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"Improving prehospital care for myocardial infarction and stroke: a systematic review"

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Background:

Myocardial infarction (MI) and stroke are leading global causes of morbidity and mortality. Early recognition and timely intervention in the prehospital phase are critical determinants of survival and functional outcomes. Despite advances in emergency medical services (EMS), delays in diagnosis, transport, and communication persist, limiting optimal patient care.

Objective:

To systematically review recent evidence on strategies aimed at improving prehospital management and outcomes of patients with myocardial infarction and stroke.

Methods:

This review followed the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020)* guidelines. Searches were conducted in PubMed, Scopus, Web of Science, CINAHL, and Cochrane Library from January 2018 to October 2025. Eligible studies included randomized controlled trials, observational studies, and systematic reviews evaluating prehospital interventions for MI or stroke. Data were extracted on intervention type, time-to-treatment outcomes, mortality, and functional recovery. Quality was appraised using JBI and ROB-2 tools, and findings were synthesized narratively.

Results:

Out of 2,413 identified records, 38 studies met inclusion criteria. The most effective interventions included prehospital electrocardiography (ECG) with transmission and early cath-lab activation for STEMI, structured stroke triage scales (FAST, RACE, FAST-ED), mobile stroke units (MSUs), and telemedicine-supported EMS. These strategies collectively reduced treatment delays—average door-to-balloon time by 32 minutes and door-to-needle time by 20 minutes—and improved short-term mortality and neurological outcomes. Coordinated regional systems and feedback-based performance monitoring further enhanced efficiency and sustainability of care.

Conclusions:

Integrated prehospital strategies significantly improve time-sensitive outcomes for myocardial infarction and stroke. Combining digital technology, standardized triage, and EMS–hospital coordination fosters faster diagnosis, timely treatment, and reduced mortality. Future efforts should emphasize system-wide implementation, workforce training, telemedicine expansion, and equitable access—particularly in low-resource or rural settings.

Keywords:

Prehospital care, myocardial infarction, stroke, emergency medical services, telemedicine, mobile stroke unit, response time, systematic review.

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Introduction

Cardiovascular and cerebrovascular diseases remain the leading causes of morbidity and mortality worldwide, accounting for an estimated 18.6 million deaths annually (World Health Organization [WHO], 2023). Among these, acute myocardial infarction (MI) and stroke represent two of the most time-sensitive medical emergencies, where prompt recognition and intervention are essential to improving survival and functional outcomes. For myocardial infarction—particularly ST-elevation MI (STEMI)—rapid reperfusion through percutaneous coronary intervention or thrombolytic therapy is critical, as each minute of delay contributes to increased myocardial necrosis and mortality (Ibanez et al., 2018). Likewise, in acute ischemic stroke, the principle of "time is brain" underscores the importance of early detection and rapid initiation of thrombolysis or thrombectomy to preserve neurological function (Powers et al., 2023).

The prehospital phase—encompassing patient symptom recognition, emergency medical service (EMS) activation, assessment, and transport to definitive care—represents the first and most crucial step in the chain of survival. Evidence demonstrates that early prehospital interventions can significantly reduce total ischemic time for both MI and stroke (Zachrison et al., 2023). For example, the implementation of prehospital electrocardiography (ECG), real-time transmission of data to receiving hospitals, and pre-activation of catheterization laboratories have collectively shortened door-to-balloon times and improved reperfusion success (Bagai et al., 2020). Similarly, prehospital stroke scales such as the Cincinnati Prehospital Stroke Scale (CPSS) and Los Angeles Motor Scale (LAMS) have improved stroke recognition, triage accuracy, and reduced door-to-needle times for thrombolytic therapy (Lin et al., 2021).

Despite these advancements, wide disparities persist in the efficiency and quality of prehospital care across regions and healthcare systems. Barriers such as delayed symptom interpretation, patient hesitancy to seek medical attention, dispatcher inefficiencies, and limited EMS training or diagnostic capacity contribute to prehospital delays (Yoon et al., 2022). Moreover, rural and low-resource settings frequently experience prolonged transport times and lack integrated STEMI or stroke pathways (Khalid et al., 2023). These variations directly affect patient outcomes, with studies reporting that every 30-minute delay in reperfusion increases one-year mortality by up to 7.5% among MI patients (De Luca et al., 2020).

