

OPINIONS, PERSPECTIVES COMMENTARY

# Virtual Lifelines: Telehealth's Paramedicine Role in Emergency Medical Services

Alan Silburn, BP, BN, MPh, FAWM, FAEEM, FRSPH

Western Sydney University, Campbelltown, NSW, Australia

Corresponding Author: Alan Silburn, Email: alan.silburn@health.nsw.gov.au

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## Abstract

Telehealth transformed medical care by providing a role as paramedicine for wider accessibility and enhanced effectiveness in emergency pre-hospital settings. Telemedicine systems, mobile telecommunications, and video-to-video communication have proven beneficial to paramedics and their patients. The combination of real-time consultations with better diagnostic accuracy and early interventions becomes possible through these technologies when treating acute emergencies, stroke, and myocardial infarction. The focus of telehealth on bringing advanced emergency medical care services with medical and paramedical decision-making in the pre-hospital environment provides promising advantages, but traditional communication systems and inadequate infrastructure continue to create implementation barriers. Technological progress creates expanding possibilities for telehealth to enhance healthcare delivery while improving patient outcomes, thus requiring sustained funding and development in this field.

## Plain Language Summary

Telehealth has transformed pre-hospital emergency care by giving paramedics access to specialist guidance and real-time patient data, improving diagnostic accuracy, safety, and treatment outcomes. Operating via real-time, delayed, or continuous monitoring, it supports better decisions and reduces unnecessary hospital admissions. Telehealth enhances cost-efficiency, equitable access, workforce sustainability, and community health, particularly in rural areas. Key challenges include unstable networks, system incompatibility, and incomplete patient records. Strategic funding, standardised electronic health records, and policy reform are needed to embed telehealth as a core, essential component of modern emergency medical services rather than a supplementary tool.

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Paramedicine, working through the combined contributions of professionals delivering healthcare in community and emergency settings outside hospitals, has evolved significantly with telehealth integration. Paramedics often work under challenging conditions with limited access to clinical information, making telehealth solutions vital for decision support.<sup>1</sup> Telehealth encompasses the use of virtual technologies to provide health services, including health promotion, monitoring, diagnosis, and clinical management. Historical forms of remote care demonstrate its longstanding role

in health systems, from the use of smoke signals to warn African villages of infectious disease outbreaks to today's sophisticated telemedicine platforms.<sup>2</sup> The integration of telehealth into emergency medicine service (EMS) demonstrates the increasing importance of digital systems in improving safety, efficiency, and patient outcomes in time-critical care.<sup>3</sup>

This commentary evaluates the development of telehealth in pre-hospital emergency services using the quintuple aim framework: lowering costs of care, improving individual patient care, enhancing community health,

ensuring a sustainable model for care teams, and achieving equitable access. By analyzing benefits, barriers, and implementation strategies, this article highlights telehealth's role in reshaping emergency care delivery.

### Telehealth's Paramedical Applications

Telehealth applications in modern emergency medical services (EMS) operate through three primary service types: synchronous (real-time), asynchronous, and remote monitoring systems.<sup>3</sup> Synchronous telemedicine allows paramedics to communicate directly with specialists through voice or video links, facilitating rapid consultation during critical emergencies.<sup>2,4</sup> Asynchronous systems store patients' data, such as electrocardiograms (ECGs), imaging, and clinical histories, for later review by specialists, while remote monitoring enables continuous patient tracking through wearable devices and sensors.

Studies show that integrating these systems enhances pre-hospital consultations and minimizes errors during handovers to hospital teams, leading to measurable improvements in patient safety and diagnostic accuracy.<sup>5-7</sup> Aya-tollahi et al.<sup>6</sup> demonstrated that improved data access leads to safer decisions and better outcomes. Ho et al.<sup>7</sup> reported that the lack of integration between pre-hospital and hospital systems caused delays and incomplete handovers, prompting Singapore to develop its Hospital and Emergency Ambulance Link: a wireless data-sharing platform connecting ambulance services with hospital records. To illustrate, Table 1 summarizes common pre-hospital telehealth use cases, associated outcomes, and geographies.

Integrating telehealth into EMS workflows supports lower costs of care by optimizing triage, reduced unnecessary ambulance dispatches, and decreasing overtriage, which can lead to high-speed responses and increased road safety risks.<sup>9,12</sup> Pre-arrival patient assessments using the original emergency call or direct patient

telecommunication enable EMS teams to determine the level of patient risk before dispatch, decreasing overtriage and enhancing dispatch efficiency.<sup>2,9,12</sup> Evidence shows that telehealth-supported decision-making reduces hospital transfers, emergency department congestion, and overall system expenditures.<sup>1,3</sup>

Beyond cost efficiency, telehealth enhances patient care by improving diagnostic accuracy, enabling real-time trauma assessments, and supporting remote specialist guidance.<sup>2,3</sup> The combination of video and verbal assessment allows paramedics to perform trauma evaluations while specialists interpret focused sonography remotely, which ensures timely and appropriate interventions, particularly in resource-limited or rural areas.<sup>2</sup> In acute cardiac care, 12-lead ECG transmission facilitates early identification of ST-elevation myocardial infarction (aka STEMI), allowing paramedics to administer aspirin pre-hospital and enabling hospitals to prepare for immediate intervention.<sup>4,8</sup> Direct communication between paramedics and specialists improves diagnostic precision, reduces delays, and contributes to better patient outcomes.<sup>2</sup> Access to complete electronic health records further supports safer pre-hospital consultations, minimizes critical errors during transfers, and improves overall patient safety.<sup>5,6</sup>

In addition, the application of paramedical telehealth strengthens community health by overcoming geographical barriers to specialist care. Mobile telecommunications provide scalable, infrastructure-light solutions, broadening access to emergency expertise and promoting equitable care delivery.<sup>13</sup> State-based network partnerships and national electronic health record systems, such as Singapore's Hospital and Emergency Ambulance Link, mitigate challenges arising from fragmented pre-hospital information systems, enabling real-time hospital-ambulance data sharing and reducing delays or incomplete clinical handovers.<sup>7,10,11</sup>

Table 1. Examples of telehealth in EMS and outcomes.

