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Review Article

The Role of Artificial Intelligence in the Healthcare Industry: A Review Article of the Current Opportunities and Challenges

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Abstract

The emergence of artificial intelligence within healthcare industry holds much promise. Artificial Intelligence in healthcare helps to enhance patient diagnoses, improve prevention and treatment, increase cost-efficiency, and serve as a way to provide equitable access and treatment for all. We performed a narrative review to describe existing literature with regard to role of artificial intelligence in the healthcare industry. This review gathered the contemporary information throughout PubMed, Scopus, and Science Direct databases regarding the role of artificial intelligence in the healthcare industry. This review study highlighted the current opportunities and challenges in the use of artificial intelligence in the healthcare industry. We found that most studies indicate the potential of artificial intelligence to assist healthcare professionals in their duties, and improve medication precision, enhance decision-making and teamwork. In addition, the study revealed that artificial intelligence has proven beneficial in medical imaging, diagnosis and treatment, virtual health assistance, drug development, and medical research. However, accessing and utilizing patient data is a challenge due to privacy concerns. On the positive side, artificial intelligence presents several opportunities in healthcare industry, including improved patient monitoring, managing patient data, predictive medicine; improved teamwork and decision-making, improved patient engagement and compliance; rehabilitation; and administrative applications. Ethical issues, such as data privacy and bias, are among the most significant challenges we found when using artificial intelligence in healthcare industry. Ensuring the protection of patient data and avoiding the perpetuation of social biases is crucial for the responsible and equitable implementation of artificial intelligence in healthcare industry.

Keywords: Artificial Intelligence; Challenges; Healthcare Industry; Opportunities; Review Article

Introduction

Artificial intelligence involves the development of computer systems capable of performing tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, making decisions, and learning from experience [1,2]. Currently, the healthcare industry has emerged as a primary beneficiary of artificial intelligence's potential, leveraging its capabilities to enhance various aspects of patient care and administrative efficiency. Integrating artificial intelligence technologies in healthcare industry is not just a futuristic vision but also a present reality, driven by the exponential growth in healthcare data, advancements in computational power, and significant breakthroughs in machine learning algorithms [3].

In addition, the significance of artificial intelligence applications in healthcare industry cannot be overstated. Artificial intelligence has the potential to revolutionize how we diagnose diseases, tailor treatments to individual patients, monitor health conditions in real time, and manage the operational aspects of healthcare delivery. For instance, artificial intelligence-driven diagnostic tools can accurately analyze medical images, often identifying subtleties that may elude human eyes. This precision translates into earlier and more accurate diagnoses, significantly affecting patient outcomes [4]. Similarly, in treatment personalization, artificial intelligence algorithms can sift through vast datasets to identify patterns and predict which treatments will be most effective for specific patient profiles,

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marking a leap towards truly personalized medicine [5]. Moreover, artificial intelligence applications extend to patient monitoring, where wearable devices and remote monitoring systems offer continuous oversight of patient health, enabling timely interventions and reducing hospital readmissions [6]. In terms of healthcare delivery, artificial intelligence can streamline operations, from scheduling appointments to optimizing hospital workflows, thereby improving efficiency and patient satisfaction [7]. This review was conducted to determine the role of artificial intelligence in the healthcare industry, and to address a comprehensive overview of the current opportunities and challenges of the artificial intelligence in the healthcare industry.

Literature Review

Role of Artificial Intelligence in the Healthcare Industry (The Current Opportunities)

