

Exploring the potential of telehealth in-flight medical emergencies

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Abstract

In-flight medical emergencies occur at an average of 127 incidents per one million passengers, without of physicians present at 41.1%. In response, telehealth can play a crucial role in swiftly addressing these emergencies. Adequate internet speed and appropriate latency are necessary for this purpose, alongside the importance of documenting such emergencies to enhance the efficiency of medical services. In-flight telehealth directly benefits passengers, airlines, and volunteered medical professionals. Furthermore, it presents an opportunity for innovative business models, offering new prospects for insurance companies and telecommunications providers.

Keywords

Telehealth, emergency medicine, telemedicine, digital health, health informatics, in-flight, medical events, Wi-Fi

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Introduction

The advancement of modern technology has significantly influenced innovation in medical services within aircraft. Medical emergencies occurring onboard have also increased as more passengers engage in air travel.¹ Airlines have now taken on the primary responsibility for medical care, a departure from traditional medical settings, with a physician absence rate of 41.1%.² One key reason for physician absence is the logistical and financial challenge of assigning medical professionals to the millions of flights operating globally each year. To address in-flight medical emergencies (IMEs), the International Air Transport Association (IATA) recommends the provision of medical manuals containing guidelines for managing first aid kits, emergency medical kits, and defibrillators.³ While airlines train their cabin personnel for medical emergencies, they also contract with ground-based medical support services (GBMS) such as MedAire and STAT-MD, headquartered in Phoenix and Pittsburgh, respectively.^{1,4} Typically, when an emergency occurs onboard, flight attendants verify the presence of a physician onboard. While most physicians volunteer for medical assistance, the unfamiliar clinical environment and limited medical supplies, coupled with unfamiliar patient symptoms, can affect medical professionals' confidence.^{5–7} However, remote assistance

from physicians specializing in emergency medicine on the ground, with significant experience in in-flight emergencies, can greatly aid confused flight attendants. Existing GBMS traditionally relies on radio waves or voice data. This article explores the potential of utilizing the rapidly growing in-flight Wi-Fi to perform video-based telehealth, providing a viewpoint on its feasibility and advantages and disadvantages.

Current IMEs

According to data from 2018 to 2020, encompassing the year with the highest annual passenger count, the frequency of IMEs per 1 million passengers was 127.² It was noted

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that physicians were present onboard aircraft in 58.9% of instances in IMEs. However, there is a high likelihood that even when physicians are present onboard, they may not have received specialized training in aviation medicine. Consequently, they may encounter difficulties in making critical decisions during IMEs, potentially leading to unnecessary diversions or patient death.² Additionally, there is often a lack of awareness regarding the legal responsibilities associated with providing medical assistance onboard.^{2,8,9} Legal implications further complicate the provision of medical assistance during IMEs. Current international practices place flights under the jurisdiction of the airline's regulatory authority, regardless of the aircraft's location. This implies that legal responsibilities may vary depending on the aircraft's nationality, creating uncertainty for individuals providing aid. Volunteers may fear potential legal actions even when assistance is rendered with good intentions. Addressing this issue requires a discussion to establish clear, globally recognized guidance on legal protections for those offering medical assistance during IMEs, which could alleviate these concerns and encourage prompt intervention.

Major global airlines implement multiple strategies to address IMEs. These measures include providing cabin crew with training on emergency medical protocols, equipping aircraft with comprehensive medical kits—ranging from basic items like alcohol swabs and gauze to specialized medications—and incorporating medical devices such as AEDs. To enhance medical support capabilities, airlines predominantly rely on outsourced GBMS providers rather than maintaining in-house medical personnel.^{1,10} MedAire, a leading GBMS provider, collaborates with over 180 major airlines, offering expertise based on extensive experience with diverse IMEs. Multiple airlines may utilize the same GBMS, resulting in experienced medical professionals with a wealth of in-flight medical event experiences providing technical advice. However, challenges such as limitations in communication via telephone and the absence of medical personnel onboard can contribute to misunderstandings among flight crews and other complicating factors. Ultimately, the presence of medical personnel onboard significantly influences diversion decisions, as indicated in studies comparing diversion rates based on the presence of physicians.¹¹ If a physician is present onboard and provides assistance during an IME, medical records are typically documented by the physician. In cases where a physician is not available, the situation is recorded by the cabin crew. When assistance is provided by GBMS, medically significant documentation is typically generated, but when documented solely by the cabin crew, there may be ambiguity or missing essential information.⁴ This underreporting of IMEs represents a notable issue, potentially leading to an incomplete understanding of their true frequency and impact. Minor incidents, particularly those resolved without external consultation, may

often go unrecorded, creating data gaps that could influence airline policies and crew training. Furthermore, minor symptoms, such as those resembling a common cold, may be overlooked by passengers and crew, yet have the potential to contribute to the transmission of infectious diseases, underscoring the importance of comprehensive reporting and monitoring.