Use case	Telehealth application	Measured outcomes	Setting (Ref)
Stroke assessment	Real-time video consultation between paramedics and neurologists	Improved clinical decision-making, faster specialist consultation, enhanced triage accuracy	Singapore, USA <sup>2,11</sup>
Myocardial infarction	12-lead ECG transmission to hospital specialists	Faster diagnosis, earlier reperfusion, decreased infarct size, reduced time to intervention	USA, Australia <sup>4,8</sup>
Trauma assessment	Remote video support for focused sonography	Improved diagnostic accuracy, faster critical care decisions, timely interventions	Rural USA, Africa <sup>2</sup>
Patient triage	Pre-arrival telecommunication with EMS teams	Improved dispatcher decision-making, reduced over-triage, more efficient ambulance allocation	Singapore, UK <sup>9,10</sup>
Chronic disease monitoring	Asynchronous review of patient history, vitals, ECGs	Enhanced clinician access to patient data, reduced errors in complex cases, improved patient safety	UK, Australia <sup>5,6</sup>
Remote monitoring	Continuous sensor and video tracking	Early detection of clinical deterioration, prompt interventions, reduced complications	Rural China, USA <sup>3</sup>

ECG: electrocardiogram; EMS: emergency medicine service.

Supporting sustainable workforce models is another key benefit. EMS work is physically and emotionally demanding, with high burnout risk exacerbated by workload and unpredictable case complexity.<sup>1,2</sup> Telehealth provides decision support tools and timely access to accurate clinical data, improving workforce confidence, efficiency, and safety.<sup>5,6</sup> Integrated systems facilitate remote supervision, specialist guidance, and ongoing professional development. The availability of electronic health records allows paramedics to make rapid decisions regarding the appropriate treatment approach, particularly when managing complex cases or end-of-life situations, while pre-arrival assessments improve security for both patients and responders.<sup>5,6</sup>

Despite these advantages, persistent barriers limit telehealth effectiveness. The performance of video-enabled systems depends on equipment reliability and broadband stability, which remain challenges in rural areas where connectivity is intermittent.<sup>2,13</sup> Administrative inefficiencies, such as inaccurate emergency call identification and limitations in cross-district data sharing, reduce system effectiveness.<sup>7,11</sup> Incorrect patient information, including names, dates of birth, and medical record numbers, can prevent records from being retrieved.<sup>6,12</sup> Addressing these issues requires robust patient identification protocols, investment in infrastructure, adherence to interoperability standards, and integration of national electronic health records.<sup>7,11,13</sup>

Integrating telehealth into EMS workflows not only enhances individual patient care and operational efficiency but also has broader implications for public health systems and policy. By improving access to specialist care, reducing unnecessary hospital transfers, and supporting timely interventions in rural and underserved areas, telehealth strengthens the capacity of health systems to deliver equitable and efficient emergency services.<sup>1,2,13</sup> These benefits align with core public health objectives, including population-level health improvement, reduction of health disparities, and resilience during health crises.<sup>1,3</sup>

From a policy perspective, telehealth integration into pre-hospital care reinforces the importance of national digital health infrastructure, standardized electronic health records, and interoperability frameworks to ensure seamless data sharing across regions.<sup>10,11</sup> Investment in telehealth is therefore not merely a technological upgrade but a strategic public health intervention, capable of supporting system-wide improvements in quality, safety, and equity.<sup>1,3,13</sup> Policies that promote sustainable workforce development, funding models, and regulatory frameworks for telehealth can further embed these innovations into routine EMS practice, reinforcing the role of paramedicine as a critical component of modern, community-oriented health systems.<sup>1,2,3</sup>

The analysis of telehealth within public health systems reveals its advantages reach past immediate medical results because it strengthens emergency care networks through improved resilience and equality.<sup>1,3,13</sup> The future policy framework needs to focus on integrating telehealth solutions while establishing standardized systems that scale up to support pre-hospital care development at the same pace as overall health system targets.<sup>10,11</sup>

## Conclusion

Telehealth has revolutionized pre-hospital emergency care by providing advanced clinical communication capabilities, access to specialist guidance, and improved patient outcomes. The integration of connected, data-intensive systems now enables paramedics to deliver faster, safer, and more appropriate emergency medical care.

Despite these advances, widespread adoption remains constrained by three principal challenges: limitations in data infrastructure, inter-agency interoperability barriers, and restricted accessibility in rural settings. Realizing the full potential of telehealth in paramedic practice will require strategic investment, comprehensive policy reform, and national health record integration to address these systemic obstacles. The future of emergency care delivery depends on embedding telehealth not merely as a supplementary tool but as a fundamental, integral component of routine emergency response practices.

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## Authors' Contributions

The author solely contributed to the conception, design, analysis, and drafting of the manuscript.

## Data Availability Statement (DAS), Data Sharing, Reproducibility, and Data Repositories

All data referenced in this study are publicly available through published literature, government reports, or open-access databases cited in the manuscript.

## Application of AI-Generated Text or Related Technology

No AI-generated text or related technologies were used in the preparation of this manuscript.

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