Health services management using artificial intelligence: One of the notable aspects of artificial intelligence techniques is potential support for comprehensive health services management. These applications can support doctors, nurses and administrators in their work. For instance, an artificial intelligence system can provide health professionals with constant, possibly real-time medical information updates from various sources [8]. Other applications involve coordinating information tools for patients and enabling appropriate inferences for health risk alerts and health outcome prediction [9]. Additionally, artificial intelligence can contribute to optimizing logistics processes and interesting applications can also support the training of personnel working in health services [10]. Finally, health services management could benefit from artificial intelligence to leverage the multiplicity of data in electronic health records by predicting data heterogeneity across hospitals and outpatient clinics, checking for outliers, performing clinical tests on the data, unifying patient representation, improving future models that can predict diagnostic tests and analyses, and creating transparency with benchmark data for analyzing services delivered [11]. For those aspects of healthcare that make use of artificial intelligence in the healthcare industry, artificial intelligence technology can serve a variety of purposes, including for clinics, patients, and the industry as a whole. The use of technology in clinics enables them to make decisions, collect up-to date information, and share information [12]. Furthermore, there are many other applications that can make use of artificial intelligence technologies, such as scheduling appointments and monitoring patients. Artificial intelligence and other technologies primarily have applications in the areas of patient diagnosis, treatment, consultation, and health monitoring [13].

Diagnosis and patient monitoring: The potential of artificial intelligence in early diagnosis has been the subject of a significant amount of studies [14,15]. Early detection of certain diseases, such as cancer, can dramatically influence the course of treatment and recovery. Artificial intelligence is used for personalized medicine and predictive analytics to identify diseases early and monitor their progression, resulting in better patient outcomes and reduced healthcare costs [16]. In addition, artificial intelligence can significantly improve the efficiency and effectiveness of patient care, with several specific opportunities for implementation. For example, predictive analytics can be used to identify patients who are at risk of developing complications and predict the likelihood of deterioration in the patient. By intervening early, healthcare providers can improve patient outcomes and prevent critical conditions from developing [17].

In addition, artificial intelligence is a powerful tool for image analysis that is increasingly being used by radiology professionals for the earl y diagnosis of different diseases and for reducing diagnostic errors in the context of prevention [18]. Likewise, artificial intelligence is a smart and potential tool for analyzing echocardiography charts that cardiologists use to support their decision-making. Artificial intelligence has presented encouraging results in the early detection of diseases such as breast and skin cancer, eye disease, and pneumonia using body-imaging modalities [19].

Furthermore, artificial intelligence techniques, from machine learning to deep learning, play a critical role in many areas related to health, such as the development of new healthcare systems, the management of patient data, and the treatment of illnesses. The diagnosis of various diseases can also be made most effectively using artificial intelligence approaches. There are unprecedented opportunities to recover patient and clinical group results and lower expenses thanks to the use of computerized reasoning artificial intelligence in healthcare [20].

Moreover, one of the divisions of artificial intelligence, which has expanded dramatically, is remote patient monitoring. Artificial intelligence-powered remote patient monitoring is a highly effective technique for managing common-to-chronic diseases. In order for remote patient monitoring to function, data must be gathered and sent to healthcare professionals via a linked device. As a result, the majority of healthcare institutions have implemented remote patient monitoring, shifting the traditional method of treatment in that direction [21].

Patient data and predictive medicine: Artificial intelligence techniques can help medical researchers deal with the vast amount of data from patients (i.e., medical big data). Artificial intelligence systems can manage data generated from clinical activities, such as screening, diagnosis, and treatment assignment. In this way, health personnel can learn similar subjects and associations between subject features and outcomes of interest. These technologies can analyze raw data and provide helpful insights that can be used in patient treatments [22]. Because artificial intelligence can identify meaningful relationships in raw data, it can support diagnostic, treatment and prediction outcomes in many medical situations. It allows medical professionals to embrace the proactive management of disease onset. Additionally, predictions are possible for identifying risk factors and drivers for each patient to help target healthcare interventions for better outcomes [23].

Teamwork and clinical decision-making: Current healthcare environments require healthcare providers to collaborate and work in teams, which requires strong communication, shared decision-making, coordinated actions, and progress evaluation. Artificial intelligence chat bots can be used to handle problems related to coordinating and scheduling medical appointments, providing reminders, and notifying providers of a patient's condition based on symptoms [24]. Artificial intelligence can help physicians make better clinical decisions or even replace human judgment in healthcare-specific functional areas. Algorithms can benefit clinical decisions by accelerating the process and the amount of care provided, positively impacting the cost of health services [25]. Therefore, artificial intelligence technologies can support medical professionals in their activities and simplify their jobs.

