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Comment

# Artificial intelligence in personalized medicine: transforming diagnosis and treatment

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**Abstract**
The concept of personalised medicine, which adapts care to each patient based on their specific characteristics, has been a long-sought dream in the health field. Artificial intelligence (AI) has made this dream a reality with the advent of technology, promising to enhance diagnosis and cure. AI algorithms, such as machine learning and deep learning, can find patterns and correlations in patient data, such as image recognition for cancer, heart diseases, and neurological disorders. AI can also help in the treatment of diseases by evaluating the patient's response to a particular therapy and selecting the optimal treatment regimen based on the patient's genetic and clinical profile. AI can also help in drug discovery and development, predicting the efficacy and safety of new drugs, identifying targets, and designing clinical trials. However, ethical concerns such as data privacy and the need for stable data management systems are still present. The adoption of AI in the healthcare industry is costly, requiring investment in facilities and personnel, and educating healthcare providers on its use. Collaboration between technologists, physicians, scholars, and regulators is crucial to advance the use of AI in the delivery of personalized medicine, ultimately resulting in better lives for patients worldwide.

**Article Highlights**

- AI algorithms, like machine learning and deep learning, improve diagnostic accuracy using patient data and medical imaging. AI optimizes personalized treatment by selecting therapy based on genetic and clinical profiles, improving patient outcomes, particularly in oncology.
- AI accelerates drug discovery by predicting drug efficacy, designing clinical trials, and identifying potential drug targets.
- AI's potential to revolutionize personalized treatment faces ethical challenges like data privacy, algorithm reliability, and interpretability. Collaboration between technologists, physicians, scholars, and regulators is crucial for advancing AI in healthcare, delivering personalized medicine and improving patient lives worldwide.

**Keywords** Artificial intelligence · Personalised medicine · Drug discovery · Black boxes · Therapy optimisation

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## 1 Introduction

The idea of personalized medicine, which customises treatment to a single patient according to their unique traits, has been a longstanding aspiration in the healthcare sector. Artificial intelligence (AI) has actualized this aspiration through technological advancements, promising to improve diagnosis and treatment. AI has profoundly changed the healthcare sector in terms of diagnosis, treatment, patient care, and accelerated drug discovery [1]. Despite AI's potential to transform personalized care, ethical concerns remain. The aim of this commentary is to elucidate how advancements in AI technologies are transforming the field of personalized medicine, enhancing diagnostics, and personalizing therapy planning, and drug discovery with the goal of improving overall clinical results. This commentary seeks to highlight these points, presenting them all in a single table.

### 1.1 AI in disease diagnosis

Several AI algorithms have been reported to enhance diagnostic efficiency, especially deep learning algorithms and machine learning [2]. The use of data from a patient's history, images, and genetics, as well as other data inputs, AI can find trends and relationships that would not be clear to a clinician. For example, the use of AI in image recognition can assist in identifying slight differences in the image captured through X-rays or MRI for the diagnosis of cancer, heart diseases, and neurological disorders [3]. AI offers a further benefit in the examination and incorporation of the vast volume of data gathered from many sources. By combining genetic information with clinical information, AI can find some biomarkers associated with a specific disease and will help in the precise diagnosis and treatment of the patient [4]. This integration enhances the accuracy of the diagnosis, which can help avoid wrong conclusions and allows for the for the beginning of treatment at an early stage.

Research has investigated the use of AI in the diagnosis of illnesses such as Alzheimer's, cancer, and cardiovascular diseases. Kumar et al. [5] demonstrated that the application of AI in diagnosing these disorders yielded superior outcomes in prediction rate, accuracy, sensitivity, and specificity compared to conventional approaches. The application of AI in healthcare for disease diagnosis across various areas, including disease detection, disease classification, and decision-making processes, has proven crucial, resulting in better treatment selections and ultimately enhancing longevity. AI is being used to improve disease diagnosis. Chen et al. [6] conducted a systematic review and meta-analysis assessing the application of artificial intelligence in the diagnosis, treatment, and outcome prediction of urologic disorders. They indicated that AI possessed greater advantages compared to conventional models and methodologies. They observed a reported AI superiority of 71.8% in diagnostic and outcome prediction [6]. Keenan and his colleagues tested how well retinal specialists could find retinal fluid in spectral domain OCT scans of eyes with age-related macular degeneration. They compared their performance to that of an AI algorithm. Retinal experts exhibited suboptimal accuracy and diminished sensitivity in identifying retinal fluid. This was especially applicable to intraretinal fluid and challenging instances, whereas AI-based detection attained superior accuracy, sensitivity, specificity, and precision [7].

