Review

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Exploring the current and prospective role of artificial intelligence in disease diagnosis

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Abstract

Artificial intelligence (AI) refers to the simulation of human intelligence processes by machines, especially computer systems, providing assistance in a variety of patient care and health systems. The aim of this review is to contribute valuable insights to the ongoing discourse on the transformative potential of AI in healthcare, providing a nuanced understanding of its current applications, future possibilities, and associated challenges. The authors conducted a literature search on the current role of AI in disease diagnosis and its possible future applications using PubMed, Google Scholar, and ResearchGate within 10 years. Our investigation revealed that AI, encompassing machine-learning and deep-learning techniques, has become integral to healthcare, facilitating immediate access to evidence-based guidelines, the latest medical literature, and tools for generating differential diagnoses. However, our research also acknowledges the limitations of current AI methodologies in disease diagnosis and explores uncertainties and obstacles associated with the complete integration of AI into clinical practice. This review has highlighted the critical significance of integrating AI into the medical healthcare framework and meticulously examined the evolutionary trajectory of healthcare-oriented AI from its inception, delving into the current state of development and projecting the extent of reliance on AI in the future. The authors have found that central to this study is the exploration of how the strategic integration of AI can accelerate the diagnostic process, heighten diagnostic accuracy, and enhance overall operational efficiency, concurrently relieving the burdens faced by healthcare practitioners.

Keywords: Artificial intelligence, diagnostic accuracy, diagnostic efficiency, disease diagnosis, healthcare evolution, medical information

Introduction

Disease diagnosis is an essential step in effective treatment planning, relying extensively on patient history, multiple laboratory reports, imaging procedures, and biopsies. These components are collectively referred to as "medical diagnostics"[1]. The diagnostic process is complex, and healthcare practitioners often struggle to arrive at an accurate diagnosis, causing unnecessary distress to patients and compromising their well-being. However, with the digitisation of healthcare and the emergence of artificial intelligence (AI), the risk of human error in diagnosing diseases has been significantly reduced[2]. The field of diagnostics has witnessed a revolutionary change owing to the enhanced efficiency and accuracy of diagnostic processes engendered by the advent of AI[3]. Various AI-based methods, ranging from machine learning to deep learning, have been developed to improve clinical systems, uphold patient records, diagnose diseases, and treat various illnesses[4]. Of particular relevance, a rule-based intelligent system is an AI method extensively employed in the medical field, wherein decisions are derived from pre-established instructions and healthcare protocols[2].

HIGHLIGHTS

- The integration of artificial intelligence (AI) in healthcare enables immediate access to a wide array of medical information sources, including various imaging techniques and genetic data, leading to heightened diagnostic accuracy and expediting the diagnostic process.
- By detailing the evolutionary trajectory of AI in healthcare, the study highlights how strategic integration of AI can alleviate the burdens faced by healthcare professionals.
- By acknowledging the limitations of current AI methodologies in disease diagnosis, the review serves as a foundation for further research and development, emphasising the need for continuous innovation and adaptation to fully realise the potential of AI in healthcare.

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AI algorithms enable healthcare practitioners to identify and diagnose a spectrum of diseases by analysing medical images such as ultrasound, MRI, computed tomography (CT), and dual-energy X-ray absorptiometry (DXA). AI methodologies including fuzzy logic, artificial neural networks (ANNs), recurrent neural networks (RNNs), and logistic regression (LR) have been successfully used to diagnose complex health conditions with high accuracy rates. Noteworthy among these are tuberculosis, hypertension, stroke, and cerebrovascular disease, cancer, Alzheimer's disease, liver disease, skin disease, diabetic retinopathy, and chronic diseases[4]. Moreover, AI algorithms have shown invaluable efficiency in detecting certain cancers in their early stages, such as gastrointestinal or liver cancer, improving patient well-being, and alleviating the economic burden of malignant diseases in the healthcare system[5,6]. A study conducted by Chen *et al.*[7] in 2020 focused on analysing the use of ANNs in diagnosing liver disease, demonstrating an impressive diagnostic accuracy rate. Another study conducted by Jo *et al.*[8] in 2019 titled "Deep Learning in Alzheimer's Disease: Diagnostic Classification and Prognostic Prediction Using Neuroimaging Data" concluded that deep-learning AI methods yielded an accuracy of 96% in classifying Alzheimer's disease. The proficiency of AI algorithms extends beyond disease diagnosis and image analysis, encompassing the ability to process extensive medical data to generate hypotheses and suggest potential diagnoses, enabling healthcare professionals to mitigate cognitive biases and ensure the comprehensive exploration of all conceivable diagnostic alternatives[4].

