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The Role Of Mobile Health (Mhealth) Applications In Improving Emergency Medical Response: A Systematic Review

Nasser Musaed Alghamdi[1], Mohammed Abdullah Ibrahim Alzahrani[1], Omaer Aiydh Almagati[1], Mohammed Abdullah Almatrafi[1], Khaled Ali Al Malki[1], Raed Saad AL-Mutairi1, Abdulaziz Ali Abdullah Alotaibi[1], Ahmed mustafa mesawa1, Abdulaziz Abdulrahman Hashim Alsharif

Saudi Red Crescent Authority, Saudi Arabia.

Abstract

Background:
Timely emergency medical response is essential for improving outcomes in life-threatening conditions such as cardiac arrest, stroke, and severe trauma. Mobile health (mHealth) applications—delivered through smartphones, tablets, and digital platforms—are increasingly used to enhance prehospital decision-making, streamline communication, and optimize EMS–hospital coordination. Despite growing adoption, the evidence regarding their effectiveness remains fragmented.

Methods:
A rapid systematic review was conducted following targeted searches in PubMed/PMC, ClinicalTrials.gov, and leading emergency medicine and neurology journals from 2019 to 2025. Eligible studies included randomized controlled trials (RCTs), controlled cohort studies, interrupted time-series analyses, and prospective validations evaluating mHealth interventions in EMS or ED interfaces. Outcomes of interest included process measures (time efficiency, communication quality, triage accuracy) and patient-centered outcomes (survival, morbidity).

Results:
Twelve high-quality studies were synthesized across six domains. Tele-EMS systems demonstrated non-inferiority to on-scene physicians, with improved efficiency and care quality (Kowark et al., 2023; Schröder et al., 2024). Smartphone-dispatched responder apps were associated with higher survival in out-of-hospital cardiac arrest when alerts were accepted, though acceptance rates remained low (Smith et al., 2022). Stroke applications, such as JOIN, reduced door-to-needle times, while NIHSS-based prehospital scoring modestly prolonged scene times without improving diagnostic accuracy (Martins et al., 2020; Guterud et al., 2023). Communication apps shortened EMS–ED handover calls by 22% without harming outcomes (Fukaguchi et al., 2022). Trauma triage tools achieved AUROC ≈0.80 with under-triage near accepted thresholds (Biesboer et al., 2024). Emerging innovations, such as caller livestreaming, showed feasibility but lack robust outcome evidence (Magnusson et al., 2024).

Conclusion:
mHealth applications meaningfully improve critical process indicators in emergency response—particularly tele-consultation, structured communication, and coordinated stroke workflows. However, evidence linking these tools directly to long-term survival and functional outcomes remains limited. Future research should prioritize multicenter RCTs, cost-effectiveness analyses, and human-factors evaluations to ensure effective integration of mHealth into diverse EMS systems.

Keywords: mHealth, emergency medical services, tele-EMS, mobile applications, out-of-hospital cardiac arrest, stroke, trauma triage, prehospital care.

Introduction

Mobile health (mHealth) applications are increasingly embedded across the emergency care continuum—from dispatch and bystander activation, to on-scene decision support, teleconsultation, and hospital pre-notification. This review focuses on high-quality empirical studies that quantify the impact of these tools on process and patient-centered outcomes in EMS and time-critical emergencies.

Emergency medical services (EMS) play a pivotal role in ensuring timely and effective care for patients experiencing life-threatening conditions such as cardiac arrest, stroke, or severe trauma. The effectiveness of EMS is closely linked to rapid decision-making, efficient coordination, and seamless communication across prehospital and hospital settings. Delays in recognition, treatment initiation, or hospital transfer can significantly worsen outcomes, making innovations that streamline these processes particularly valuable (Kowark et al., 2023; Martins et al., 2020).

Mobile health (mHealth) applications—defined as software solutions delivered via smartphones, tablets, or other mobile devices—have emerged as transformative tools within the emergency care continuum. These technologies extend beyond basic telephony to enable secure data sharing, teleconsultation, real-time monitoring, triage decision support, and volunteer responder activation. By integrating mHealth solutions, EMS systems can reduce treatment delays, improve communication between dispatch centers and emergency departments, and optimize prehospital triage protocols (Fukaguchi et al., 2022; Schröder et al., 2024).

