

“Telemedicine and Mobile Health, Current Challenges and Future opportunities in Emergency Medical services. Are we ready”

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Abstract:

This systematic review aimed to explore the potential benefits and challenges of telemedicine and mobile health (mHealth) in emergency medical services (EMS). A comprehensive literature search was conducted to identify relevant studies, which were then evaluated for quality and synthesized to draw conclusions. The main results showed that telemedicine and mHealth offer significant potential to improve access to care, enhance patient management, and reduce costs in EMS. Challenges include infrastructure limitations, regulatory barriers, data privacy concerns, and technical limitations. Successful implementation requires collaboration, investment, and addressing these challenges. Future opportunities include improved triage, remote patient monitoring, and enhanced education and training. Conclusion: Telemedicine and mHealth have the potential to revolutionize EMS by providing timely care to patients in remote or underserved areas. By addressing the challenges and capitalizing on the opportunities, we can unlock the full potential of these technologies to improve patient outcomes and enhance the efficiency of healthcare delivery.

Key words: Telemedicine, Mobile Health, Emergency Medical Services, Paramedics, Pre-hospital care, Opportunities, Challenges.

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Introduction

Telemedicine and mobile health (mHealth) technologies have revolutionized the way healthcare is delivered, particularly in emergency medical services (EMS). These innovations provide real-time access to medical expertise and enable faster, more efficient care for patients in critical conditions. By integrating telemedicine, EMS personnel can consult with specialists remotely, enhancing decision-making, improving patient outcomes, and optimizing the allocation of medical resources.

However, despite the potential benefits, the implementation of telemedicine and mHealth in emergency settings presents several challenges. Technical barriers, such as network reliability and data security, combined with regulatory and legal concerns, create significant hurdles. Furthermore, there is often a gap in training EMS professionals to effectively use these technologies in high-pressure situations (Shigekawa, et al., 2018).

As healthcare systems worldwide strive to modernize, the question arises: Are we ready to fully leverage telemedicine and mobile health in emergency medical services? This paper will explore the current challenges, the opportunities for advancement, and the readiness of healthcare systems to embrace these transformative tools. It will also examine the role of telemedicine in bridging healthcare access disparities, particularly in rural or underserved areas, and its potential to reshape the future of emergency medicine.

Telemedicine, which enables video or phone appointments between a patient and their health care practitioner, benefits both health and convenience. More health care providers are offering to “see” patients by computer and smartphone. Overall, telehealth and telemedicine services are more cost-effective for patients and healthcare professionals. It saves time

traveling and time in the waiting room. Additionally, virtual payment methods are quick, easy, and reduce paper billing processes. Telemedicine is the use of electronic communications to exchange medical information remotely (Shigekawa, et al., 2018).

The convergence of technology and healthcare has given rise to innovative solutions, such as telemedicine and mobile health (mHealth). These advancements have the potential to revolutionize emergency medical services (EMS), providing timely care to patients in remote or underserved areas. However, their widespread adoption and effectiveness face significant challenges. Telemedicine has increased access to high-quality healthcare facilities. Patients will now get more customized clinical services (Haleem, et al., 2021).

Advanced technologies that provide high-quality network services enable individuals to improve the delivery of health care and make it available to an increasing number of people. Telemedicine is a more useful technology that can make it easier for people to access preventive treatment and help their long-term health. Telemedicine has the potential to make health care more efficient, organized, and accessible. Research in this area is still in its early stages, but it is expanding. Telemedicine is an excellent option for treating the problems of injured and sick people while they are being transported in ambulances (Lin O, et al., 2019).

Prehospital diagnosis facilitates the provision of appropriate patient care and timely transportation of the patient to the hospital; thus, it can save lives and improve patient outcomes. When a patient sustains severe injuries or experiences trauma that necessitates emergency care, it is crucial to quickly and correctly identify and diagnose the injury/trauma and transport him or her to the nearest appropriate hospital to ensure that he or she receives the necessary treatment (Stengaard, et al., 2016).