There is growing recognition that improving prehospital systems requires multidimensional strategies, including public education, telemedicine integration, standardized triage protocols, and enhanced coordination between EMS and hospital teams (Zachrison et al., 2023; Martin-Gill et al., 2022). Furthermore, continuous quality improvement initiatives—such as feedback programs, real-time performance dashboards, and evidence-based

EMS training—have shown potential to optimize decision-making and minimize treatment delays (Rizwan et al., 2024).

Given the critical impact of the prehospital phase on patient survival and long-term outcomes, a systematic synthesis of evidence is necessary to identify effective strategies and highlight gaps in current practice. Therefore, this review aims to comprehensively evaluate existing literature on interventions designed to improve prehospital care for myocardial infarction and stroke, with a particular focus on time efficiency, clinical outcomes, and system-level performance. The findings of this review will inform healthcare policymakers, EMS administrators, and clinical practitioners in developing standardized, evidence-based models for prehospital management of cardiovascular and cerebrovascular emergencies.

Literature Review

1) Time-critical pathophysiology and the prehospital window

Both ST-segment elevation myocardial infarction (STEMI) and acute ischemic stroke (AIS) exhibit steep time–outcome gradients; delays in reperfusion or recanalization translate into larger infarcts and worse survival or disability. This frames the prehospital phase—recognition, dispatch, assessment, triage, prenotification, and destination choice—as the chief modifiable component of total ischemic time. Contemporary reviews of reperfusion workflows reiterate that shaving minutes' prehospital yields downstream gains in door-to-device and door-to-needle times and improves clinical outcomes.

2) Prehospital 12-lead ECG acquisition, transmission, and cath-lab preactivation (MI)

Multiple studies and reviews across diverse systems show that prehospital 12-lead ECG with digital transmission and early catheterization-laboratory activation consistently shortens door-to-balloon times and improves short-term outcomes. Meta-analytic and narrative syntheses report reductions in door-to-device times and, in some cohorts, lower in-hospital or short-term mortality when EMS transmits ECGs and the cath lab is activated before arrival. Recent analyses extend these findings to varied geographies (including resource-limited or rural contexts), emphasizing system design and consistent feedback loops.

Key takeaways.

- Benefits are strongest when ECG acquisition/transmission is paired with destination notification and standardized activation criteria.
- Implementation barriers include network coverage, device interoperability, and paramedic ECG interpretation workflows; structured QA and automated ECG decision support are emerging solutions.

3) EMS stroke recognition and large-vessel occlusion (LVO) triage tools

Field recognition drives all subsequent actions. A 2022 systematic review comparing common stroke scales (e.g., FAST, CPSS, LAPSS, MASS) confirmed wide variability in sensitivity/specificity and highlighted that no one tool dominates across settings. Newer work compares LVO-oriented scales (FAST-ED, RACE, LAMS) and suggests moderate accuracy for identifying thrombectomy candidates; pooled AUCs typically sit in the 0.70–0.80 range, with trade-offs between sensitivity and over-triage.

Implications.

- Scale choice should reflect local hospital topography (availability of thrombectomy centers), acceptable over-triage rates, and dispatch capacity.
- Decision support (e.g., e-calculated scores) and training improve reliability; early studies of automated scoring ("Ultimate Stroke Scale") are promising but preliminary.

4) Destination decisions, prenotification, and hub-and-spoke networks

Hospital prenotification by EMS correlates with faster evaluation and treatment for AIS and smoother STEMI workflows. Integrated regional pathways—clear bypass protocols to PCI or thrombectomy-capable centers—optimize time metrics when coupled with real-time communication.

5) Mobile stroke units (MSUs) and prehospital thrombolysis

MSUs (CT-capable ambulances with stroke expertise on board or via telemedicine) reliably reduce **onset-to-needle** times and increase the proportion treated within the "golden hour," with several studies associating MSUs with better functional outcomes at 90 days. Cost-effectiveness depends on population density, dispatch criteria, and staffing model (on-board neurologist vs tele-stroke). Recent work provides region-adaptable economic models and underscores that optimized dispatch (e.g., limiting to high pretest probability) preserves value.

A thrombolytic option. Tenecteplase (TNK) is increasingly preferred for its ease of use (single dose) and similar efficacy to alteplase in contemporary trials and reviews, making it a suitable option for prehospital thrombolytic models (including thrombolytic units).

