# Telehealth in Remote Areas: A New Artificial Intelligence-Based Model

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**Abstract**

The existence of technology has led to many developments in various fields, including health. Telehealth through the use of artificial intelligence can help increase access to health, especially in remote areas. This study aims to describe the potential and challenges of implementing an artificial intelligence (AI) based Telehealth model in increasing access to health in remote areas. Using descriptive qualitative research methods with thematic data analysis, this research analyzes data obtained from literature studies and previous research related to Telehealth AI. The results reveal that Telehealth AI has the potential to reduce inequalities in access to health, improve health outcomes, and save healthcare systems costs. However, challenges such as adequate regulation, data security, limited technological infrastructure, and digital literacy need to be overcome to maximize benefits. This research provides important insights to support the development of effective and inclusive Telehealth AI in remote areas.

***Keywords:*** *Telehealth, Artificial Intelligence, Remote Areas, Health.*

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## A. INTRODUCTION

Telehealth is a revolutionary concept in healthcare that has changed the way we access medical services. In this modern era, technology has been at the heart of changes in the healthcare sector. However, in several remote areas around the world, limited access to traditional health facilities is a serious obstacle to timely and quality care. This is why developing new models of telehealth is critical, especially those powered by artificial intelligence (AI), to address underlying health challenges (Pierce et al., 2021).

Remote areas often have limited access to healthcare facilities. Long geographic distances, poor infrastructure, and a lack of qualified medical personnel are some of the main factors contributing to disparities in health access in these areas. As a result, residents in remote areas often experience delays in diagnosis, inadequate treatment, and poor health outcomes (Dumitrache et al., 2020).

Telehealth has emerged as a potential solution to address healthcare access disparities in remote areas. Through telehealth, patients can receive medical consultations, diagnosis, and treatment remotely via communication technology. This can reduce the burden of travel required by patients and allow them to access the health care they need from the comfort of their own homes (Haynes et al., 2021).

Despite its great potential, implementing telehealth in remote areas is not without challenges. Underdeveloped telecommunications infrastructure, availability of equipment, and lack of training for medical personnel and patients are some of the main obstacles faced in realizing this concept (Soto et al., 2022).

In addressing these challenges, artificial intelligence (AI) has emerged as a critical component in developing effective telehealth models. AI can be used to analyze medical data, support diagnoses, integrate data from multiple sources, and even automate large parts of the treatment process. The use of artificial intelligence in various health fields such as medical imaging, cancer treatment, and chronic disease management has resulted in significant improvements in diagnosis and treatment. However, the application of AI in the context of telehealth in remote areas is still an area that needs to be deepened (Amjad et al., 2023).

Through the brief explanation above, this research was then carried out to be able to see how the implementation of telehealth can be carried out in remote areas with the help of artificial intelligence.

## B. LITERATURE REVIEW

### 1. Telehealth

The word tele in Greek means: far, at a distance, so telemedicine can be interpreted as medical services, even though separated by distance. Telehealth is a method that can be used to improve health care and provide health education through telecommunications technology. Telehealth can also be a solution for patients who cannot reach health services directly or can be reached by patients who live far from health services. In the current public health emergency, telehealth can maintain access and continuity of care for patients, while minimizing the risk of Covid-19 transmission (Fieux et al., 2020).

Additionally, Telehealth is an alternative service delivery mode that allows people living in rural and remote areas to access health care in their local communities. Telehealth refers to the delivery of services that utilize information and communications technologies such as telephone, videoconferencing, electronic messaging, or digital monitoring to improve health care. With improvements to the internet and infrastructure, video conferencing in particular has gained ground to increase the prominence of telehealth delivery in health care (Caffery et al., 2022).

The terms telehealth or telemedicine can be used interchangeably to refer to services using electronic technology for patients limited by distance. In its application, the use of telehealth is very helpful in fulfilling health welfare for patients and their families (Tian et al., 2021).

According to Anthony Jnr telehealth has types, including:

a. Synchronous

   Type of direct online communication with computer mediation and online services at the same time using telephone, video conferencing, etc. This type of service is also known as "real-time" service and can function as a substitute for face-to-face meetings that are not available (García et al., 2022).

b. Asynchronous
   Indirect type of online communication that uses computer mediation and online services, and the implementation time is not simultaneous/delayed using email, messages on patient portals, electronic consultations, etc (Heponiemi et al., 2023).
c. Virtual agent
   This type of virtual agent or chatbot is used to answer questions that often arise or are asked by patients, and several health references from the World Health Organization (WHO) also appear (Chua et al., 2023).
d. Artificial intelligence (AI)
   This type is a technology that can provide data to health workers in the form of blood pressure, and oxygen saturation through sophistication and also with sensory assistance such as the Apple Watch (Mamdiwar et al., 2021).