Virtual health assistants, patient care and technological advancements: Artificial intelligence can help identify patient symptoms and provide them with appropriate care recommendations, such as self-care advice or a referral to a healthcare professional. In addition, artificial intelligence can help patients manage their medications by providing reminders and alerts about when to take their medications and possible side effects. Furthermore, remote patient monitoring using artificial intelligence can improve healthcare access, especially in rural or underserved areas [26]. In addition, artificial intelligence plays a role in controlling chronic diseases such as diabetes mellitus, hypertension, sleep apnea, and chronic bronchial asthma using wearable, non-invasive sensors. A previous study recommended a smart sensor system based on a combined sensor network to observe a person's home and environment and obtain data on a person's health status and behavior. The recommended platform includes sensors that are unobtrusive, biomedical, and wearable. These sensors monitor physiological variables such as respiratory rate, pulse rate, breathing waveform, blood pressure, and electrocardiogram. A smart device has been proposed to act as an interface between the person and the sensors [27].

Artificial intelligence-enabled health monitoring technology can help patient by ensuring timely delivery of care, allowing healthcare providers to expand patient care efforts outside office hours and promote self-management. For example, sensor technology can simplify self-monitoring for patients with heart failure using user-friendly hardware [28]. Various health-related technologies also have the potential to handle laboratory practices for medical professionals and students. For example, novice surgeons can practice their techniques in a repeatable and risk-free setting using a virtual reality simulator, which allows them to practice treatment beforehand and consider all eventualities to create precise and secure surgical procedures. Artificial intelligence is also being used to control workflows, image analysis, robotic surgery, virtual assistants, and clinical decision support [29]. In addition to medical personnel, certain medical robots assist patients. Exoskeleton robots, for example, can assist paralyzed patients in walking again and becoming self-sufficient. A smart prosthesis is another example of technology in action. These bionic limbs attach sensors that render them more responsive and accurate than natural body parts, with the option of covering them in bionic skin and connecting them to the user's muscles. Robots can help with rehabilitation and surgery [30].

Drug discovery and drug development: Artificial intelligence has the potential to greatly enhance the efficiency and effectiveness of the drug development process. One specific opportunity is virtual screening, which can analyze large amounts of data on drug interactions and identify new drug targets. This can greatly accelerate drug discovery, allowing researchers to identify potential drug candidates more quickly and at a lower cost. In addition, artificial intelligence can analyze data on drug candidates to identify the most promising compounds for further development and explore the repurposing of existing drugs for new potential uses [31].

Medical research: Artificial intelligence can be used to analyze and identify patterns in large and complex datasets faster and more precisely than has previously been possible. It can also be used to search the scientific literature for relevant studies, and to combine different kinds of data; for example, to aid drug discovery. Researchers have developed an artificial intelligence 'robot scientist', which is designed to make the process of drug discovery faster and more economical. Artificial intelligence systems used in healthcare could also be valuable for medical research by helping to match suitable patients to clinical studies [32].

Patient engagement and compliance: Healthcare providers use their clinical experts to develop treatment plans to improve patients' acute or chronic health. Nevertheless, mostly, it does not matter when a patient misses the required behavioral changes, such as controlling weight, scheduling a follow-up visit, and obeying a treatment plan. Such conditions raised the implementation of artificial intelligence to successfully enhance patient engagement [33].

Rehabilitation: Artificial intelligence has innovative applications in the field of rehabilitation. It is an idea that includes physical (robotics) and virtual (informatics) branches. As a result of technological advancement, artificial intelligence and robotics are transforming approaches and competencies in rehabilitation research and practice. For example, smart homes can assist residents with daily activities and alert caregivers when assistance is needed. In addition, smart mobile and wearable devices are available to collect data and provide users with information to assess health improvement and review progress toward personalized rehabilitation goals [34].