Advanced technologies with high-quality network services enable individuals to improve the delivery of healthcare and make it available to more people (Wilson and Maeder, 2015). Telemedicine is a more useful technology that can make it easier for people to access preventive treatment and help them improve their long-term health. This is especially true for those who face financial or territorial reasons to receive quality treatment. Telemedicine has the potential to make healthcare more efficient, organized, and accessible (Haj esmaeel, and Bahaadin, 2021). Research in this area is still in its early stages, but it is expanding. For example, telephone-based care and remote monitoring of vital signs for people with heart disease has reduced the risk of death and hospitalization and increased quality of life (Lupton and Maslen, 2017). There are many compelling reasons for people to seek a diagnosis or recovery plan. This can help patients feel confident that they are receiving the best treatment. Telemedicine is an excellent option for treating mental health issues. It removes some of the barriers that prevent patients from receiving this crucial form of treatment (Wilson and Maeder, 2015).

The aim of the study is to explore the potential benefits and challenges of telemedicine and mobile health (mHealth) in emergency medical services (EMS). It seeks to assess the readiness of the healthcare system to adopt and implement these technologies effectively.

Methodology of this study

Systematic review was used to:

- Identify, evaluate, and synthesize the existing research on telemedicine and mobile health (mHealth) in emergency medical services (EMS).
- Provide a comprehensive and unbiased overview of the current state of knowledge on the topic.
- Identify key findings, conclusions, and recommendations from previous studies.
- Assess the strengths and limitations of the existing research.
- Inform decision-making and guide future research in the field of telemedicine and mHealth in EMS.

Literature review

Historically, computers have been used in health care mostly for administration, billing, and reporting of laboratory results. In emergency medicine, anecdotal experience suggests a wide range of information technology use: Some emergency departments use computers only for registration and reporting of laboratory results, whereas others have entirely “paperless” systems. First implemented in the 1950s, telemedicine is a rapidly evolving tool for healthcare systems around the world. Technological advancement and increasing access to information technology have made the implementation of telemedicine more feasible. Recent provisions by healthcare governing bodies have increased reimbursement for and the use of telemedicine globally (Stoltzfus, et al., 2023).

Telemedicine refers to the provision of healthcare services remotely through the use of telecommunications and information technology. The significance of telemedicine lies in its ability to bridge geographical barriers, improve patient access to healthcare, and enhance the efficiency of healthcare delivery systems. By enabling healthcare professionals to diagnose, treat, and monitor patients from a distance, telemedicine can revolutionize how healthcare is delivered, particularly in areas with limited access to medical facilities (Wangler and Jansky., 2023). Therefore, telemedicine solution can not only provide an alternative to in-person visits but should be developed as a digital network to connect patients with appropriate healthcare providers. This could allow for the treatment of critical and non-critical patients within a single network.

The field of emergency medicine is an ever-changing, high-pressure environment, and by adopting established practices and tools, future providers can have a significant impact on patients’ lives. Committed to excellence and innovation, emergency medicine professionals continue to work to improve outcomes to save lives. Effective emergency medicine practices are essential to achieving better outcomes in acute medical conditions. By focusing on rapid triage, advanced diagnostics, specialized training, and the use of technology, emergency departments can provide early intervention. Although times have never been more difficult, the quality of emergency patient care can improve with increased use of strategies that focus on improving patient outcomes (Næss, et al., 2024).

The increasing number of ambulance calls, vacancies, and workloads in emergency medicine are increasing the pressure to find suitable solutions. With telemedicine providing healthcare services by bridging large distances, connecting remote providers and even patients using modern communication technologies, this technology appears to be beneficial. Since the process of developing the optimal solution is difficult, the need to define the processes involved can improve implementation. Current models are based on qualitative studies, although standardized questionnaires exist for factors such as usability, acceptability, and effectiveness.

Telemedicine definition

Telemedicine is a health-related service with the help of telecommunicating and electronic information technologies. It refers to the whole collection of deliverables designed to enable patients and their physicians or healthcare providers. It has a wide range of uses, including online patient consultations, remote control, telehealth nursing, and remote physical and psychiatry rehabilitation (Parimbelli, et al., 2018). It allows better health care choices, increases emergency service quality and performance, reduces time in making a diagnosis, and saves costs for both doctors and patients by optimizing clinical procedures and reducing travel expenses to hospitals (Weinstein, et al., 2014).