Based on the above understanding, it can be concluded that telehealth is the use of information technology to provide health services to the community, where service providers or service recipients can provide information from a distance or near. Telehealth also allows service providers and recipients to use live video, and send voice, and information remotely using certain platforms (Taylor et al., 2021).

## 2. Artificial Intelligence

Artificial Intelligence (AI) is a branch of computer science that is concerned with automating intelligent behavior. This statement can also be used as a definition of AI. This definition shows that AI is part of the computer so it must be based on theoretical sound and application principles from the field (Benvenuti et al., 2023). These principles include the data structures used in knowledge representation, the algorithms needed to apply that knowledge, and the programming languages and techniques used to implement them. Artificial intelligence technology is studied in fields such as robotics, computer vision, artificial neural networks, natural language processing, speech recognition, and expert systems (Yang et al., 2021).

Meanwhile, according to Dedi Nugraha and Sri Winiarti, Artificial Intelligence is a branch of science related to the use of machines to solve complex problems more humanely. This is usually done by following/imitating the characteristics and thinking analogies of human intelligence/intelligence, and applying them as algorithms recognized by computers (Nawaz & Gomes, 2019). With a more or less flexible and efficient approach can be taken depending on the needs, which affect how the behavior of artificial intelligence manifests. AI is usually associated with Computer Science but is also closely related to other fields such as Mathematics, Psychology, Observation, Biology, Philosophy, and others. The ability to combine knowledge from all of these fields will ultimately benefit progress in efforts to create artificial intelligence (Van der Schaar et al., 2021).

Meanwhile, according to Solikhun, Artificial Intelligence (AI) is defined as intelligence demonstrated by an artificial entity. Such systems are generally considered computers. Intelligence is created and inserted into a machine (computer)

so that it can do work like humans can do. Artificial Intelligence (Artificial Intelligence or AI) is defined as intelligence exhibited by an artificial entity. Systems like this are generally considered computers. Intelligence is created and inserted into a machine (computer) so that it can do work like humans can do. AI is a field of study based on the premise that intelligent thought can be thought of as a form of computation (Giroux et al., 2022).

**3. Remote Area**

Remote Villages are Rural Areas that are isolated from the Center. Growth/other areas due to not having or lacking Transportation Facilities (Infrastructure), thus hampering regional growth/development. Based on the definitions set out above, the criteria for determining (indicating) Remote Villages are: rural area (village administrative unit); Less/None Accessibility Facilities/Infrastructure; Geographically Far from Growth Centers; and There is Geographical Isolation that separates it from other areas. Typology grouping for Remote Villages is based on the remote village assessment criteria described earlier (Davenport et al., 2019).

Based on the simulation of the assessment of these criteria, a typology grouping for Remote Villages can be formulated as follows:

a. Type A (Isolated Due to Lack of Accessibility Facilities)
   Rural areas are isolated due to the lack of accessibility facilities that connect these areas with growth centers (Dong et al., 2020)
b. Type B (Isolated by Distance)
   Rural areas are isolated because they are geographically far from the center of growth (Sewell et al., 2019)
c. Type C (Isolated due to Geographical Isolation)
   Rural areas are isolated due to the existence of Geographic Isolation which separates the area from the Growth Center (Mojahed et al., 2021)
d. Type D (Isolated for Special Reasons)
   Rural areas are isolated for special reasons, for example, the influence of customs to isolate oneself (Ugolini et al., 2020)

Based on this typology, remote areas have their characteristics. So, the approaches and solutions used to solve the problems must be adapted to the real problems in the area based on the typology (Tabrizchi & Kuchaki Rafsanjani, 2020)

## C. METHOD

This research is a descriptive qualitative research that aims to describe and analyze phenomena related to artificial intelligence (AI)-based Telehealth in the context of remote areas. The qualitative research method was chosen because it is more suitable for exploring in-depth understanding of complex topics such as the implementation of Telehealth AI. A descriptive approach is used to describe in detail the characteristics, processes, and impacts of Telehealth AI in remote contexts. The data used in this study were obtained from various results of previous studies and

studies that still have relevance to the discussion of this research. Data collection was carried out through a literature study, by accessing various sources of literature, scientific articles, and research reports related to Telehealth AI and issues related to its implementation in remote areas. The data that has been collected includes information about the effectiveness of Telehealth AI, challenges in its implementation, positive impacts, and negative impacts that may arise (Abdussamad & Sik, 2021).