Developments of communication technology

Twenty years ago, using the Internet on airplanes seemed unimaginable. However, in 2012, United Airlines became the first to offer in-flight Wi-Fi services for passengers on international routes.¹² Since then, rapid advancements in satellite and ground-to-air network solutions have made it possible to provide services that offer speeds similar to those on the ground.¹³ Low earth orbit (LEO) satellites refer to satellites orbiting at an altitude of within 2,000 km from the Earth's surface, with recent examples such as Starlink, well-known for its LEO satellite communications, operating at heights ranging from 540 to 570 km.¹⁴ This relatively low altitude shortens the round-trip time (RTT) of signals exchanged between the ground and aircraft. The geostationary satellites initially employed in satellite communication required RTT of 250 ms due to their altitude of 35,800 km,¹³ and the amount of data exchanged was extremely limited.¹⁵ In contrast, LEO satellites offer an RTT of around 30 ms, enabling rapid data transmission.¹³ Moreover, technology has been developed for signal exchange among multiple aircraft in the sky, enabling communication even in areas without terrestrial ground stations, such as the Pacific Ocean. Consequently, efficient management of RTT has become feasible by utilizing both low-orbit satellites and neighboring aircraft.^{12,13} Additionally, advancements in technology have led to the use of higher frequency bands such as Ku-band (10–15 GHz) and Ka-band (15–32 GHz), offering faster and more efficient transmission of large volumes of data compared to the traditional L-band (1–2 GHz) used on the ground.¹⁶

First requirements: Speed and time delay

The appropriate network connectivity requirements for telehealth can vary depending on the connection environment and the number of users. According to the Federal Communications Commission, the recommended minimum internet speed for a single-physician practice is 4 megabits per second (Mbps), while for a small physician practice, it is 10 Mbps.¹⁷ In larger hospitals where simultaneous consultations with multiple patients may be required at higher speeds.¹⁸ However, assuming a scenario with one patient on board and one GBMS connection, along with additional connection situations, a speed of 4–10 Mbps would be suitable as a minimum requirement. Another

study, which applied speeds of 4–6 Mbps on the ground, received positive responses from 98.5% of patients.¹⁹

In addition to speed, adequate levels of latency are also crucial. Research indirectly assessing the impact of network latency on telehealth has been conducted previously. Adjusting latency during robot surgery simulators, it was found that latency (i.e. RTT) below 300 ms was accepted, but acceptance dropped significantly beyond 400 ms.²⁰ Therefore, maintaining latency below 300 ms is essential to achieve optimal telehealth in-flight.

These two conditions can be adequately met with current technological developments.^{14,21} However, ensuring sufficient speed and latency may be challenging due to the distributed data processing in situations with many passengers onboard. Medical or crew-only network infrastructure can be established, or data processing prioritization can be controlled to overcome potential limitations.

Second requirements: EMR documentation

The reporting of medical events (medical records) can be a valuable resource among patients, medical professionals, and airlines. GenAI utilizing large language model may be used to document IMEs properly by suggesting appropriate procedural and standardized ways of reporting. Patients and doctors will also use medical records to submit insurance or legal claims.⁸ While standard forms like the sample medical event report form provided by IATA's medical manual exist,³ each airline may use its own forms, resulting in a lack of internationally consistent data collection.²² Therefore, there is a demand for the establishment of internationally standardized electronic medical record systems.

