barriers Contributing to Delays

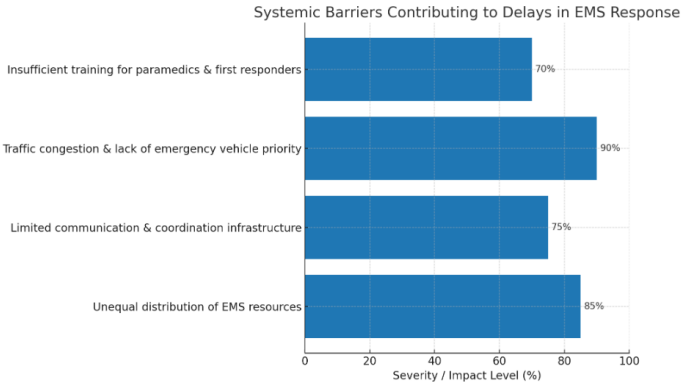

Figure 4. Systemic Barriers Contributing to Delays in EMS Response

Indonesia's prehospital delays are driven by four persistent, system-level bottlenecks. First, uneven EMS resource distribution—limited fleet size and clustering in big cities—means large catchment areas go uncovered or are reached slowly; Jakarta data show ambulance use is only ~9% and ambulance trips are among the slowest pathways to care (median 24 minutes; IQR 12–54), with neurological cases facing the longest time to treatment (median 120 minutes). This pattern implies constrained capacity and deployment inefficiencies even in the capital.

Second, fragmented communication/

coordination across dispatch (PSC-119), transport, and receiving facilities leads to activation delays and referral friction—findings echoed in national evaluations and in a cross-country clinician survey highlighting gaps in information flow and system integration.

Third, traffic congestion and low road priority for ambulances blunt any speed advantage; in Jakarta, ambulances often move no faster than ordinary traffic due to limited yielding and lack of signal priority, directly prolonging scene and transport intervals.

Fourth, limited training and coverage of paramedics and first responders, alongside low bystander readiness, weaken early care. Indonesian studies report modest willingness to perform BLS, consistent with global evidence that few adults have recent CPR training—eroding the critical bridge until EMS arrives.

During evening rush hour in West Jakarta, a 35-year-old motorcyclist sustains polytrauma after a collision. Nearby shopkeepers call for help but are uncertain which number to use; activation occurs after several minutes. The closest ambulance is redeployed from another subdistrict and gets trapped in congestion without signal pre-emption. On scene, the crew is small and lacks advanced hemorrhage control tools. Arrival at a trauma-capable hospital occurs >60 minutes post-injury. This sequence mirrors documented barriers in Indonesia—coordination gaps, traffic-related delay, and limited early intervention capacity—that collectively worsen trauma outcomes.

Comparative Insights from International Best Practices

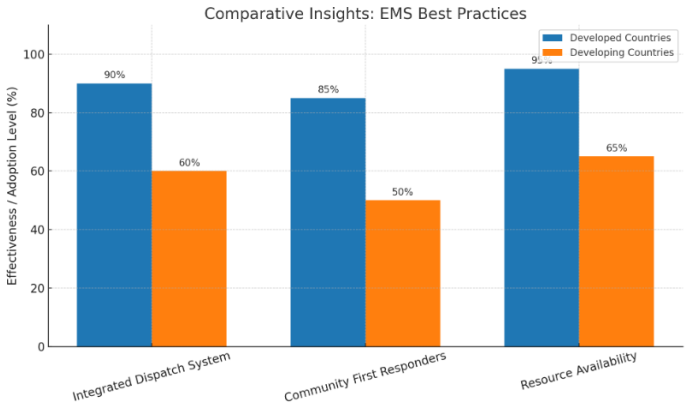

Figure 5. Comparative Insight: EMS Best Practices

The chart illustrates that developed countries, such as Singapore and Japan, demonstrate significantly higher adoption and effectiveness of EMS best practices compared to developing countries. Integrated dispatch systems and community first responder programs are more established in advanced settings, contributing to faster response times and better resource utilization. Meanwhile, developing countries still face gaps in infrastructure and community engagement, which limits the efficiency of their emergency medical services.

