

A Critical Review on Challenges and Limitations in Artificial Intelligence-Based e-Health Applications



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Abstract

Artificial intelligence (AI) has the potential to transform healthcare by providing intelligent decision-making support and automating certain tasks. However, AI-based e-health applications face several challenges and limitations that must be addressed. This review highlights some challenges, including data quality and availability, ethical and legal implications, privacy and security concerns, regulatory frameworks and standards, and a shortage of skilled professionals. Addressing these challenges is crucial to ensure the effectiveness, safety, and ethical use of AI-based e-health applications. This review underscores the importance of developing AI-based e-health solutions focusing on ethical considerations, privacy and security, and regulatory compliance to improve healthcare outcomes while protecting patient privacy and security.

Keywords: AI; E-Health; IOT; Data Quality

Introduction

Artificial intelligence (AI) has become an increasingly popular technology in healthcare, with the potential to revolutionize the way healthcare is delivered. AI-based e-health applications can help healthcare professionals make more informed decisions, automate routine tasks, and improve patient outcomes. However, the development and deployment of AI-based e-health applications face several challenges and limitations that must be addressed to ensure their effectiveness, safety, and ethical use. This review aims to highlight some of these challenges and limitations, including data quality and availability, ethical and legal implications, privacy and security concerns, regulatory frameworks and standards, and a shortage of skilled professionals. By understanding these challenges and limitations, healthcare organizations and AI developers can work towards developing effective and safe AI-based e-health solutions that improve patient care while ensuring the protection of patient privacy and security.

Related Works

- i. "Artificial Intelligence for Health and Health Care" by Eric J Topol [1] - This book provides a comprehensive overview of how AI is transforming healthcare, including the use of AI-based e-health applications. It covers topics such as personalized medicine, predictive analytics, and precision health, and discusses the ethical and legal implications of AI in healthcare.
- ii. "Artificial Intelligence in Healthcare: Past, Present and Future" by Jiang F et al. [2]. - This review article provides a historical perspective on the use of AI in healthcare and discusses current and future applications of AI in various healthcare domains, including e-health applications. It also highlights the challenges and limitations of AI in healthcare and proposes strategies for addressing them.
- iii. "Current status and future direction of artificial

intelligence in healthcare and medical education” by JS Jung [3]. - This review article provides an overview of current and emerging applications of AI in healthcare, including e-health applications. It discusses the potential benefits of AI in healthcare and the challenges that need to be addressed to fully realize its potential.

iv. “Artificial Intelligence in healthcare opportunities and Challenges” by S Reddy et al.[4] - This article provides a comprehensive overview of the challenges and opportunities of AI in healthcare, including e-health applications. It discusses the importance of ethical and regulatory considerations and proposes strategies for addressing challenges such as data quality and availability and the shortage of skilled professionals.

v. Artificial intelligence in healthcare: a comprehensive review of its ethical concerns” by C Kooli et al.[5] - This review article provides a comprehensive overview of the current state of AI in healthcare, including e-health applications. It discusses the potential benefits and challenges of AI in healthcare and proposes strategies for addressing challenges such as data privacy and security, ethical and legal implications, and regulatory compliance.

AI-Based e-health Application

Artificial intelligence (AI) based e-health applications are software systems that utilize AI algorithms to perform various tasks in healthcare, such as diagnosis, treatment, and monitoring of patients. These applications have the potential to revolutionize healthcare by providing intelligent decision-making support and automating routine tasks, thereby freeing up healthcare professionals to focus on more complex tasks. AI-based e-health applications can analyze vast amounts of patient data, such as medical histories, lab results, and imaging scans, to provide personalized treatment plans and improve patient outcomes. They can also assist healthcare professionals in making more informed decisions by providing real-time information and recommendations based on the patient’s medical data [6,7].