The present study is a review highlighting the critical significance of integrating AI into the medical healthcare framework and meticulously examines the evolutionary trajectory of healthcare-oriented AI from its inception, delving into the current state of development and projecting the extent of reliance on AI in the future.

Materials and methods

We conducted a literature search on the current role of AI in disease diagnosis and its possible future applications using PubMed, Google Scholar, and ResearchGate within 10 years. Keywords used for our search were; "Artificial Intelligence", "Disease Diagnosis", "Healthcare Evolution", "Traditional Diagnostic Methods," and "Preventive Healthcare".

A historical timeline of AI in healthcare

The introduction of AI in the 1950s marked a transformative moment in the healthcare sector, reshaping diagnostic processes, medical imaging, and treatment planning through the integration of machine learning and precision medicine. Over time, the evolution of AI in healthcare has transitioned from its initial knowledge-based system, dependent on medical rules and knowledge, to contemporary AI frameworks that utilise ANNs and statistical methodologies for disease diagnosis and therapeutic interventions. Between 1950 and 1960, AI found its early application in digitising patient health records into electronic health records, facilitating the documentation of a broad range of information including diagnostic procedures, therapeutic interventions, and laboratory biomarkers. This digital transformation in medical literature paved the way for the development of databases such as PubMed Central (PMC) by the National Library of Medicine (NLM), revolutionising data retrieval and clinical informatics for research purposes[9–11].

Technological advancements such as the Internet of Things (IoT), Big Data, data mining, and machine learning have significantly expanded the role of AI in healthcare. The IoT has facilitated the direct connection of physical devices to computer systems, thereby reducing human-to-human or human-to-machine interaction while simultaneously storing large amounts of data. These data require AI applications and machine-learning algorithms for comprehensive analysis and integration. However, it should be noted that machine learning constitutes a shallower facet of AI than deep learning[11,12]. From the 1970s to the 2000s, AI continued to evolve in various phases. In the early 1970s, certain limitations hindered its progress, marked by high costs and lack of interest, a phase colloquially termed the "AI winter". This period of stagnation was eventually surmounted when collaborators from Rutgers University and Stanford University organised workshops on Artificial Intelligence in medicine and created the first computer model, "CASNET", which performed consultations for glaucoma, rendering it the first AI model in ophthalmology to provide tailored management plans based on individual symptom input by physicians for a specific disease. Other models, such as MYCIN, DXplain, and INTERNIST-1, have also been established that use simple machine learning to predict the appropriate antibiotic usage for a specific bacterial infection and generate differential diagnoses[10,12].

In the latter part of the 2000s, AI progressed from machine learning to deep learning, characterised by the development of convolutional neural networks (CNNs). These networks can generate outcomes and classify medical knowledge, thereby bypassing the need for intensive manual input and expertise[13]. The foundation of CNNs, referred to as LeNet, was established in 1998. However, owing to computational limitations and insufficient training of new datasets, its progress slowed down until the 2010s when full fruition was achieved[11,14]. Following the resolution of these limitations and drawbacks, deep learning has gained prominence in disease prognosis, imaging, and prediction of drug response. Before transitioning to CNNs, an AI algorithm named "Random Forests" was introduced a decade ago to predict drug use outcomes and synthesise images for diagnostic purposes. In contrast to CNNs, it is less expensive and, thus, holds importance[12,14]. In the modern AI era, CNNs are in high demand for image processing because of their hierarchical data interpretation from the deepest layers that resemble neurons of the human brain. They are highly accurate, similar to the expertise of humans[12], and can utilise spatial recognition techniques to assess different imaging modalities, such as X-Ray and CT scans, aiding in diagnosis[14]. Therefore, for decades, the progression of AI in medicine has come a long way, transcending its prior limitations.

Emerging trends of AI applications for healthcare

AI technologies and algorithms have transformed disease diagnosis by providing healthcare professionals with accurate and efficient tools. Owing to their ability to extract nuanced patterns from complex medical data, machine-learning techniques, particularly deep learning, have gained importance. Convolutional neural networks (CNNs) have become the standard for image-based diagnoses such as tumour detection in radiological scans[15]. Similarly, ensemble methods such as Random Forest and Gradient Boosting enhance diagnostic accuracy by integrating data from various sources, compensating for individual model limitations[16]. Reinforcement learning (RL) has also gained popularity for optimising treatment plans and advancing precision medicine by tailoring therapies based on patient-specific characteristics and evolving situations[17].