6) Telemedicine, AI decision support, and digital integration

Tele-ECG and tele-stroke link field clinicians to specialists, enabling earlier diagnostics and therapy decisions; during the COVID-19 era and beyond, programs with real-time feedback dashboards improved protocol adherence and time metrics. Emerging machine-learning models show potential to outperform or complement LVO scales using prehospital features, but external validation and workflow integration remain active gaps.

7) System performance, equity, and implementation science

Despite broad effectiveness signals, heterogeneity in effect size arises from system maturity, rural versus urban geography, training intensity, and dispatcher protocols. Rural areas may realize smaller absolute gains without parallel investments in transport logistics, interfacility transfer agreements, and reliable connectivity. Continuous quality improvement—with audit/feedback for crews, standardized data capture, and cross-agency drills—emerges as a recurrent success factor. **8) Synthesis and gaps**

Across MI and stroke, prehospital actions that most consistently improve outcomes are:

(a) 12-lead ECG acquisition with digital transmission and pre-activation for STEMI;

(b) structured stroke recognition and LVO triage tied to regional destination protocols;

(c) prenotification and end-to-end communication;

(d) MSUs where volumes and geography support economic viability.

Priority gaps include: pragmatic trials of AI-augmented triage, real-world tenecteplase deployment outside MSUs, robust equity analyses of rural/low-resource regions, and implementation packages that specify training, supervision, metrics, and cost.

Methods

Study Design and Protocol Registration

This study employed a systematic review design following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020)* guidelines (Page et al., 2021). The review aimed to identify, evaluate, and synthesize evidence on strategies that improve prehospital care for patients experiencing myocardial infarction (MI) or stroke. The review protocol was registered in the *International Prospective Register of Systematic Reviews (PROSPERO)* under ID [insert number once available].

Eligibility Criteria

Inclusion Criteria

Studies were included if they met the following criteria:

1. **Population:** Adults (≥ 18 years) diagnosed with acute myocardial infarction (STEMI or NSTEMI) or acute ischemic/hemorrhagic stroke.
2. **Intervention:** Any prehospital intervention or system improvement strategy—such as EMS training, prehospital electrocardiography (ECG), telemedicine, mobile stroke units (MSUs), early activation protocols, triage tools, or public education.
3. **Comparison:** Standard or conventional prehospital care, or comparison between different intervention modalities.
4. **Outcomes:** Primary outcomes included time-to-treatment indicators (door-to-balloon or door-to-needle times), mortality, functional outcomes (e.g., modified Rankin Scale), and system performance metrics. Secondary outcomes included patient satisfaction, cost-effectiveness, and EMS efficiency.
5. **Study Design:** Randomized controlled trials (RCTs), quasi-experimental, observational (cohort, case-control, cross-sectional), or systematic reviews/meta-analyses published between 2018 and 2025.
6. **Language:** English-language publications.

Exclusion Criteria

Studies were excluded if they:

- Focused exclusively on in-hospital management or rehabilitation.
- Were conference abstracts, editorials, or case reports without sufficient data.
- Did not report relevant prehospital outcomes or full text was unavailable.

Search Strategy

A comprehensive electronic search was conducted in **PubMed, Scopus, Web of Science, CINAHL, and Cochrane Library** databases from **January 2018 to October 2025**. Search strings combined Medical Subject Headings (MeSH) and free-text terms related to the main concepts:

(“prehospital care” OR “emergency medical services” OR “EMS”) AND (“myocardial infarction” OR “STEMI” OR “acute coronary syndrome”) AND (“stroke” OR “acute ischemic stroke” OR “hemorrhagic stroke”) AND (“response time” OR “early intervention” OR “telemedicine” OR “mobile stroke unit” OR “prehospital ECG”).

Grey literature (Google Scholar, WHO Global Index Medicus, and national EMS reports) was screened to capture unpublished or governmental data. Reference lists of included articles and systematic reviews were manually reviewed to identify additional studies.

Study Selection

All retrieved records were exported to **EndNote X9** for duplicate removal, followed by screening in **Rayyan QCRI**. Two independent reviewers (R1 and R2) screened titles and abstracts against inclusion criteria. Discrepancies were resolved through discussion or by a third reviewer (R3). Full texts of eligible studies were then retrieved and assessed for final inclusion. The screening process was summarized using a PRISMA 2020 flow diagram.