## D. RESULT AND DISCUSSION

### 1. Benefits of Telehealth in Remote Areas

Telehealth plays an important role in increasing access to health for residents in remote areas. In these areas, traditional health facilities are often limited, and residents often have to travel long distances to reach medical services. Telehealth overcomes these geographic barriers by providing broader and easier access to quality healthcare services. One of the significant benefits of Telehealth is reduced travel costs. Patients in remote areas often have to pay large sums for transportation and accommodation costs when they have to go to the nearest health facility. With Telehealth, patients can receive medical care without having to travel long distances, saving them money and reducing their financial burden.

Telehealth also allows for faster emergency services. In a health emergency, every second counts. In remote areas, it is often difficult to reach medical facilities within a short time. With Telehealth, patients can contact medical professionals online and receive guidance and initial care that can save lives in critical situations. An important benefit of Telehealth is the use of communications technology to connect patients with healthcare providers. This includes the use of video conferencing, text messaging applications, and online platforms that enable remote medical interactions. This technology helps in conveying necessary medical information without having to meet physically.

Telehealth is also useful for routine consulting services. Patients in remote areas can easily schedule a consultation with their doctor without having to travel far. This improves patient adherence to care and monitoring of their health. The benefits of Telehealth in remote areas are not only limited to medical access but also to improving quality of life. Patients can have their treatment more comfortable, with less disruption to their routine. This can reduce the stress associated with long journeys and improve their overall well-being.

Telehealth also supports the use of electronic medical data, allowing healthcare providers to more accurately track a patient's health history. This allows for better diagnosis and more targeted treatment. It is important to understand that Telehealth benefits in remote areas may have different characteristics compared to urban areas. Considerations such as technology availability, training, and differentiated patient support need to be taken into account in optimizing the benefits of Telehealth in this region. The implementation of Telehealth in remote areas also has a significant impact on community health services as a whole. This can increase healthcare capacity, enable providers to reach more patients and improve operational efficiency.

It can be said that overall, the benefits of Telehealth in remote areas are increased access, reduced costs, and faster and more efficient delivery of medical services. This is an important step in bridging the health access gap between remote and urban areas and ensuring that residents across the region have equal access to quality health care.

## 2. Challenges in Telehealth for Remote Areas

One of the main challenges in implementing Telehealth in remote areas is the limited telecommunication infrastructure. These areas often lack adequate infrastructure, such as high-speed internet networks and stable connectivity. This can hinder the ability of patients and healthcare providers to effectively connect to and access Telehealth services. The availability of adequate communication devices is also a barrier in remote areas. Patients in these areas may not have sufficient access to devices such as smartphones, tablets, or computers that are necessary to access Telehealth. This can be a serious obstacle in providing them with remote health services.

Not only infrastructure problems, but also the poor quality of the internet network can disrupt the implementation of Telehealth. In remote areas, the quality of the internet connection is often inconsistent, and patients and healthcare providers may experience interruptions or dropouts during Telehealth consultations. This can reduce the effectiveness of communication and harm the patient experience. The reliability of the electricity supply is also a challenge in remote areas. Some remote areas may experience frequent power outages, which may affect the continuity of Telehealth services. Electronic devices used in Telehealth require a steady supply of electricity, and electrical problems can hinder the treatment process.

In addition to technical issues, training, and digital literacy are additional challenges. Patients and medical personnel in remote areas may not have a sufficient level of understanding about the use of Telehealth technology. This requires additional efforts in providing training and mentoring so they can access and use these services effectively. The cost of implementing Telehealth can also be an obstacle. Building adequate telecommunications infrastructure and acquiring the necessary technological equipment requires significant investment. In remote areas with limited resources, adequate financing and budgeting can be a challenge.

Another challenge is the regulatory and compliance aspects of using Telehealth in remote areas. Applicable regulations and compliance with medical standards may need to be adapted or updated to facilitate broader use of Telehealth. Medical data security is a sensitive issue in Telehealth. In remote areas that lack a strong cybersecurity infrastructure, the risk of patient data privacy breaches can increase. Medical data protection is one of the challenges that must be overcome.

In remote areas, maintaining Telehealth devices and technology may be difficult due to limited access and resources. Routine maintenance and technology upgrades can be a complicated task. Remote areas may have special needs that need to be considered in Telehealth implementation, such as different languages or

cultures. Adapting to these special needs is also a challenge that must be faced. Overcoming these challenges is an important step in ensuring that Telehealth can provide maximum benefit to residents in remote areas. Collaborative efforts from governments, health agencies, and technology service providers will be key in overcoming these barriers.