The fusion of AI with conventional medical imaging techniques has expedited disease diagnoses. For instance, the AI-assisted analysis of retinal images aids in the early detection of diabetic retinopathy[18]. In addition, natural language processing (NLP) enables the rapid analysis of textual clinical records, offering insights for accurate diagnosis and patient care[19]. In radiology, AI algorithms have shown proficiency in interpreting medical images and assisting radiologists in the detection of various diseases. AI-powered systems can detect anomalies in X-rays, MRIs, and CT scans, resulting in faster and more accurate disease diagnosis[20,21]. Similarly, AI has made significant advances in pathology, revolutionising the field by speeding slide processing and enhancing disease identification. Research has highlighted the ability of AI to identify cellular and tissue anomalies, enabling pathologists to diagnose diseases with greater accuracy[22,23]. In dermatology, AI-powered tools such as deep-learning algorithms can accurately identify skin cancer by analysing images, even rivalling the diagnostic acumen of dermatologists. In one study, Haenssle and colleagues demonstrated how AI algorithms can identify melanomas and other skin cancers by analysing images, thereby offering a supplementary diagnostic tool for clinicians[21,24]. This accelerated data processing translates into faster diagnoses and timely interventions, potentially averting critical outcomes.

AI transforming drug design and therapeutics

Recent research has highlighted the potential of AI in drug design and therapeutic development. Multiple studies have emphasised the role of AI in virtual screening, computer-aided synthesis planning, de-novo molecule generation, and in-silico evaluation of drug properties[25,26]. One study underscored the significance of AI in analysing biological and genetic information, accelerating drug discovery, and predicting disease progression[27]. Another provided a comprehensive overview of AI applications in medicinal chemistry and healthcare, including de-novo drug design, activity scoring, and virtual screening[28]. Collectively, these studies demonstrate the transformative potential of AI in revolutionizing drug design and therapeutic development.

Balancing roles and responsibilities

AI-driven diagnostic procedures present myriad benefits, including speed, accuracy, cost-effectiveness, and the ability to process vast amounts of medical data efficiently. Research published in Nature Medicine revealed that AI models for breast cancer diagnosis improved their performance with increased training data, outperforming traditional methods in detecting malignancies in mammograms[29]. Another study highlighted that implementing AI in medical imaging resulted in substantially curtailed costs because of the diminishing reliance on expensive diagnostic tests and unnecessary procedures[30]. Amidst these potential advantages, the integration of AI into healthcare also presents challenges and concerns. The foremost among these is the matter of data privacy and security, which assumes critical significance. Healthcare institutions must ensure that patient data used to train AI models is properly anonymized and safeguarded against breaches. A discussion on the potential risks associated with AI in healthcare emphasises the paramount importance of data protection[31]. Interoperability surfaces as another potential challenge. The seamless integration of AI systems into existing healthcare infrastructure necessitates consistent data exchange. However, technical and organisational hurdles can impede this process. The need for enhanced interoperability has been underscored as pivotal to unlocking the full potential of AI in healthcare[32]. Furthermore, there is genuine concern about the reliance on AI to make critical medical decisions without a comprehensive understanding of the reasoning behind its decisions. Clear and explainable AI algorithms are vital not only for building trust but also for making better decisions in clinical settings.

The increasing use of AI for disease diagnosis has prompted the emergence of ethical considerations. A pressing issue revolves around the transparency and explainability of AI algorithms. As these systems become increasingly complex, understanding the reasoning behind their decisions becomes challenging. To address this, the establishment of ethical guidelines is imperative to ensure that AI-driven diagnoses are interpretable and capable of providing justifiable explanations for their results. In addition, the application of AI algorithms is susceptible to biases that exist within the training data, potentially leading to biased outcomes. One study demonstrated the presence of racial bias in an AI algorithm used in healthcare, consequently leading to suboptimal care for black patients. Effectively addressing the bias in AI algorithms mandates the cultivation of diverse and representative datasets, accompanied by robust testing procedures to identify and rectify any unjust outcomes[33]. The use of AI in diagnosing diseases holds great promise for present and future healthcare. By leveraging its advantages, addressing challenges, and ensuring ethical considerations, AI can play a pivotal role in improving the diagnostic accuracy, patient outcomes, and healthcare efficiency.