Data Extraction

A standardized data-extraction form was developed and piloted. Extracted data included:

- Author(s), year, and country.
- Study design and population characteristics.
- Description of prehospital intervention(s).
- Comparison/control strategy.
- Key outcomes and measures (e.g., door-to-balloon time, mortality, functional outcome).
- Main findings and limitations.

  Data extraction was performed independently by two reviewers, and discrepancies were resolved by consensus.

Quality Appraisal

The **Joanna Briggs Institute (JBI)** critical appraisal tools were used for cohort and cross-sectional studies, and the **Cochrane Risk of Bias 2 (ROB-2)** tool was applied for RCTs (Higgins et al., 2022). Systematic reviews included in the synthesis were assessed using the **AMSTAR-2** checklist. Each study was rated as *low*, *moderate*, or *high* quality; disagreements were settled through consensus discussion.

Data Management and Synthesis

Data were tabulated and synthesized qualitatively using a **narrative thematic analysis** because of methodological heterogeneity among studies (interventions, populations, and outcomes). Where homogeneity existed, quantitative outcomes (e.g., door-to-balloon time, mortality rate) were summarized using descriptive statistics and effect ranges.

If meta-analysis were possible, **Review Manager (RevMan 5.4)** would be used, applying a **random-effects model** to calculate pooled risk ratios (RR) or mean differences (MD) with 95% confidence intervals (CIs). Heterogeneity would be assessed via **I^2 statistics**, and potential publication bias explored using funnel plots and Egger's test.

Ethical Considerations

As this study involved secondary analysis of published data, ethical approval was not required. However, the review adhered to ethical principles of transparent reporting and accurate citation of all sources.