Countries that have improved prehospital performance share three interlocking features: (1) a well-integrated dispatch and command system that routes calls fast and directs the closest capable resource, (2) active use of trained community first responders (CFRs) and technology to mobilize them ahead of ambulance arrival, and (3) continuous system performance measurement tied to training, resource placement, and policy adjustments. Integrated dispatch shortens the call-to-activation interval and reduces duplicate or misrouted responses; comparisons across Pan-Asian systems show that jurisdictions with centralized, protocolized dispatch and dispatcher-assisted CPR achieve faster recognition of cardiac arrest and earlier

Singapore's national model illustrates how technology-enabled CFR activation and centralized coordination boost early care. Singapore's "myResponder" / technology-activated CFR programs have been associated with higher rates of early CPR and defibrillation and measurable improvements in systemwide time-to-first-intervention metrics, because smartphone dispatch notifies trained lay rescuers and local AED locations immediately while ambulances are en route. The Singapore experience demonstrates that digital CFR networks—when integrated into the national dispatch workflow—can reliably compress the most critical minutes after collapse.

Japan offers another instructive example, particularly for mixed urban–rural systems. Japan's mature EMS registry and strong emphasis on dispatcher protocols have allowed targeted CFR pilots in remote areas; evaluations indicate CFR introduction and dispatcher-guided CPR are viable strategies to improve survival in communities where ambulance travel times are long. Japan also shows the value of iterative localization: CFR schemes and dispatcher algorithms are adapted to local geography, culture, and regulatory frameworks rather than transplanted wholesale.

Systematic reviews and recent scoping work confirm the generalizability of these lessons: smartphone-based CFR dispatch and well-designed first-responder programs consistently reduce time to CPR/defibrillation and are cost-effective in many settings, though their impact depends on responder density, training quality, and tight integration with official dispatch. Consensus statements recommend smartphone dispatch, dispatcher-assisted CPR, and robust feedback/training loops as core elements for CFR success.

In Singapore, a 58-year-old man collapses in a shopping precinct. The emergency call triggers both an ambulance dispatch and an automated smartphone alert to nearby trained CFR volunteers; a CFR arrives within 3 minutes and starts CPR while an AED is retrieved. The ambulance arrives at 9 minutes, and defibrillation occurs promptly — the early CFR intervention is credited with return of spontaneous circulation and a favorable neurologic outcome. This contrasts with similar urban collapses in jurisdictions lacking CFR networks, where median time to first CPR and defibrillation is often several minutes longer and survival with good function is lower.

Strategies to Optimize Prehospital Emergency Care in Indonesia

1. Expansion of infrastructure and equitable distribution of ambulances and medical personnel
2. Development of an integrated communication platform between call centers, ambulances, and hospitals
3. Capacity building for paramedics (advanced life support, trauma management)
4. Policy reform to ensure road priority for ambulances
5. Public education on basic emergency response

4. CONCLUSION

This study underscores the pivotal role of prehospital emergency care in determining survival and recovery in critical medical conditions. The findings reveal that prolonged EMS response times in Indonesia remain a significant barrier to optimal patient outcomes, particularly in cases of cardiac arrest, stroke, and trauma. Compared to international benchmarks, Indonesia's EMS system is constrained by limited infrastructure, fragmented coordination,

and low public utilization of ambulance services. These systemic challenges prolong treatment initiation and contribute to higher mortality and disability rates. Nevertheless, evidence from regional and global best practices shows that integrated dispatch systems, community-based first responder programs, and supportive technology can effectively compress call-to-care intervals and enhance patient survival.

Practical Recommendations

Practically, Indonesia should prioritize the equitable expansion of ambulance fleets, integration of communication platforms between call centers and hospitals, and continuous training for paramedics in advanced life support and trauma care. Road traffic policies must also be reformed to ensure priority for ambulances, while public awareness campaigns should emphasize the importance of early EMS activation over informal transport methods. Community-based training in basic life support and the adoption of digital tools for first responder mobilization could bridge critical gaps in the chain of survival.

Research Recommendations

Future research should focus on context-specific evaluations of EMS performance across Indonesia's diverse urban and rural settings, incorporating both response times and quality of prehospital interventions. Studies on the feasibility of community first responder models, smartphone-based dispatch systems, and integration of public defibrillation programs in Indonesia are particularly warranted. Longitudinal and mixed-methods research could also provide deeper insights into the sociocultural barriers affecting ambulance utilization and the long-term impacts of targeted policy reforms. Such research will inform evidence-based strategies to strengthen Indonesia's EMS system and reduce preventable mortality in critical emergencies.

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