Globally, diverse applications illustrate the potential of mHealth in emergency contexts. Tele-EMS platforms in Germany have demonstrated non-inferiority to on-scene physicians, supporting safe and efficient care delivery in resource-limited situations (Kowark et al., 2023). Volunteer responder networks, such as the GoodSAM and Heartrunner apps, have been linked to improved survival rates in out-of-hospital cardiac arrest, though challenges remain regarding alert acceptance and AED retrieval behaviors (Smith et al., 2022; Berglund et al., 2023). Stroke-specific applications, such as JOIN, have shown promise in reducing door-to-needle times by enabling remote decision-making and image sharing, highlighting their capacity to accelerate reperfusion therapy (Martins et al., 2020). Meanwhile, trauma triage and structured communication apps continue to refine decision support and streamline EMS–hospital coordination (Biesboer et al., 2024).

Despite these promising outcomes, evidence remains mixed regarding the direct impact of mHealth on patient survival and functional recovery. Many studies emphasize process improvements—such as reduced communication time or faster treatment initiation—while robust mortality and morbidity endpoints are less frequently reported (Guterud et al., 2023; Magnusson et al., 2024). Furthermore, challenges related to user adoption, technological infrastructure, and integration into diverse EMS models limit generalizability across regions.

Given the increasing adoption of digital health tools in emergency medicine and the critical need for evidence-based evaluation, this systematic review aims to synthesize current empirical findings on the role of mHealth applications in enhancing emergency medical response. By examining their effects on process measures, clinical outcomes, and system efficiency, the review provides a comprehensive assessment of their potential to transform time-sensitive care delivery.

Literature Review

Research on mobile health (mHealth) applications in emergency medical services (EMS) has expanded substantially over the past decade, reflecting the global drive toward digital transformation in healthcare. Evidence clusters into several thematic domains, each demonstrating unique opportunities and challenges for improving prehospital and emergency response outcomes.

1. Tele-EMS Physician Support

Telemedicine-supported EMS (Tele-EMS) has gained traction as a strategy to extend physician expertise to the field without requiring physical presence. The landmark non-inferiority randomized controlled trial (RCT) in Aachen, Germany, demonstrated that tele-EMS was non-inferior to on-scene EMS physicians regarding intervention-related adverse events, while also enabling more than half of tele-EMS cases to be managed without direct physician presence (Kowark et al., 2023). Long-term system data further support these findings, showing that tele-consultations increased steadily over seven years while average consultation duration decreased, suggesting improved efficiency and scalability (Schröder et al., 2024). Importantly, additional analyses revealed improved care processes in life-threatening missions, including earlier administration of analgesia and ECG monitoring, underscoring tele-EMS as a viable solution in physician-scarce systems (Schröder et al., 2021).

2. Smartphone-Dispatched Responders in Out-of-Hospital Cardiac Arrest (OHCA)

Rapid bystander response remains a cornerstone of OHCA survival. Volunteer responder apps, such as GoodSAM in the United Kingdom, have demonstrated significant associations between alert acceptance and increased survival to hospital discharge, with adjusted odds ratios exceeding three. However, acceptance rates remain low, highlighting barriers to volunteer engagement and geographic coverage (Smith et al., 2022). Similarly, the SAMBA RCT in Sweden tested whether instructing responders to fetch automated external defibrillators (AEDs) improved AED attachment rates, but found no statistically significant effect, likely due to high baseline AED use and compliance challenges (Berglund et al., 2023). These findings emphasize that while smartphone-dispatched responders can improve outcomes, maximizing impact requires strategies to increase acceptance density, responder motivation, and AED accessibility.

3. Stroke Coordination and Decision Support

Time-to-treatment is critical in acute ischemic stroke, where every minute of delay reduces the likelihood of favorable outcomes. The JOIN application has been validated as an effective platform for real-time sharing of imaging and clinical data, enabling remote specialists to support EMS teams and reducing door-to-needle times in single-center studies (Martins et al., 2020). However, the ParaNASPP stepped-wedge cluster RCT in Norway presented mixed results: while the app facilitated structured communication and use of the NIHSS score prehospital, it did not significantly increase diagnostic positive predictive value and modestly increased on-scene time (Guterud et al., 2023). Narrative reviews suggest that app-based stroke

coordination consistently improves workflow metrics, yet robust evidence linking these tools to long-term functional outcomes remains limited (Bonura et al., 2022/2023).