One of the most significant benefits of AI-based e-health applications is their ability to help identify potential health issues before they become severe. For example, AI algorithms can analyze a patient’s medical data to detect early warning signs of chronic diseases, such as diabetes or heart disease, allowing for early intervention and treatment. However, there are several challenges and limitations that need to be addressed in the development and deployment of AI-based e-health applications. These challenges include data quality and availability, ethical and legal implications, privacy and security concerns, regulatory frameworks and standards, and a shortage of skilled professionals. Despite these challenges, the potential benefits of AI-based e-health applications make them an exciting area of development in healthcare. With the right strategies and guidelines in place, AI-based e-health applications have the potential to transform the healthcare industry and improve patient outcomes [8].

Assistive Technique Used

There are several assistive techniques used for artificial intelligence (AI)-based e-health applications, including:

i. Machine Learning (ML) - ML algorithms can analyze vast amounts of medical data to identify patterns and make predictions about a patient’s health status. For example, ML algorithms can be used to predict the risk of developing a specific disease or to personalize treatment plans based on a patient’s medical history.

ii. Natural Language Processing (NLP) - NLP algorithms can analyze and interpret natural language text, such as medical records and clinical notes, to provide insights into a patient’s health status. For example, NLP algorithms can be used to identify and extract information from electronic health records (EHRs) to assist healthcare professionals in making more informed decisions [9].

iii. Computer Vision (CV) - CV algorithms can analyze medical images, such as X-rays, CT scans, and MRIs, to assist healthcare professionals in diagnosing and treating patients. For example, CV algorithms can be used to identify abnormalities in medical images and provide real-time insights to healthcare professionals [10].

iv. Robotics - Robotics technology can be used in healthcare to assist with surgical procedures and provide remote patient monitoring. For example, robotic surgical systems can be used to perform minimally invasive procedures with greater precision and accuracy, while remote monitoring robots can be used to monitor patients and provide real-time insights to healthcare professionals [11] (Figure 1).

These assistive techniques can help AI-based e-health applications to analyze and interpret medical data, provide personalized treatment plans, assist with diagnosis and treatment, and monitor patients remotely. They have the potential to transform healthcare by improving patient outcomes and reducing healthcare costs.

Critical Challenges

There are several challenges that need to be addressed in the development and deployment of artificial intelligence (AI)-based e-health applications, including:

i. Regulatory frameworks and standards - The use of AI-based e-health applications is subject to regulatory frameworks and standards, which can vary by region and jurisdiction. Developers of AI-based e-health applications need to be aware of the regulatory requirements and standards in their respective regions and ensure that their applications are compliant [12].

ii. Data quality and availability - AI-based e-health applications require large volumes of high-quality medical data to train their algorithms effectively. However, medical data can be

incomplete, inconsistent, and difficult to access, which can limit the accuracy and reliability of AI-based e-health applications [12,13].

iii. Shortage of skilled professionals - The development and deployment of AI-based e-health applications require a range of skills, including data science, software development, and healthcare expertise. However, there is a shortage of skilled professionals with these skills, which can limit the development and deployment of AI-based e-health applications [13].

iv. Privacy and security concerns - Medical data is sensitive

and confidential, and the use of AI-based e-health applications raises privacy and security concerns. AI-based e-health applications need to have robust security measures in place to protect patient data and prevent unauthorized access [14].

v. Ethical and legal implications - The use of AI in healthcare raises ethical and legal questions, such as patient privacy, informed consent, and liability. The ethical and legal implications of AI-based e-health applications need to be carefully considered and addressed to ensure that they are used in a responsible and ethical manner [15] (Figure 2).

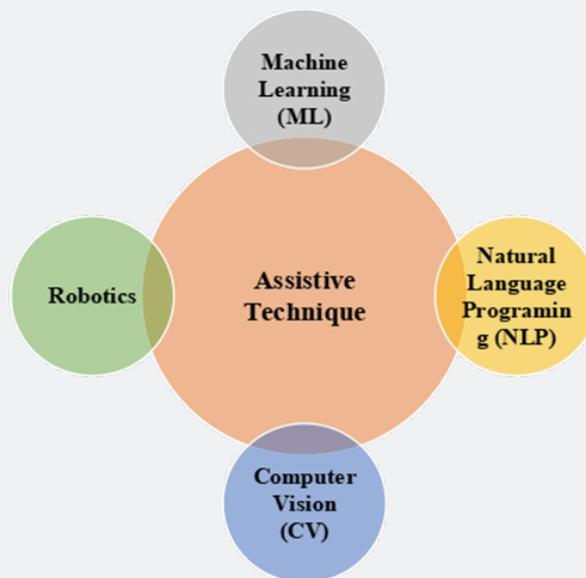


Figure 1: Assistive Technique Used for AI-Based e-health Application.