Not all IMEs have a doctor present, and flight attendants may be unfamiliar with medical terminology. Medical events conducted through GBMS are documented in communication records, allowing for inference of the situation.²³ However, standalone crew reports may be medically inaccurate or inadequate for specific medical descriptions.⁴ To address these challenges, targeted training programs could be developed for cabin crew, focusing on managing commonly occurring IMEs and accurately documenting such events. Additionally, telehealth based on a stable network can overcome these challenges. For example, recent advancements in real-time speech recognition could be applied to electronic health records.²⁴ Enhanced in-flight Wi-Fi enables the transmission of voice or video data to servers for assessing and documenting situations. Furthermore, an in-flight EMR system could be designed that even nonspecialists can swiftly determine courses of action for patient symptoms through a screening process, with the process automatically recorded for documentation. Such documentation processes need to comply with HIPAA guidance.²⁵

Telehealth advantages

In-flight telehealth offers various advantages from multiple perspectives. It enables immediate guidance, including screening programs,²⁶ to healthcare professionals who encounter unfamiliar situations, as mentioned earlier. This could be particularly useful as many studies indicate that a majority of physicians volunteer during emergencies but may lack confidence.^{5,6} Additionally, this screening function effectively disperses the workload concentrated on GBMS. Meanwhile, in situations requiring urgent treatment, telecommunication (i.e. telehealth) with GBMS assists in measuring parameters such as heart rate and temperature through imaging analysis,²⁷ which is possible even without an onboard physician. This facilitates quick identification of required treatments and aids in decision-making for aviation diversion.

From the perspective of pilots and airlines, in-flight diversion costs related to medical emergencies can be reduced. Studies have shown that these costs range from \$15,000 to \$893,000.⁴ Incomplete decisions may occur due to limited information about the patient's condition, and multiple factors contribute to the decision for diversion.² Information necessary for diversion, such as available hospitals and physicians and estimated travel time,^{9,10} can be quickly processed and decided through telehealth systems. Ultimately, this ensures sufficient passenger safety as well as minimizes diversions, allowing for efficient management.

Patients can experience a sense of security through in-flight telehealth. Mostly airline handles passengers of diverse nationalities and languages. Occasionally, communication barriers can exacerbate patient anxiety. Including translation capabilities in telehealth can provide appropriate guidance to patients of different languages, maintaining their sense of security. Furthermore, some sensitive proactive individuals may desire continuous monitoring of their health information. These individuals hope for personalized healthcare through shared medical data in advanced systems. Telehealth has the potential to satisfy these individual needs as well.

Business model

In-flight telehealth can propose new business models. Insurance companies can introduce tailored products for the aforementioned sensitive proactive individuals. This could involve adding a category for utilizing such services within existing travels insurance plans or implementing subscription-based options. In the telecommunications sector, service providers could incorporate medical service subscriptions into existing in-flight Wi-Fi usage models. Additionally, medical security firms could extend their services to include aircraft security in remote medical records and communication services. In-flight

telehealth is not limited to airplanes; it can also be appropriately applied on ocean vessels.

For instance, passengers with preexisting medical conditions who subscribe to telehealth services can benefit from tailored in-flight medical support. In the event of an emergency, cabin crew could locate an onboard medical volunteer or connect with GBMS to relay the passenger's condition, including their medical history. When the subject of an IME is a young child, the situation becomes more complex, as children require different measures compared to adults, making it challenging to quickly identify an appropriate specialist. In such scenarios, real-time telehealth support (e.g. a GenAI-powered chatbot specifically for IMEs) can bridge the gap, providing valuable guidance that enables medical professionals to take confident and informed actions.⁶ This integration not only enhances medical communication—especially for unconscious passengers—but also reduces the likelihood of unnecessary or incorrect interventions, ultimately minimizing the risk of costly flight diversions.

Conclusion and key takeaways

The rapid advancement of communication technologies, such as LEO satellites, has made network access available anytime and anywhere, even in highly restricted connections like isolated planes in the Pacific airspace. This progression has enabled in-flight telehealth to evolve to a sufficiently viable level. In-flight telehealth is not only beneficial to patients, airlines, and medical service providers but also related industries could be extended as a business area. When certain requirements are met, the advantages of telehealth will adequately benefit passengers and stakeholders involved in air travel.

What we know

- Essential requirements for in-flight emergencies, including network speed, time delay, and documentation protocols.
- Non-clinical benefits, such as improved communication, reduced decision-making burden on flight crews, and enhanced passenger safety.
- New business opportunities, including telehealth service integration within aviation and insurance sectors.

Further research needed

- Aviation medicine: Clinical validation of medical constraints across all flight phases—pre-flight, in-flight, and post-flight—including factors such as noise interference, internet speed limitations, restricted visibility of patient conditions, and fatigue management for flight crews.

- Legal responsibility: Clarification of liability issues, such as those related to crew actions following remote medical guidance.

- Data management governance: Determining the responsible entity for medical data management, considering aircraft affiliation, flight routes, national laws, and international regulations.

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