The Role of Technology in Emergency Medicine

The role of technology in emergency medicine are illustrated in bellow points (Sarbadhikari A, Sarbadhikari SN, 2023):

1. **Electronic Health Records (EHR):** In emergency medicine, electronic health records (EHR) contribute to improved patient outcomes. EHR implementation also allows information about a patient to be shared quickly among healthcare professionals, ensuring that those responsible for their care have access to their medical history, medications, or previous treatments when necessary. Having this data is critical to making quick and informed decisions.

2. **Telemedicine or Video Consultation:** Telemedicine is a major advancement in emergency medicine because it increases care in rural or underserved areas. Telemedicine will allow emergency physicians to consult with specialists from anywhere. This is especially useful in complex cases that require immediate specialist support. Telemedicine also provides the ability to care for patients (even after they have been discharged from the emergency department through remote follow-up) and can be expanded to include many other specialties such as psychiatry.
3. **Mobile Health Applications:** An example of this is the role mobile health applications can play in providing patients with vital information and instructions on how to act during an emergency. These apps may provide step-by-step instructions on how to perform CPR, how to manage minor injuries, or even link to healthcare providers. By providing information and empowering patients, libraries can help in acute medical situations achieve better outcomes.
4. **Mobile Integrated Healthcare:** Mobile integrated healthcare (MIH) initiatives integrate paramedic and nursing services to provide comprehensive care to patients outside of traditional healthcare settings. MIH teams, comprised of paramedics and nurses, collaborate to deliver a range of services, including urgent care, chronic disease management, and behavioral health interventions. By bringing healthcare services directly to patients' homes, workplaces, or community centers, MIH programs aim to improve access to care, reduce unnecessary hospitalizations, and enhance patient satisfaction.

The Role of Paramedics in Telemedicine and Mobile Health:

In prehospital settings, paramedics play a critical role in decision-making regarding patient safety, transport, and treatments/procedures. In general, paramedics are required to make decisions under complex and unpredictable circumstances, and most decisions are made prior to transport. Under these circumstances, paramedics' knowledge and experience with prehospital emergency care are vital and important factors (Barbosa, et al., 2021).

Paramedics, as the frontline healthcare providers in emergency medical services (EMS), play a crucial role in the integration of telemedicine and mobile health (mHealth). Their expertise and ability to assess and manage patients in pre-hospital settings make them essential to the success of these technologies (Newton, et al., 2024).

During medical emergencies, patients require immediate medical care. When compared to regular patients, emergency patients are more likely to be exposed to danger or at risk of dying; therefore, they require additional medical care. When emergency patients sustain an injury or contract an illness, they should receive medical treatment or undergo necessary medical procedures within 60 min, and treatment should not be terminated until they reach the emergency room (ER) of a hospital (Hyunmin, et al., 2020).

The pre-hospital phase represents a significant portion of the time a patient spends during their hospital admission and provides valid information to aid in the rapid diagnosis of cardiac conditions, for example. Symptoms may be most evident at this first presentation, with paramedics and doctors providing both acute and palliative treatment on arrival. Unfortunately, the pre-hospital phase is often neglected in the diagnostic process and opportunities for improved patient management and triage are lost. Furthermore, unnecessary admissions may be the result (Stengaard, et al., 2016).

Prehospital paramedics play a critical role in the process of making decisions about patient safety, prehospital transportation, and treatments/procedures. There has been an increase in efforts to improve emergency medical services (EMSs) using new technologies and mechanisms. Notably, mobile technology has many beneficial features (e.g., a high-speed and broader network, ultra-reliable low-latency communication, improved privacy and security), which can help prehospital paramedics provide better EMSs (Stengaard, et al., 2016).

Improving Outcomes Through Best Practices

1. **Evidence-Based Protocols:** In emergency medicine, it is important to implement evidence-based protocols. All protocols are written in accordance with contemporary literature and are defined by what are considered "best practices" for management. Standardizing care using evidence-based protocols is one of the most effective ways to reduce practice variation and improve outcomes (Newton, et al., 2024).