4. EMS–Emergency Department (ED) Communication

Efficient communication between EMS and hospital teams is essential for ensuring continuity of care. The NSER mobile app in Japan reduced average phone negotiation time by 45 seconds (a 22% decrease) during EMS–ED handovers without compromising patient outcomes (Fukaguchi et al., 2022). By providing structured, real-time information transfer, such apps streamline prehospital notification processes and reduce communication bottlenecks, supporting faster ED preparedness. While the absolute time savings may appear modest, in time-critical emergencies even small reductions can translate into meaningful clinical benefits.

5. Prehospital Trauma Triage and Decision Support

In trauma care, mHealth tools are increasingly leveraged to enhance triage accuracy. The NEI-6 model, embedded in a mobile application and validated across multiple U.S. trauma centers, demonstrated an area under the receiver operating characteristic curve (AUROC) of 0.80, with undertriage rates near 9–10%—approaching the thresholds of acceptability in trauma systems (Biesboer et al., 2024). Earlier predictive models, such as those by van Rein et al. (2019), have established baseline performance benchmarks, guiding subsequent app development. These decision support applications hold promise for reducing both overtriage and undertriage, though their real-world adoption and integration into complex trauma networks require further evaluation.

6. Emerging Innovations: Caller Livestreaming and Beyond

Newer technologies, including video livestreaming from bystanders' smartphones directly to dispatch centers, represent the next frontier in mHealth-supported emergency response. A recent scoping review highlights the feasibility of such tools in enhancing dispatcher situational awareness and guiding early interventions, though robust trials linking livestreaming to patient outcomes remain scarce (Magnusson et al., 2024). These developments suggest a shift toward integrating real-time multimedia communication into emergency response systems, potentially transforming dispatcher and EMS decision-making.

Synthesis of Evidence

Overall, the literature reveals that mHealth applications consistently improve **process measures**—including reduced consultation times, faster treatment initiation, and more efficient EMS–hospital communication. Some domains, such as tele-EMS and stroke workflow, provide growing evidence for clinical benefits, while others, such as OHCA responder dispatch and trauma triage, show promise but remain limited by adoption barriers and methodological variability. The predominance of observational studies and single-center trials underscores the need for larger, multicenter RCTs to establish definitive impacts on survival and long-term functional outcomes.

Methodology

Methods (rapid systematic approach): We conducted targeted searches of PubMed/PMC, ClinicalTrials.gov, and major emergency medicine and neurology journals for 2019–2025 using terms combining EMS, emergency, prehospital, telemedicine, smartphone, app, stroke, OHCA, triage, and tele-EMS. Inclusion criteria: human studies; EMS or ED interface; mHealth/app/tele-EMS interventions; RCTs, controlled cohort, interrupted time-series, or prospective validation; process or outcome endpoints. Exclusions: purely technical papers, simulation only (unless directly informing prehospital assessment), pediatric-only unless

generalizable, and non-app telephony without digital features. Data extraction captured setting, design, sample size, mHealth component, and key outcomes. Given access limits, this is a rapid evidence synthesis rather than a full meta-analysis.

Results

Results synthesize 12 studies across domains. Tele-EMS shows safety and system-level efficiencies. For OHCA, volunteer dispatch apps can be associated with improved survival when used, but changing AED attachment behavior via instructions alone may not produce significant gains in high-baseline settings. Stroke apps can reduce door-to-needle time in single-center studies; however, adding NIHSS via an app prehospital did not improve PPV in a cluster RCT and modestly increased on-scene time. Communication apps reduce EMS–ED phone time. Trauma triage apps achieve promising discrimination with under-triage near accepted thresholds.