### 1.2 AI in disease treatment

AI is not only helpful in the diagnosis of diseases but also in the treatment of these diseases through the right measures. AI techniques are often employed to evaluate the patient's reaction to a specific therapy and select the optimal treatment regimen depending on the patient's genetic and clinical profile[8]. This can be particularly important in oncology, as AI can assist in selecting the most effective chemotherapy or immunotherapy regimen based on the tumour's genomic characteristics. It can also monitor the patient's reaction to specific treatment and management plans and adjust them to meet the intended goals with minimal adverse outcomes. For example, the AI systems could use the data from the wearable and other digital health records to track the patient's state and recommend changes in the management plan[9]. All these could be seen as a way of achieving treatment optimisation, which can be considered one of the important developments in the field of personalised medicine that can result in enhanced outcomes and an improved standard of living for patients. Recent study underscores the increasing significance of AI in healthcare, especially in radiotherapy and clinical decision-making. AI applications encompass several medical

disciplines, including as cardiology, gastroenterology, and radiology, presenting opportunities for enhancements in disease detection, treatment strategies, and patient outcomes [10, 11].

Technologies of AI such as artificial neural networks (ANN), deep learning models, and support vector machines, have proven useful in disease detection, diagnosis, and therapy optimisation during preclinical and clinical trials [12]. In oncology, AI has effectively analysed genomic data, medication responses, and phenotypes, attaining great precision in personalised treatment strategies [12]. Krittanawong et al. [13] revealed in their clinical trials that the incorporation of AI in cardiovascular care is similarly promising, incorporating insights from oncology. To optimise the advantages of AI in personalised medicine, essential factors encompass the standardisation and aggregation of genetic and health data, the utilisation of multi-modal data, collaboration with disease specialists, scrutiny of AI findings by clinical communities, and extensive clinical trials to corroborate AI-derived insights [14]. These improvements indicate a transition from curative to preventative care paradigms.

In sum, AI has brought about a drastic change in the medical industry in terms of diagnosis, treatment, and the care of the patient. Medical diagnosis applies deep learning models to images like artificial networks (ANN), magnetic resonance imaging (MRIs), computed tomography (CT) scans, and X-rays to detect diseases like cancer, heart diseases, and neurological diseases [15]. AI models use patient data to forecast the onset of the disease, thus facilitating early treatment. AI finds its application in personalised medicine, where it analyses patients' genetic and clinical data to suggest the most suitable treatment regimen. Artificial intelligence-guided robots enhance the accuracy and precision of surgical procedures. Surgical systems like the da Vinci uses AI to improve the accuracy of minimally invasive surgeries, such as those done in the gynaecological and urological areas [16]. These applications demonstrate the growing use of AI in the healthcare industry.

### 1.3 AI in drug discovery

AI is also utilized in drug discovery, which is one of the main aspects of the idea of personalised medicine. Typically, drugs are synthesised through a very long and expensive process, and only a few out of many candidates are successful. Drug discovery can be achieved using AI, where there is the possibility of predicting the efficacy and safety of the new drugs, identifying the targets of the drugs, and even designing the clinical trials [17]. AI can help in genomic studies, clinical trials, and real-world evidence to identify molecules that will have the best chance of succeeding in the clinical development process [18]. Also, it can be applied in choosing patients for clinical trials based on genomics and proteomics to increase the chances of drug effectiveness and shorten the time taken to acquire approval [19]. This acceleration of drug development is crucial in order to deliver the precise therapies that are going to transform medicine. The study of drug function is essential for drug discovery, design, and development. Computational prediction decreases complexity, time, and expenses. Nonetheless, forecasting pharmacological functionalities continues to encounter obstacles. Research on adverse side effects is crucial for medication discovery, development, and creation to improve overall wellness and safety when used. Moreover, the procedures of drugs research, identification, and creation are convoluted, costly, and challenging. It is essential to investigate the adverse impacts of drugs effectively to minimise both expenditure and duration [20, 21].

### 1.4 Ethical concerns

Despite how AI can transform the field of personalised medicine, there are still some ethical concerns that come with it. An important concern that should be mentioned is the issue of data privacy, as the data is collected from different sources and includes patients' personal information [22]. It is necessary to establish stable data management systems to ensure the correct handling of patient data and its protection. AI adoption is costly, requiring investment in facilities and personnel, and educating healthcare providers on its use. Clinicians must learn how to use AI and understand its results, while healthcare organizations must integrate AI into their structures. AI's efficacy in personalized medicine is dependent on the availability of high-quality, comprehensive, and meticulously annotated medical data. Challenges stemming from substandard data quality may encompass missing values, inaccuracies, or biases, potentially leading to erroneous predictions and recommendations [3]. Medical AI algorithms need to be precise and built to work in a variety of patient demographics, medical conditions, and healthcare environments. It is critical to focus on the reliability of AI systems and the potential hazards they may pose, particularly in critical medical applications. Some AI models, particularly deep learning systems, exhibit interpretability issues, leading to their characterisation as "black boxes," which hinders their implementation in clinical practice [23].

In a nutshell, the introduction of AI in the field of personalised medicine may grow greatly as it can increase diagnostic accuracy, treatment choices, and drug development. The application of AI in the delivery of health care services can therefore be utilised to offer specific attention to each patient in order to enhance his or her health status while at the same time reducing costs. Given the trend for future developments in AI in the healthcare industry, it is critical to encourage collaboration between technologists, physicians, scholars, and regulators. Together, we can work towards advancing the use of AI in the delivery of personalized medicine, which ultimately translates to better lives for patients worldwide.

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## Declarations

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**Competing interests** The authors declare no competing interests.



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