## 3. The Role of Artificial Intelligence in Telehealth

Artificial intelligence (AI) has become an increasingly important component in the development of Telehealth. In Telehealth, AI can be used for a variety of purposes that include medical data analysis, disease prediction, and personalization of care. One of the main roles of AI in Telehealth is its ability to quickly and accurately analyze medical data. AI can process data from a variety of sources, including medical test results, patient health history, and electronic medical records. This helps doctors in making a more accurate and quick diagnosis. With the help of AI, healthcare providers can have access to sophisticated data analysis tools that can help them identify disease patterns and characteristics that may be difficult for humans to recognize. For example, AI can help in the early detection of diseases such as cancer or heart problems by analyzing medical images or laboratory test data.

AI also can predict disease. By using algorithms trained on big data, AI can identify early signs of disease and risk factors that may lead to certain medical conditions. This allows for earlier intervention and more effective disease prevention. One of the main benefits of AI in Telehealth is the ability to design treatment plans tailored to each patient's unique needs. AI can leverage patient medical data, including disease history and risk factors, to produce more personalized and effective treatment recommendations. AI is also used for remote patient monitoring. With connected medical devices, AI can monitor the patient's condition continuously and provide early warning if there are changes that need attention. This could improve the monitoring of patients who have chronic conditions.

Artificial intelligence can integrate medical data from various sources, such as electronic medical records, laboratory test results, and patient medical records. This helps healthcare providers understand a patient's comprehensive medical history and make better decisions on treatment. AI also serves as a decision-support tool for healthcare professionals. By generating recommendations based on data, AI can assist doctors in making decisions about a more appropriate diagnosis and treatment. It is important to note that using AI in Telehealth requires good training and quality data. AI models must be provided with sufficient data to be able to produce accurate and relevant predictions.

Overall, artificial intelligence has an important role to play in improving the quality and effectiveness of Telehealth. With its capabilities for rapid medical data analysis, disease prediction, and personalized care, AI helps healthcare providers provide better care to patients, especially in Telehealth contexts that require remote services.

## 4. AI-Based Telehealth Model Implementation

The implementation of an AI-based Telehealth model is a step forward in providing better healthcare. To maximize its benefits, effective integration, medical personnel training, and strict data security are key aspects to consider. System integration is one of the main components in implementing Telehealth AI. AI models must be able to interact with existing healthcare systems, including electronic medical record systems, patient administration systems, and other systems. Good integration ensures that data can move seamlessly between these systems, increasing maintenance efficiency. In system integration, it is important to ensure data and format consistency. Data collected by Telehealth AI models should be easily accessible to healthcare providers in a format that is compatible with existing systems. Data standardization is key to avoiding communication barriers.

Medical personnel training is an important element in the implementation of Telehealth AI. Doctors, nurses, and other medical personnel need to be given adequate training to use Telehealth technology effectively. They must also understand the output of AI models, including how to translate the results of AI analysis into sound clinical decisions. Apart from training, it is also important to develop clear protocols and guidelines related to the use of Telehealth AI. It includes guidance on when and how to use AI models, criteria for referring patients to Telehealth, as well as actions to take in emergencies. Data security is a crucial aspect of implementing Telehealth AI. Sensitive patient data must be strictly protected against potential breaches. The use of data encryption, limited access, and security monitoring should be a priority in designing telehealth systems.

The quality of the internet connection also influences the implementation of Telehealth AI. In remote areas, it is necessary to ensure that an adequate internet connection is available to enable seamless Telehealth services. Many problems in Telehealth can be caused by disruptions in network quality. The hardware and software used in Telehealth AI require good management. Routine maintenance, software updates, and device management need to be considered to ensure optimal availability and performance. Telehealth AI implementation must involve a process of continuous evaluation and improvement. Clinical outcome and patient experience data need to be analyzed regularly to identify areas where the system can be improved.

Finally, it is important to ensure that the healthcare organization as a whole is ready to adopt Telehealth AI. This includes changes in work culture, change management, and a commitment to maximizing the benefits of this technology in delivering better healthcare. By keeping these points in mind, the implementation of AI-based Telehealth models can be done effectively and help improve healthcare access, accuracy, and efficiency.