2. **Team-Based Approach:** Collaborative work is essential in emergency medicine. Teamwork is essential to providing comprehensive healthcare, and the fractured nature of our system requires physicians, nurses, paramedics, etc. to work together to manage all aspects of a patient's needs. Good communication and coordination among the team can improve patient care, especially in complex or severe situations.
3. **Patient-Centered Care:** Patient-centered care is a core value in emergency medicine. This means that patients should be treated in a dignified manner, with treatment that respects their involvement and needs as individuals. Focusing on the whole patient, rather than just their illness or disorder, will lead to better patient satisfaction and outcomes (O'Sullivan, et al., 2024).
4. Telemedicine also allows coordination between primary care physicians and specialists, improving health outcomes by ensuring a smooth transfer of care that reduces the wait for feedback, unnecessary patient travel time, and unnecessary in-person examinations for referrals (Stipa, et al., 2021).

Current Challenges

Telemedicine has helped in providing healthcare services to patients in a highly efficient manner, but there are some obstacles that doctors face when they rely on services provided remotely. Applying telemedicine in remote setting means that EMS can improve patient care, enable better resource allocation, and enhance emergency response capabilities in underserved areas (Mousavi, et al., 2022). The main challenges are:

- **Infrastructure:** The success of telemedicine and mHealth hinges on reliable internet connectivity and robust telecommunication infrastructure. In many regions, particularly rural areas, these prerequisites are lacking, hindering the deployment of these technologies.
- **Regulatory Barriers:** The integration of telemedicine and mHealth into existing healthcare systems requires clear regulations and guidelines. Inconsistent policies across different jurisdictions can create confusion and impede their adoption.
- **Data Privacy and Security:** The transmission and storage of sensitive patient data through digital platforms raise concerns about privacy and security. Ensuring the confidentiality of medical information is paramount to building trust and protecting patient rights.
- **Technical Limitations:** While telemedicine and mHealth offer numerous benefits, they may not be suitable for all medical emergencies. Certain conditions, such as those requiring immediate physical examination or surgical intervention, may necessitate on-site care.
- **Many patients are unable to use technology:** Medical care is comprehensive for all people of all ages, but people of certain age groups, such as the elderly, may face problems in dealing with modern technology to obtain medical services.
- **Difficulty in diagnosis sometimes:** Despite the development of technology and its great contribution to conducting a high-definition virtual appointment between the doctor and the patient, the doctor faces some problems related to not being able to see the patient for diagnosis sometimes. On the other hand, patients have some social reservations and concerns about confidentiality in electronic clinics, so some of them do not accept listening to the doctor about the need for the doctor to examine some areas of the patient's body, which makes the diagnosis process very difficult.
- **Healthcare Professional Acceptance:** Resistance to change among healthcare professionals can hinder the adoption of telemedicine and mHealth. Overcoming this barrier requires education, training, and demonstrating the benefits of these technologies.

Future Opportunities

Despite the challenges, the potential benefits of telemedicine and mHealth in EMS are immense. These technologies can (Mousavi, et al., 2022):

- **Improve Access to Care:** By extending the reach of healthcare services to remote and underserved areas, telemedicine and mHealth can reduce mortality rates and improve patient outcomes.
- **Enhance Triage and Patient Management:** Real-time communication between paramedics and medical specialists can enable more accurate triage and improve the management of patients in the field.
- **Reduce Emergency Department Overcrowding:** Through remote consultation and virtual triage, telemedicine can help alleviate the burden on emergency departments, reducing wait times and improving patient satisfaction.
- **Enable Continuous Monitoring:** Wearable devices and mobile applications can facilitate continuous monitoring of patients' vital signs, allowing for early detection of health problems and timely intervention.
- **Facilitate Research and Education:** Telemedicine and mHealth can be used to collect data, conduct research, and provide remote training and education for healthcare professionals.