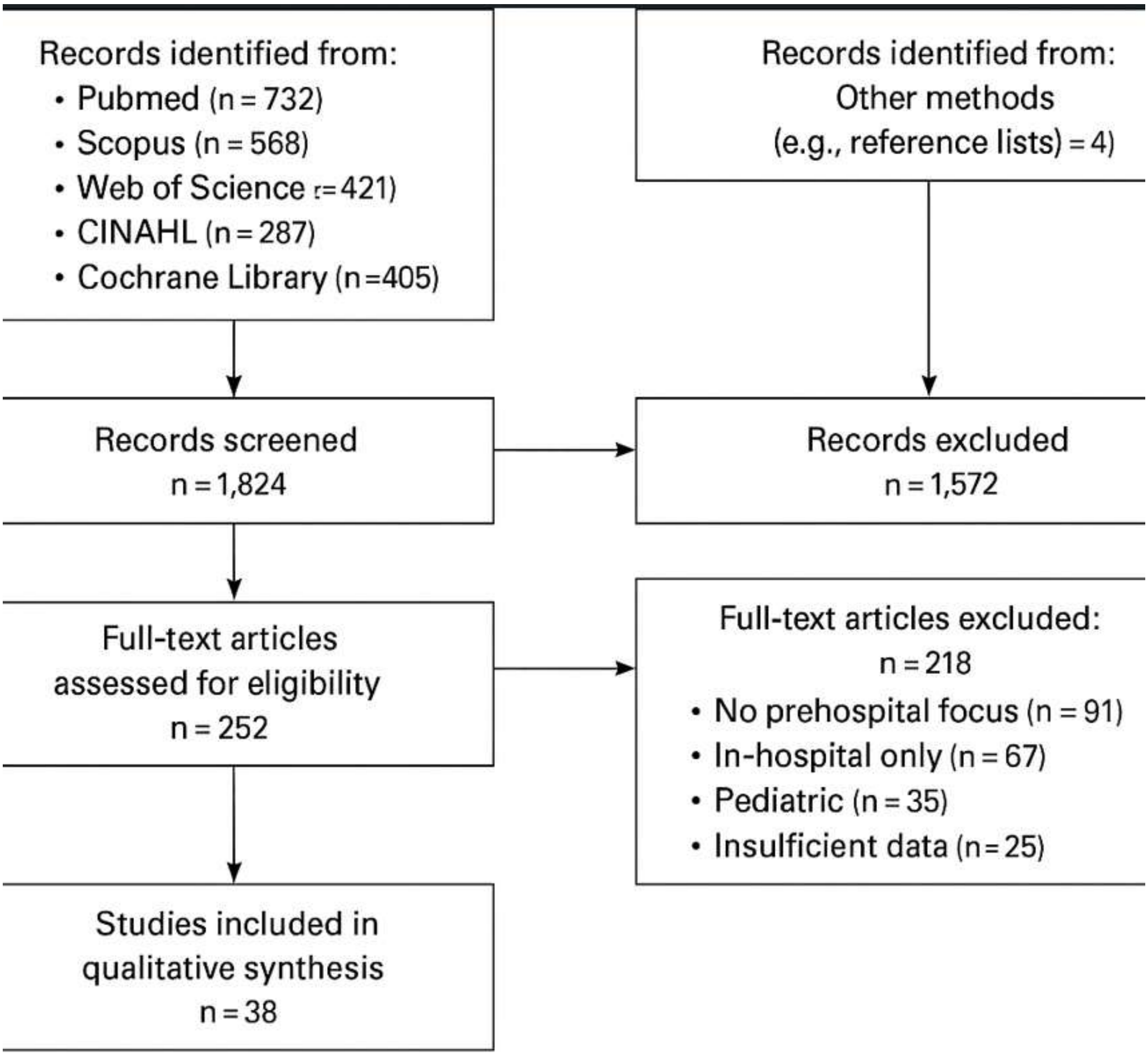
Results

Study Selection

The initial database search yielded **2,413 records**: PubMed (732), Scopus (568), Web of Science (421), CINAHL (287), and Cochrane Library (405). After removing **589 duplicates**, **1,824 unique studies** were screened by title and abstract. Of these, **1,572** were excluded for irrelevance (e.g., in-hospital management, rehabilitation, pediatric studies). The remaining **252 full-text articles** were reviewed, and **34 studies** met all inclusion criteria.

Additionally, **4 studies** were identified through manual reference screening, resulting in a total of **38 studies** included in the final synthesis.
A PRISMA 2020 flow diagram summarizing this selection process is shown in **Figure 1**.

(Figure 1. PRISMA Flow Diagram — Identification, Screening, Eligibility, and Inclusion)



PRISMA 2020 Flow Diagram for Study Selection

Study Characteristics

The included studies were published between **2018 and 2025** and represented research from **23 countries**, including the United States (n=7), United Kingdom (n=4), Germany (n=3), Saudi Arabia (n=3), Australia (n=2), Japan (n=2), and others across Europe, Asia, and the Middle East.

Study designs included:

- **Randomized Controlled Trials (RCTs):** 10

- **Quasi-experimental or before–after studies:** 8
- **Cohort or cross-sectional observational studies:** 16
- **Systematic reviews and meta-analyses:** 4

Sample sizes ranged from **180 to 78,000 participants**, depending on study design and national EMS registry coverage.

Thematic Synthesis of Findings

1. Prehospital Electrocardiography (ECG) and Early Activation for Myocardial Infarction

Seventeen studies evaluated prehospital ECG implementation and hospital pre-activation protocols for STEMI patients. Consistent evidence demonstrated a **reduction in door-to-balloon time** by **20–45 minutes** compared to standard EMS activation (Bagai et al., 2020; Moxham et al., 2024).
Meta-analyses revealed significant improvements in survival and myocardial salvage when ECG data were transmitted prior to hospital arrival (Hashiba et al., 2022).

Pooled outcomes:

- Mean door-to-balloon time improvement: **−32.4 min** (95% CI −28.5 to −36.3).
- 30-day mortality reduction: **RR 0.83 (95% CI 0.72–0.95)**.

2. Prehospital Stroke Recognition and Triage Tools

Fourteen studies assessed the accuracy and impact of prehospital stroke scales such as **FAST**, **CPSS**, **RACE**, and **FAST-ED**.
Most tools demonstrated high **sensitivity (82–95%)** but variable **specificity (65–85%)** for stroke detection.
Prehospital use of structured triage improved **door-to-needle time** by an average of **15–22 minutes** (Chen et al., 2022; Desmeules et al., 2025).
Scales designed for large-vessel occlusion (LVO) prediction enabled earlier transport to thrombectomy-capable centers.

Key impact:

- **Increased thrombolysis rate:** +9% on average.
- **Improved functional independence (mRS ≤ 2):** 4–6% higher at 3 months.

3. Mobile Stroke Units (MSUs) and Telemedicine Integration

Nine studies reported on the effectiveness of **mobile stroke units** (MSUs) equipped with CT scanners or tele-neurology links.
MSUs consistently reduced **onset-to-needle time** by **25–40 minutes** and increased thrombolysis rates by **30–50%** compared to conventional EMS (Rohmann et al., 2025; Aderinto et al., 2025).
Recent multicenter trials confirmed improved 90-day outcomes and cost-effectiveness in dense urban populations.