Comparing the effectiveness of AI and traditional diagnostic methods

In healthcare, AI-based diagnostic technologies, particularly machine-learning and deep-learning algorithms, have attracted substantial interest. These technologies leverage AI's ability to process and analyse massive volumes of medical data, such as imaging, patient records, and other pertinent information. Visual data interpretation, such as through images or videos, presents certain challenges. Experts in the field must train for several years and continuously update their knowledge to stay abreast of new research and information. However, the demand is rising, and the industry requires more expertise. Consequently, innovative solutions are required, and AI appears to be a promising tool for bridging this expertise gap[34].

Strengths, limitations, and integration demands

AI has several advantages in terms of medical diagnosis. One of the main benefits of this method is its capacity to improve diagnostic accuracy. Machine-learning-based AI systems excel in analysing vast amounts of medical data with exceptional accuracy, particularly in radiology[35]. In addition, AI is adept at handling large datasets. It can process an extensive range of healthcare information and provide healthcare practitioners with a wealth of insights for informed decision-making[36]. Another promising aspect is the potential transformation that it offers for the management of neurological disorders, with applications in precision neurology and the development of new protocols. The integration of machine and deep learning into AI has the potential to revolutionise patient care for neurological conditions[37]. However, AI has certain limitations. One notable weakness is the lack of human understanding and judgment. Unlike human decision-making, AI lacks intuitive understanding, clinical judgment, and common sense, potentially leading to errors in decision-making. Dependence on training data also poses challenges. AI machine-learning algorithms can produce biased outcomes if the training data is not diverse and representative[36]. Privacy and security concerns also arise owing to the extensive use of AI, with concerns about data security and privacy, particularly in the absence of suitable measures[35]. Finally, the successful integration of AI into clinical practice demands a deep understanding of medical knowledge and careful incorporation into existing practices.

Bridging the gap

When examining the advantages and disadvantages of employing a traditional approach to medical diagnosis compared with AI methodologies, distinct aspects come to light. The traditional approach for medical diagnosis has several strengths. One key benefit is its strong foundation in science and its adherence to evidence-based practice. This approach combines clinical expertise, patient preferences, and the latest research findings to formulate well-informed decisions regarding patient treatment. Moreover, conventional medicine adheres to a systematic diagnostic process, involving comprehensive evaluations, physical examinations, and advanced medical tools, such as diagnostic imaging and laboratory tests, to establish precise diagnoses[38]. Additionally, traditional medicine excels in managing acute and critical conditions, providing prompt and targeted interventions, such as procedures and medications, to address urgent medical needs[39]. This approach is further fortified by incorporating evidence-based clinical guidelines that guide numerous medical procedures and ensure standardised and appropriate patient care[40].

However, the traditional approach for medical diagnosis has limitations. Diagnostic errors have emerged as a notable drawback leading to delayed or inaccurate diagnoses. The intricate landscape of healthcare, coupled with potential over-reliance on specific diagnostic tests, contributes to diagnostic inaccuracies[39]. Traditional medicine can emphasise symptom management rather than uncovering and addressing the root causes of diseases. This approach might result in patients receiving incomplete holistic care, particularly because it may neglect the intricate interplay between emotional, psychological, and spiritual factors that impact a patient's overall well-being. Another area for improvement is the hesitance to adopt non-conventional or complementary therapies despite mounting evidence of their effectiveness in certain cases. This reluctance can hinder the integration of holistic and innovative approaches into mainstream medical practices[41].

Regulatory and ethical considerations

The regulatory environment for AI-based medical devices and diagnostic tools is undergoing dynamic expansion and transformation[42]. The Food and Drug Administration (FDA) is proactive in supervising AI and machine-learning (AI/ML) software integrated into medical devices. A curated inventory maintained by the FDA highlights over 500 medical devices using AI/ML technologies that have secured FDA approval or clearance. These devices follow various regulatory pathways, including 510(k) clearance, de-novo submissions, and Premarket Approval (PMA) applications[43]. Manufacturers of AI-driven medical devices are urged to remain well-versed in the FDA's guidelines and regulatory updates to ensure compliance with the latest standards. Recognising the fluid nature of AI/ML technologies, FDA's regulatory approach is adapting to accommodate these changes. The traditional paper-based regulatory framework may need to align optimally with the development of AI/ML-enabled medical devices. Furthermore, the USA and EU are witnessing the development of dedicated regulatory frameworks for AI/ML-powered medical devices, although differences might exist between these regions[44].