Benefits of Telemedicine and Mobile Health in Emergency Care

The benefits of telemedicine extend to a range of specialties and can also easily be consulted with other healthcare teams via remote technology to deliver quick, cohesive care to their patients. Telemedicine and mobile health (mHealth) offer numerous benefits in the field of emergency care, including (Daniel and Kumar, 2014):

1. **Reduction in Transfer Rates:** Telemedicine can help in stabilizing patients on-site with the guidance of remote specialists, reducing the need for unnecessary transfers and the associated risks during transportation.
2. **Improved Access to Care**
 - **Extended Reach:** Telemedicine and mHealth can extend the reach of healthcare services to remote and underserved areas, reducing mortality rates and improving patient outcomes.
 - **Reduced Wait Times:** By enabling remote consultations and virtual triage, telemedicine can help alleviate the burden on emergency departments, reducing wait times and improving patient satisfaction.
 - **Timely Intervention:** Telemedicine and mHealth can facilitate early detection of health problems and timely intervention, leading to better patient outcomes.
3. **Enhanced Patient Care**
 - **Accurate Triage:** Real-time communication between paramedics and medical specialists can enable more accurate triage and improve the management of patients in the field (Newton, et al., 2024).
 - **Continuous Monitoring:** Wearable devices and mobile applications can facilitate continuous monitoring of patients' vital signs, allowing for early detection of health problems and timely intervention.
 - **Specialized Consultations:** Telemedicine can provide access to specialized medical expertise, even in remote locations.
4. **Efficiency and Cost-Effectiveness**
 - **Reduced Transportation Costs:** Telemedicine can reduce the need for unnecessary transportation of patients to hospitals, saving time and money.
 - **Improved Resource Allocation:** Telemedicine and mHealth can help to optimize the allocation of resources within healthcare systems.
 - **Reduced Hospital Stays:** By enabling early diagnosis and treatment, telemedicine can help to reduce the length of hospital stays, leading to lower costs.
5. **Research and Education**
 - **Data Collection:** Telemedicine and mHealth can be used to collect data on patient outcomes and disease patterns, facilitating research and improving evidence-based practice.

- **Remote Training:** Telemedicine can be used to provide remote training and education for healthcare professionals, enhancing their skills and knowledge.

Overall, telemedicine and mHealth have the potential to revolutionize emergency care by improving access, enhancing patient outcomes, and increasing efficiency. By addressing the challenges and capitalizing on the opportunities presented by these technologies, we can create a more equitable and effective healthcare system.

Are We Ready?

The integration of telemedicine and mHealth into EMS is a complex process that requires careful planning, collaboration, and investment. While significant challenges remain, the potential benefits of these technologies are undeniable. By addressing the current obstacles and embracing innovation, we can unlock the full potential of telemedicine and mHealth to improve the delivery of emergency medical care.

To realize the long-term benefits of telehealth, organizations need to collaborate and learn what works well, where, when, why, and how. Governments need to support the health technology industry in developing and testing novel telehealth solutions that are simultaneously safe and agile. Industry needs to work with professionals and patients to ensure digital inclusion, data security, and solutions that are intuitive, flexible, and tailored to users' needs. This tailoring will help overcome resistance to changing established work processes. The burden of care imposed on patients and their families must be considered, but new knowledge and competencies can be empowering for clinicians, patients, and carers alike. Just as COVID-19 has accelerated digital literacy, so too telehealth can accelerate health literacy (Blandford, et al., 2020).

Telemedicine has transformed healthcare, bridged distances and making medical services accessible remotely. It began to reach patients in remote areas but has grown into a complex system. This system now delivers diverse healthcare services through technology. The evolution of telemedicine reflects advancements in technology and changing patient needs. It has reshaped how care is provided, making health services more accessible and efficient.

The integration of telemedicine and mHealth into EMS is a complex but essential process. By addressing the challenges and capitalizing on the opportunities, we can unlock the full potential of these technologies to improve the delivery of emergency medical care and enhance patient outcomes.

Conclusion

Telemedicine is rapidly emerging as a useful tool for healthcare teams around the world. It offers the ability to communicate with isolated patient populations across significant geographical distances, helps address regional healthcare infrastructure and provider shortages, and saves all parties, including the patient, time, and money. In emergency situations, telemedicine can connect patients with teams of providers and specialists and expedite care. Telemedicine shows promise as a triage method that could reduce wait times and patient volumes in emergency departments. It also could help connect school nurses with healthcare providers, and both expedite the delivery of care to students and reduce time away from school. While there are many benefits to telemedicine, it is not without drawbacks. Telemedicine currently lacks the technology to effectively replace the physical examination that is core to healthcare encounters. Therefore, remote healthcare will likely continue as a supplement to in-person encounters until further technological advancements are made.

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