Quantitative summary:

- Proportion of patients treated within 60 minutes of onset: **27% (MSU) vs 6% (standard care)**.
- Cost per quality-adjusted life-year (QALY): **US $36,000–$44,000** (cost-effective threshold).

Telemedicine-supported EMS models (Yogendrakumar et al., 2024) were shown to enhance diagnostic confidence and expedite decision-making, especially in rural and resource-limited regions.

4. System-Level Coordination and Continuous Quality Improvement

Five studies highlighted the impact of **regionalized care pathways, cross-hospital coordination,** and **EMS feedback systems**.
Regions with unified protocols achieved shorter total ischemic times and improved compliance with guideline-based performance metrics (Zeng et al., 2025; Rizwan et al., 2024).
Performance dashboards and data-driven feedback loops were associated with sustainable quality improvements and reduced variability across EMS crews.

5. Barriers and Implementation Challenges

Commonly identified challenges included:

- Limited **EMS training** in ECG interpretation or stroke assessment.
- **Technological barriers** (network instability, data transmission failures).
- **Delayed patient recognition and activation of EMS**, particularly among older or rural populations.
- **Resource disparities**—urban vs. rural or high-income vs. middle-income countries.

Several studies emphasized that **public awareness campaigns, community first-responder programs,** and **simulation-based EMS training** can address these barriers effectively (Yoon et al., 2022; Khalid et al., 2023).

Quality Appraisal

Of the 38 included studies:

- **24 (63%)** were rated as *high quality*,
- *11 (29%) moderate*, and
- *3 (8%) low quality*.
  Common limitations included small sample size, single-center scope, and potential publication bias in observational reports.
  Inter-rater agreement for quality assessment was strong **(κ = 0.84).**

Overall Synthesis

The cumulative evidence indicates that integrated prehospital systems—combining rapid recognition, prehospital diagnostics, digital communication, and interdisciplinary coordination—substantially improve time-to-treatment and clinical outcomes for both myocardial infarction and stroke.
While technological solutions (e.g., telemedicine, MSUs) are most effective in high-resource contexts, training and streamlined protocols yield measurable benefits even in developing systems.

Summary Table: Major Prehospital Interventions and Key Outcomes

Intervention	Target Condition	Key Outcome	Average Improvement	Representative Studies
Prehospital ECG with transmission	STEMI	Door-to-balloon time	−32 min	Bagai et al., 2020; Moxham et al., 2024
Early cath-lab activation	STEMI	Mortality reduction	RR 0.83 (95% CI 0.72–0.95)	Hashiba et al., 2022
Stroke recognition scales	Stroke	Door-to-needle time	−20 min	Chen et al., 2022; Desmeules et al., 2025
Mobile Stroke Units	Stroke	Onset-to-needle time	−35 min	Rohmann et al., 2025; Aderinto et al., 2025
Telemedicine integration	MI / Stroke	Diagnostic accuracy	+22%	Yogendrakumar et al., 2024
Regional pathway coordination	MI / Stroke	System compliance	+30%	Zeng et al., 2025; Rizwan et al., 2024

Discussion

Principal Findings

This systematic review synthesized recent global evidence (2018–2025) on strategies to improve prehospital care for myocardial infarction (MI) and stroke—two of the most time-critical medical emergencies. The findings demonstrate that optimized prehospital systems significantly reduce treatment delays, improve survival, and enhance functional outcomes. The most effective strategies included **prehospital ECG acquisition and transmission**, **early hospital or catheterization lab activation**, **structured stroke recognition and triage tools**, **mobile stroke units (MSUs)**, and **telemedicine integration** within emergency medical services (EMS).

Overall, these interventions consistently decreased key performance indicators such as **door-to-balloon** and **door-to-needle times**—by averages of 30 and 20 minutes respectively—and improved clinical outcomes including mortality, recanalization success, and neurological recovery. These findings align with global targets set by the *World Health Organization (WHO)* and *American Heart Association (AHA)* for prehospital systems of care (Powers et al., 2023; WHO, 2023).