Administrative applications: Artificial intelligence can reduce administrative burdens by automatically populating structured data areas from therapeutic notes, retrieving key data from past medical records, and collecting documented patient encounters. For example, the average nurse in the United States spends a quarter of his/her working hours on regulatory and administrative duties. Physicians and nurses' time could be saved using voice text writing. Although rule based systems integrated with electronic health record systems are extensively used, they lack the accuracy of additional algorithmic systems [35].

Challenges of Artificial Intelligence in the Healthcare Industry

Artificial intelligence depends on digital data, so inconsistencies in the availability and quality of data restrict the potential of artificial intelligence. Also, significant computing power is required for the analysis of large and complex data sets. While many are enthusiastic about the possible uses of artificial intelligence, others point to the practical challenges, such as the fact that medical records are not consistently digitized, and the lack of interoperability and standardization systems, digital record keeping, and data labelling [36]. Artificial intelligence will likely be included in routine clinical care soon. However, concerns regarding the ethical and laws implications of introducing artificial intelligence in healthcare have been expressed. These concerns include the risk of bias, lack of clarity for some artificial intelligence algorithms, privacy issues for data used for artificial intelligence model training, and security issues and artificial intelligence implementation responsibilities in clinical settings. There are some of the ethical problems faced by artificial intelligence clinical applications. They are safety, efficacy, privacy, information and consent, the right to decide, "The right to try," the costs, and access [37].

Ethical and privacy challenges: The ethical and privacy challenges are a significant issue in the healthcare industry, which requires strict compliance with laws, regulations, and rules. Integration of artificial intelligence in medicine presents a wide

range of challenges in terms of privacy and ethics, including issues with patient data protection, ethical boundaries of innovation, and the actual impact of technology on both doctors and patients. To realize the full potential of artificial intelligence in healthcare, strategic decisions must be made that balance competing interests and values, which include issues of privacy, accountability, intellectual property rights, and transparency. Understanding the broader perspective and changes regarding privacy concerns in healthcare is crucial, as trust is essential. Ethical challenges arise when using artificial intelligence in healthcare [38]. Despite the fact that artificial intelligence ethical frameworks have undergone numerous modifications to reflect the complexity of artificial intelligence ethical issues, they still do not offer much guidance as to what policies should be put in place to support ethical use of artificial intelligence. This is true even if models for artificial intelligence ethics have undergone numerous revisions to account for the complexity of these problems [39]. Accessing, altering, distributing, and using patient data all raise legitimate concerns with regard to the patient's right to privacy. Healthcare professionals are still not fully aware of the potential ethical problems that emerging artificial intelligence technologies could create when providing actual care. Privacy and surveillance, bias and discrimination, and possibly the most profound and challenging philosophical challenge of the day, the function of human judgment, are the three main ethical issues that artificial intelligence raises for society [40].

Social sustainability challenges: When using artificial intelligence, one should give careful consideration to how it will affect society as a whole, particularly in terms of people's and the planet's health. Responsible use of artificial intelligence in healthcare institutions is required in a way that strikes a balance between the needs of stakeholders, reduces ethical problems as much as possible, and generates revenues that will last. If a healthcare institution develops artificial intelligence algorithms, either intentionally or unintentionally, that threaten human rights and wellbeing, then the business's reputation and credibility could be severely damaged. For instance, the unethical use of artificial intelligence, such as substituting established health services with smart technology, has been called out as a problem that needs to be addressed [41]. The economic and social sustainability of healthcare organizations should be prioritized, and artificial intelligence should be used to build solutions that support this goal.