Evidence Table (Key Studies)

Domain	Study	Country/System	Design/N	mHealth/ App	Key Outcomes
Tele-EMS	Kowark et al., 2023 (TEMS RCT)	Aachen, Germany	Open-label non-inferiority RCT; N randomized=3,531; primary analysis=3,220	Tele-EMS center with audio/video, vitals, ECG streaming to remote EMS physician	Non-inferior for intervention-related AEs; 58% of tele-EMS cases managed without on-scene physician; time to hospital slightly longer in tele-EMS arm; better treatment quality when tele-physician engaged.
Tele-EMS (system)	Schröder et al., 2024	Aachen, Germany	7-year observational; 229,384 missions; tele-EMS used in 10.1%	Tele-EMS system at scale	Tele-consultations increased (8.6%→12.9%); call duration decreased (≈12.1→9.4 min); simultaneous tele-consultations common; supports resource efficiency.
OHCA responders	Smith et al., 2022 (GoodSAM)	UK (London & East Midlands)	Adjusted cohort; London n=4,196; East Midlands n=1,001	GoodSAM volunteer responder alert app	Alert acceptance associated with ↑survival to hospital discharge; adj.

					OR ~3.15–3.19; acceptance rates low (1.3–5.4%).
OHCA responders	Berglund et al., 2023 (SAMBA RCT)	Sweden	RCT; n=947 OHCAs	Heartrunner app; randomization to fetch AED vs go directly for CPR	No significant ↑ in overall bystander AED attachment (13.2% vs 9.5%; Δ3.8%, p=0.08); contamination and compliance issues noted.
Stroke workflow	Martins et al., 2020 (JOIN)	Brazil	Before/after; 720 stroke codes; 442 AIS treated; 78 thrombolysed	JOIN app for secure clinical/imaging sharing & remote decisions	JOIN decisions ≈ in-person accuracy; door-to-needle reduced (median 90→63 min, p=0.03).
Stroke prehospital NIHSS	Guterud et al., 2023 (ParaNASPP RCT)	Norway	Stepped-wedge cluster RCT; n=801 analyzed (447 int.; 354 ctrl.) of 935 evaluated	NIHSS training + mobile scoring + structured comms	No PPV improvement (48.1% vs 45.8%); on-scene time +5 min; door-to-needle similar.
EMS↔ED comms	Fukaguchi et al., 2022 (NSER app)	Japan	Interrupted time-series; 1,966 transports over 16 weeks	NSER mobile for real-time information sharing	Phone-communication time −45 s (−22%); mortality and transport time unchanged.
Trauma triage	Biesboer et al., 2024 (EAST multicenter)	USA (5 sites)	Prospective external validation; n=2,476 validation	NEI-6 prediction model embedded in mobile app	AUROC 0.80; undertriage 9.1% (blunt 8.8%); overtriage 53.7%.
Trauma triage (model)	van Rein et al., 2019	Netherlands	Model development/validation	Prediction model (not app-specific)	Estimated undertriage ≈10% with ≈50% overtriage; informs app

					development targets.
Tele-EMS life-threatening	Schröder et al., 2021	Germany (Aachen)	Retrospective analysis	Tele-EMS physician support	Improved care processes during life-threatening missions (early analgesia/ECG etc.).
Stroke workflow (review)	Bonura et al., 2022/2023 (narrative review)	Global	Narrative review	Stroke apps (JOIN et al.)	Consistent signal of door-to-needle time improvement with app-based coordination.
Caller livestream	Magnusson et al., 2024 (scoping review)	Global	Scoping review	Video livestreaming from callers' smartphones to dispatch centers	Identifies opportunities and challenges; feasibility promising; robust outcome trials pending.

Discussion

Implications: Tele-EMS and secure app-based communication should be prioritized where physician-on-scene coverage is constrained. Bystander responder networks need strategies to increase alert acceptance (opt-in density, incentives) rather than relying solely on AED-fetch instructions. Stroke programs may benefit from app-based team coordination and image sharing, while recognizing that prehospital NIHSS may not improve diagnostic PPV; training and workflow tuning are essential to avoid on-scene delays.

Limitations: The evidence base mixes RCTs and observational designs; generalizability varies by EMS model and network density; and many studies report process over hard outcomes. Future research: cluster RCTs linking mHealth interventions to mortality and disability; cost-effectiveness; equity impacts; and human-factors evaluations at scale.

Conclusion

mHealth applications can meaningfully improve components of the emergency care chain—especially tele-consultation, secure information transfer, and coordinated stroke workflows—with growing but still mixed evidence for patient outcomes. Success depends on integration with dispatch and hospital systems, user adoption, and rigorous measurement of time-critical and clinical endpoints.

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