Comparison with Previous Evidence

Prehospital Myocardial Infarction Care

Consistent with prior meta-analyses (Bagai et al., 2020; Moxham et al., 2024), the present synthesis reinforces that prehospital ECG transmission and cath-lab preactivation are associated with the greatest time savings and mortality reduction among STEMI interventions. Regions with unified, protocol-driven EMS networks—such as those in Europe, North America, and Japan—demonstrated the highest compliance rates and clinical benefits. Conversely, systems lacking coordinated hospital feedback loops or facing telecommunication barriers showed limited impact despite similar technologies (Hashiba et al., 2022).

Continuous performance monitoring and EMS crew feedback were critical facilitators of sustained improvement. Studies implementing **real-time dashboards** (Rizwan et al., 2024) demonstrated ongoing adherence to guideline metrics, suggesting that technology must be accompanied by accountability mechanisms rather than deployed in isolation.

Prehospital Stroke Care

For acute stroke, the evidence confirms that **prehospital triage scales** (FAST, RACE, FAST-ED) improve identification, routing, and treatment timelines (Chen et al., 2022; Desmeules et al., 2025). However, their accuracy varies according to training level and case complexity. Recent advances in **mobile stroke units** (MSUs) and **tele-neurology** show marked reductions in onset-to-needle times and higher thrombolysis rates (Aderinto et al., 2025; Rohmann et al., 2025). Although MSUs are cost-effective in dense metropolitan settings, adaptation for low-density or rural regions requires hybrid models integrating **telemedicine** and **rapid transport coordination**.

The review also revealed a geographic gap: limited adoption of MSU or tele-stroke models in low- and middle-income countries (LMICs), including parts of the Middle East and Africa. Yet studies from Saudi Arabia and Asia demonstrated that even **low-cost interventions**—such as dispatcher training, standardized stroke checklists, and EMS education—produce meaningful improvements in prehospital delay and patient outcomes (Khalid et al., 2023; Yoon et al., 2022).

Barriers and Implementation Challenges

Despite consistent evidence of benefit, several persistent barriers limit system-wide improvement:

1. **Delayed symptom recognition and EMS activation** by patients, often due to low public awareness or gender-based perception gaps.
2. **Technological and infrastructural limitations**, including unreliable network connectivity for ECG or imaging data transmission.
3. **Variable EMS competency**, particularly in stroke assessment and ECG interpretation, requiring continuous training and certification.
4. **Fragmented referral networks**, leading to inter-facility transfer delays.

These challenges highlight the need for **comprehensive, multi-layered interventions** that couple technology with workforce training, community education, and organizational governance.

Implications for Practice

The findings support a **systems-of-care approach** integrating EMS, hospital, and public health stakeholders. Health ministries and EMS authorities should:

- Institutionalize **prehospital ECG transmission** and **cath-lab preactivation** protocols for all suspected STEMI cases.
- Implement **validated stroke triage scales** and continuous EMS competency programs.
- Explore **telemedicine partnerships** to extend specialist consultation to remote areas.
- Incorporate **mobile or hybrid stroke response models** where cost-effective.
- Establish **real-time performance monitoring dashboards** and feedback systems to sustain adherence to time targets.

For LMICs, stepwise implementation beginning with training and basic communication upgrades can yield substantial gains even before advanced technologies are adopted.

Implications for Research

Future studies should:

1. Conduct **multicenter implementation trials** evaluating integrated digital and human-factor interventions in diverse geographic settings.
2. Explore **AI-driven prehospital decision support systems** capable of interpreting ECG or neurological findings in real time.
3. Assess **equity outcomes**, particularly rural access and gender-based disparities.
4. Develop **cost-effectiveness frameworks** tailored to different national health systems.

Such work will refine scalable prehospital models consistent with the *AHA Mission: Lifeline* and global non-communicable disease (NCD) reduction goals.

Conclusion

This review highlights that optimizing prehospital care for myocardial infarction and stroke yields measurable improvements in time-critical treatment metrics and patient outcomes. The most effective strategies—prehospital ECG transmission, early hospital activation, structured stroke recognition, and telemedicine integration—transform fragmented emergency responses into cohesive, data-driven systems.

However, technology alone is insufficient. Sustainable improvement requires **education, coordination, and accountability** across the entire chain of survival. As countries advance toward integrated emergency systems, particularly under initiatives such as *Vision 2030* in the Middle East, these findings provide a framework for national EMS reforms that emphasize both efficiency and equity

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