## 5. Evaluation of AI-Based Telehealth Model Results

Evaluation of Telehealth AI models is an important step in ensuring that this technology delivers the intended benefits. This evaluation includes the extent to which

the model can improve patient care and diagnosis, quality of care, and cost efficiency. Evaluations should focus on the effectiveness of Telehealth AI models in improving patient care and diagnosis in remote areas. This includes analyzing whether AI models provide more accurate results in identifying disease, providing appropriate treatment recommendations, and the ability to detect changes in a patient's condition early. Evaluation of a model's effectiveness must be supported by careful data collection and analysis. Clinical data and patient care outcomes must be carefully collected to measure the impact of AI models on care outcomes.

The evaluation should also consider the patient's experience. This involves assessing the extent to which Telehealth AI models improve consultation quality and user satisfaction. Patients should feel comfortable, involved, and supported in using this technology. It is also important to evaluate whether Telehealth AI models help reduce inequalities in healthcare access in remote areas. Evaluations should examine whether these technologies provide greater opportunities for populations that previously had limited access to medical care. Evaluation of the quality of consultations involves assessing aspects such as communication between patients and healthcare providers, the ability of AI models to explain diagnoses and recommendations, and the level of trust placed by patients in the technology.

In emergency or treatment situations that require rapid action, the evaluation should examine the extent to which the Telehealth AI model is capable of providing fast and responsive medical services. The ability to save time in the treatment process is an important factor that must be evaluated. The evaluation should include an analysis of the efficiency and costs of using AI models. This involves considering whether the use of AI models reduces the overall cost of care or speeds up the treatment process. Cost savings can contribute to greater access to health services. In the evaluation, it is important to examine how the use of Telehealth AI models impacts medical personnel. Does this technology help them make better decisions or reduce their workload? Evaluation results should be used as a basis for continuous revision and improvement of the Telehealth AI model. Experience and data from the evaluation can be used to develop models that are better and more suited to the needs of patients and medical personnel in remote areas.

## 6. Positive Impacts and Further Challenges

A successful Telehealth AI model has a significant potential positive impact. First, this technology can reduce inequalities in health access. By enabling patients in remote areas to access care remotely, the gap in health access between urban and remote areas can be narrowed. Additionally, Telehealth AI can also improve health outcomes. With advanced data analysis, AI models can help in more accurate diagnosis and more effective treatment of diseases. Patients in remote areas can receive more timely and relevant care, which in turn can improve their health outcomes. Telehealth AI also has the potential to save costs for the healthcare system. By enabling remote care, patient travel costs to medical facilities can be reduced.

Additionally, AI models can help in earlier identification of diseases, which can reduce the cost of treating advanced diseases.

However, implementing Telehealth AI in remote areas also faces many challenges. One of them is regulation. These advanced health technology settings often do not fully accommodate new developments. It is important to create an appropriate and safe regulatory framework for AI models to be implemented well. Data security is another challenge to overcome. The Telehealth AI model collects and processes sensitive patient data, so data protection is crucial. Protection against privacy breaches and data misuse is a top priority in implementing AI models. Limited technological infrastructure in remote areas is also a challenge. Availability of a consistent internet connection and adequate devices can be an issue, hindering seamless access to Telehealth AI services.

Digital literacy challenges must also be overcome. Patients and medical personnel may need to be provided training to use Telehealth technology effectively. This includes understanding how to communicate with the AI model and use its output. The cost of implementing Telehealth AI is also an obstacle. Infrastructure development, procurement of equipment, and training of medical personnel require significant investment. In remote areas with limited resources, adequate financing can be a challenge. Management of the hardware and software used in Telehealth AI requires careful attention. Routine maintenance, software updates, and device management need to be considered to ensure optimal availability and performance.

Addressing these challenges requires active collaboration between governments, health institutions, technology service providers, and local communities. Effective problem-solving and adapting to the unique needs of remote areas are key to optimizing the potential of Telehealth AI.

## E. CONCLUSION

Implementation of artificial intelligence (AI)-based Telehealth models in remote areas has great potential to bring a significant positive impact on healthcare. This technology can reduce inequities in health access, improve patient health outcomes, and save costs for the healthcare system. With advanced medical data analysis, AI models can help in more accurate diagnosis, disease prediction, and personalization of treatment. However, the implementation of Telehealth AI is also faced with various challenges that need to be overcome, including adequate regulations, data security, limited technological infrastructure, digital literacy, and significant implementation costs. Collaboration between governments, health institutions, technology service providers, and local communities is key to overcoming these barriers. With a commitment to addressing the challenges and maximizing the potential of this technology, Telehealth AI can be a powerful tool in improving health access and quality of care in remote areas, supporting the overall well-being of communities.

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