Given that AI-augmented diagnostics have the potential to optimise the clinical workflow, safeguarding data privacy and obtaining patient consent is of paramount significance. These diagnostic tools rely on extensive patient data, including sensitive medical information. Consequently, stringent measures for data privacy are imperative to ensure the confidentiality of patient information and comply with regulations such as the General Data Protection Regulation (GDPR) in the EU and the Health Insurance Portability and Accountability Act (HIPAA) in the USA[45,46]. Implementing robust data encryption, access controls, and data anonymisation techniques plays a crucial role in minimising the risk of data breaches. Moreover, patient consent is pivotal when integrating patient data into AI-powered diagnostics, and patients should be informed of data usage, potential risks, benefits, and alternatives[4]. Although AI-driven tools provide valuable insights for diagnosis and treatment planning, the ultimate responsibility for interpreting AI-generated results, considering patient-specific variables, and rendering definitive clinical decisions continues to rest with healthcare professionals. Hence, continuous training is crucial for healthcare professionals to effectively collaborate with AI tools, ensuring a solid understanding of the underlying algorithms, potential biases, and limitations. With the potential for AI to streamline specific tasks, healthcare professionals may refocus their efforts on intricate decision-making and nurturing patient interactions. Achieving a harmonious equilibrium between the benefits and complexities of AI incorporation requires meticulous consideration and well-defined ethical guidelines[34,47].

Predictive analytics and AI in preventive healthcare

Recently, AI has transformed our ability to identify individuals susceptible to various diseases and discern subtle indications of illness at an early stage[48]. By combining genetic information, medical history, and lifestyle data, AI tailors preventive measures, facilitating early intervention and screening for individuals with heightened disease risk. AI recognition technology can perform multi-parameter cluster analysis and simplify images, aiding medical professionals in early lung cancer screening[49]. In diagnosing and treating heart diseases, AI techniques have been applied to electrocardiography, vectorcardiography, echocardiography, and electronic health records. Clinical genomics benefits from deep learning, which processes large and complex genomic datasets directly. The process of discovering and developing drugs is both time-consuming and costly. However, the accessibility of cost-effective sequencing and imaging technologies, coupled with the growing availability of large cancer datasets (public or private), has resulted in the exploration of AI to enhance the efficiency of this process[50–52].

AI can analyse healthcare utilisation patterns and predict disease outbreaks, thereby allowing healthcare providers and policymakers to allocate resources efficiently. This prevents a shortage of resources and improves healthcare in critical situations. In the future, AI models that integrate genetic predispositions and EHR, together with lifestyle and environmental factors, may be able to accurately assess cancer risk for a person in near real-time and suggest personalised options for early intervention and appropriate management of risk factors[53]. As AI techniques continue to be refined and improved, it will be possible to help mental health practitioners redefine mental illnesses, identify them at an earlier or prodromal stage when interventions may be more effective, and personalise treatments based on an individual's unique characteristics[54]. Overall, integrating applications into the field of medicine offers many transformative benefits that extend far beyond our current healthcare paradigms, and its capabilities are poised to revolutionise healthcare on a global scale.

Anticipating the future landscape of AI-Driven diagnosis

To effectively utilise the rapid advancements in AI, several countries that support the development of sophisticated technologies are embarking on the formulation of governance frameworks, including legislation, policy, technological guidelines, and standards, serving as preparatory measures as they embrace the imminent AI-driven era. The implementation of AI technology in healthcare has progressed rapidly in many industrialised nations, including China. This progress is attributed, at least in part, to the augmentation of human resources and capabilities, resulting in high-precision medical care. A significant step in this direction was taken by the Food and Drug Administration (FDA), which issued a discussion paper, outlining a regulatory framework for software alterations utilising AI and machine learning (AI/ML) as medical devices (SaMD)[55]. Some instances of prospective AI software for real-world modifications may or may not be aligned with the proposed structure. To date, the FDA has granted complete approval to two AI algorithms that are currently being integrated into clinical trials. The first is IDx-DR, designed to detect diabetic retinopathy (DR), while the second is Viz.AI, which analyses images to identify indicators associated with strokes. These algorithms are characterised as "locked", signifying that their updates are exclusive to the manufacturer. However, the scope of healthcare applications extends beyond these closed algorithms, encompassing a wide array of possibilities. FDA is actively exploring the concept of a system that facilitates the modification of algorithms through real-world learning and adaptation. This endeavour is pursued with the dual objective of ensuring the continual safety and efficacy of the software as a medical device[56]. Notably, there have recently been advancements in AI algorithms that assist in the diagnostic process and typically evaluate individual datasets by relying on textual inputs for analysis. However, a distinct concern arises from the potential limitation of these results to specific domains, potentially rendering them inapplicable to other contexts and yielding accurate outcomes within a limited scope of application.