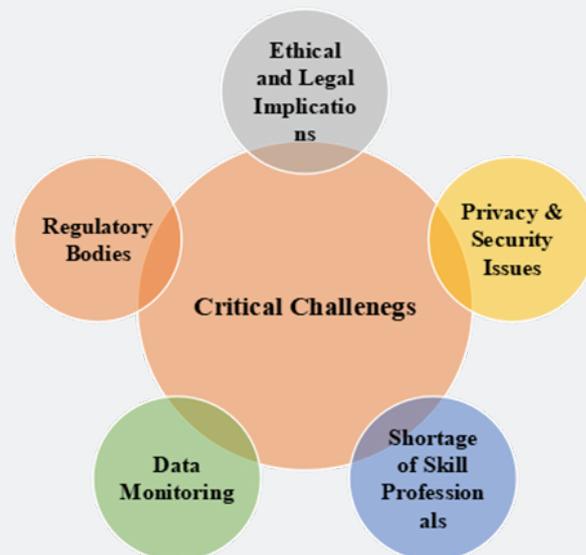


Figure 2: Challenges Faced by AI-Based e-health Application.

The above-mentioned challenges are critical to realizing the potential of AI-based e-health applications in healthcare. Strategies for addressing these challenges include improving data quality and availability, developing ethical and regulatory frameworks, enhancing privacy and security measures, and investing in education and training programs to address the shortage of skilled professionals.

Limitations

Despite the potential benefits, there are several limitations to the use of artificial intelligence (AI)-based e-health applications in healthcare, including:

a. Lack of transparency - AI algorithms can be complex, making it difficult to understand how they arrive at their predictions and recommendations. This lack of transparency can limit the trust and acceptance of AI-based e-health applications among healthcare professionals and patients.

b. Limited generalizability - AI-based e-health applications are typically trained on specific datasets, which may not be representative of the broader population. As a result, the predictions and recommendations made by these applications may not be generalizable to other populations.

c. Bias and discrimination - AI-based e-health applications can be susceptible to bias and discrimination, especially if they are trained on biased datasets or if the algorithms are not designed to mitigate bias. This can result in disparities in healthcare outcomes for certain populations.

d. Lack of clinical validation - AI-based e-health applications are often developed in research settings, and their effectiveness and safety have not been clinically validated in real-world settings. This lack of clinical validation can limit the adoption and use of these applications in clinical practice.

e. Technical limitations - AI-based e-health applications require significant computational power, storage, and bandwidth to operate effectively. These technical limitations can limit the scalability and cost-effectiveness of these applications.

f. Addressing these limitations is critical to realizing the full potential of AI-based e-health applications in healthcare. Strategies for addressing these limitations include improving the transparency and interpretability of AI algorithms, developing more representative and unbiased datasets, conducting rigorous clinical validation, and investing in the technical infrastructure necessary to support these applications.

Conclusion

In conclusion, artificial intelligence (AI)-based e-health applications have the potential to revolutionize healthcare by improving diagnosis, treatment, and patient outcomes. However, there are several challenges and limitations that need to be addressed to realize this potential fully. Challenges such as data

quality and availability, ethical and legal implications, privacy and security concerns, regulatory frameworks and standards, and shortage of skilled professionals need to be carefully considered and addressed to ensure the responsible and ethical use of AI-based e-health applications. Moreover, limitations such as lack of transparency, limited generalizability, bias, discrimination, lack of clinical validation, and technical limitations need to be addressed to ensure that AI-based e-health applications are effective, safe, and trustworthy. Identifying these challenges and limitations requires collaboration and investment from multiple stakeholders, including healthcare professionals, policymakers, researchers, and technology developers. By working together, we can realize the full potential of AI-based e-health applications to transform healthcare and improve patient outcomes.

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