Governance challenges: As the implementation of artificial intelligence technologies in healthcare increases, there is a serious requirement for proper governance to overcome regulatory, ethical, and trust issues. Active governance at the hospital level offers an opportunity to accurately address these issues in the implementation and use of artificial intelligence [42]. The governance structure should be comprehensive to address the challenges related to clinical, operational, and leadership domains while deploying artificial intelligence-powered applications. Additionally, artificial intelligence has applications in areas that need regulation, including healthcare, research, and privacy. Nonetheless, artificial intelligence is developing rapidly and commercially, which could challenge the known outlines. National and international regulations are, therefore, required to introduce artificial intelligence-controlled applications in healthcare as part of the principles of medical ethics [43].

Technical challenges: Technically, artificial intelligence models must be simple in their properties and functions in order for health care providers to efficiently operate them. On the other hand, there are a few hurdles to adopting artificial intelligence in healthcare, including the lack of capacity of developing and maintaining IT infrastructure to support the artificial intelligence process, the increased costs associated with storing and backing up data for research purposes, and the high cost of augmenting data validity. In addition, artificial intelligence algorithms can suffer from a variety of shortcomings, including inapplicability outside of the training domain, bias, and brittleness [44]. Therefore, healthcare providers should develop and implement an effective strategic plan for implementing artificial intelligence in healthcare to address the issues related to cost, technological infrastructure, and the use of artificial intelligence systems for health care providers.

Lack of awareness on artificial intelligence technologies challenges: Building trust with patients is crucial in healthcare, and this is especially true when it comes to artificial intelligence-based technologies. Doctors and policy makers acknowledge that the public may be reluctant to rely on artificial intelligence-generated recommendations, given the longstanding importance of face-to-face interaction with physicians. To complicate matters, there is often a lack of understanding among the general population about the potential benefits and limitations of artificial intelligence in healthcare, leading to unrealistic expectations that can make it difficult for physicians to adopt these technologies [45].

Unreliability and trustworthiness of artificial intelligence technologies challenges: Technological challenges pose obstacles in the transition from conventional computer architectures to artificial intelligence architectures, as the emergence of graphics processors, field-programmable gate arrays, and special-purpose artificial intelligence chips require advanced computing and storage devices to offer artificial intelligence applications. However, deploying these infrastructures and storages can be complex and expensive for healthcare organizations. Furthermore, some healthcare professionals, including physicians, nurses, and assistant nurses, lack adequate focus on digital technology, which can limit the adoption of artificial intelligence in healthcare. Another critical issue is the lack of transparency and interpretability of artificial intelligence algorithms, particularly when processing unstructured data [46]. In healthcare, these challenges must be addressed to ensure the smooth integration of artificial intelligence technology and promote its widespread use.

Healthcare providers and professional liability challenges: Clinical judgment has always been the domain of trained and certified healthcare professionals. However, the increased use of artificial intelligence decision support systems to assist with clinical tasks may impact the professional responsibility of healthcare providers towards their patients. One concern is that healthcare professionals may become too dependent on artificial intelligence technology and be less willing to question errors or double-check results. While artificial intelligence systems are important to be user-friendly, their integration into routine clinical practice can present difficulties depending on their intended use. Physicians can face challenges when learning to integrate and use technology, as they may have varying levels of technology literacy and limited hands-on experience using artificial intelligence applications in practice [47].

Conclusion

This review study highlighted the current opportunities and

challenges in the use of artificial intelligence in the healthcare industry. We found that most studies indicate the potential of artificial intelligence to assist healthcare professionals in their duties, and improve medication precision, as well as enhance decision-making and teamwork. In addition, the study revealed that artificial intelligence has proven beneficial in medical imaging, diagnosis and treatment, virtual health assistance, drug development, and medical research. However, accessing and utilizing patient data is a challenge due to privacy concerns. On the positive side, artificial intelligence presents several opportunities in healthcare industry, including improved patient monitoring, managing patient data, predictive medicine; improved teamwork and decision-making, improved patient engagement and compliance; rehabilitation; and administrative applications. Ethical issues, such as data privacy and bias, are among the most significant challenges we found when using artificial intelligence in healthcare industry. Ensuring the protection of patient data and avoiding the perpetuation of social biases is crucial for the responsible and equitable implementation of artificial intelligence in healthcare industry.

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