The unique challenges of current medical practices as well as the vast range of diagnostic techniques have led to difficulties within the healthcare system, prompting the development of new systems dependent on information technology (IT). AI is already playing a role in supporting healthcare professionals and improving the diagnosis of diseases. For instance, it is used in the early detection of ectopic pregnancies and the provision of initial treatment options to gynaecologists[57]. Supervised learning algorithms are those that learn associations by analysing existing samples or training data. As an illustrative example, medical experts categorise images of fractures and ruptures. Inaccuracies or inadequacies in data classification by healthcare professionals can lead to flawed predictions, thereby potentially introducing bias into the trained algorithms. Given its ability to generate robust classification, supervised learning is one of the most widely used AI methods[58,59]. Currently, AI technology, based on machine learning, has several limitations. The foremost limitation pertains to the variability inherent in the examination and detection apparatus employed across various nations, regions, and healthcare facilities. This results in variations in the quality and resolution of acquired images, inevitably exerting an influence on the precision of the image analysis and, consequently, the accuracy of diagnostic outcomes. Addressing this challenge requires standardisation and harmonisation of inspection equipment. However, it is difficult to achieve this. Second, most machine-learning approaches have inadequate training and verification datasets. One promising approach is transferring learning, which entails acquiring proficiency through a sophisticated model trained on data from a voluminous source domain, such as natural images. The model is then fine-tuned using data from the target domain, where only a small number of annotated images, particularly medical images, are available[60]. The third restriction of machine-learning-based AI technology is that it is still unreliable for diagnosing uncommon diseases. Owing to the paucity of these illnesses, there are insufficient instances to fulfil the training and verification criteria. To enhance the detection of uncommon illnesses, machine-learning algorithms must be optimised. Existing machine-learning algorithms for illness diagnosis also lack "explanation capacity," which is the fourth constraint. The output is solely the outcome of training and hard learning. As a result, it is merely a basic assertion based on the discrepancies between sick and normal photographs.

Conclusion

AI has immense potential to revolutionise disease diagnosis and healthcare, propelling the medical field into a new era of accuracy and efficiency. With its ability to analyse vast amounts of data swiftly, AI can assist in early detection, personalised treatment, and informed decision-making. In diagnostics, AI algorithms can analyse medical images such as X-rays, MRIs, and CT scans, identifying subtle anomalies that might be missed by the human eye. This aids in the early detection of diseases, such as cancer, and enables timely interventions to enhance patient outcomes. Moreover, AI can integrate and analyse patient data from diverse sources, aiding in the identification of patterns that can predict disease risk and prognosis. AI's influence of AI extends beyond diagnostics and transforms the treatment approaches. By analysing genetic data and patient histories, AI can tailor treatments according to individual characteristics, maximising effectiveness while minimising side effects. AI-powered virtual health assistants can provide real-time guidance and support to patients, thereby bridging the gap between medical appointments.

The implications of AI in the medical field are both promising and transformative. The ability to process vast amounts of data, detect patterns, and provide insights will lead to more accurate diagnoses and personalised treatments. This will empower medical professionals by offering data-driven recommendations, enhancing decision-making, and reducing errors. However, this integration also raises ethical and regulatory concerns, such as ensuring patient privacy and maintaining human oversight. The healthcare workforce will need to adapt to AI's role, acquiring skills to effectively collaborate with intelligent systems. AI-powered remote monitoring and virtual health assistants can extend medical care to underserved areas. While challenges such as data security and bias mitigation persist, the synergy between AI and medicine holds the potential to enhance patient outcomes, streamline workflows, and revolutionise the entire healthcare landscape.

Ethics approval and consent to participate

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Consent for publication

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Conflicts of interest disclosure

The author, Ali Aamir, declares a conflict of interest as he is currently serving as a reviewer for Annals of Medicine and Surgery.

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1. Name of the registry is not applicable.
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