***A systematic review***

**Applications of Artificial Intelligence in Clinical Practice and Healthcare (2010–2025)**

**Abstract:** Artificial intelligence (AI) is becoming increasingly important in modern healthcare due to its innovative approaches to diagnosis, therapy personalization, and patient care. This systematic study, which draws on peer-reviewed literature from 2010 to 2025, looks at the current state of AI applications in clinical practice and healthcare. 14 of the 3,476 studies discovered using databases such as PubMed, The Lancet, and Scopus eventually met the inclusion criteria outlined in the PRISMA guidelines. According to the study, AI frequently outperforms traditional diagnostic methods in diseases such as breast cancer, melanoma, diabetic retinopathy, and pneumonia. Artificial intelligence helps clinicians make decisions by forecasting therapy responses based on genetic data and electronic health records. Tools like **CURATE.AI** and **AI-powered warfarin dosing systems** have potential for optimizing drug therapy and improving safety. Furthermore, virtual health technologies improve access and continuity of care, while artificial intelligence-powered predictive analytics identify high-risk patients for chronic diseases and hospital readmissions. Despite its expanding importance, AI integration in healthcare confronts numerous hurdles, including data privacy concerns, ethical consequences, and the need for physician education. The study emphasizes the need for artificial intelligence to enhance, rather than replace, healthcare staff, paving the way for more precise, rapid, and individualized treatment delivery.

## **Keywords:** AI, healthcare technology, machine learning, diagnostics, precision medicine, clinical decision support, virtual health assistants.

## **Introduction**

**A**rtificial intelligence (AI) has become one of the most significant technologies in today's healthcare. As digital health data and enhanced computer capability grow, artificial intelligence is being employed in a variety of clinical settings, from disease diagnosis to assisting clinicians in selecting the optimal treatment for each patient. These technologies not only improve the speed and accuracy of healthcare delivery, but they also help to cut expenses and relieve burden on medical staff.

There are several branches of AI like machine learning (ML) and deep learning (DL) which allow systems to learn from large amounts of data and predict or adjudicate without being programmed to do so. Healthcare can be anything from analysing hundreds of medical images, finding trends within patient records, or even how a patient will respond to a particular drug. For example, AI can sometimes be more accurate than qualified practitioners at detecting ailments such as pneumonia or cancer from medical scans.

AI is increasingly significant in precision medicine, which tailors’ treatment to a patient's genetics, lifestyle, and medical history, in addition to diagnostics. It even assists community health by predicting future health issues based on trends in patient data. Virtual health assistants powered by AI are now being implemented to track symptoms, remind patients to take their meds, and offer general health tips, making care more accessible and continuous.

While there are many advantages to AI, there are obstacles to the use of AI in medicine. These range from maintaining data security, offering transparent and stable algorithms, as well as questioning how the AI tools are incorporated into the clinical healthcare practice. Medical staff training also needs to occur so they can effectively use and implement the technology ethically and successfully.

### **AI in Disease Diagnosis and Prognosis**

AI is also being used to treat chronic and infectious diseases like Clostridium difficile infection, inflammatory bowel disease, and type 2 diabetes. Early diagnosis is aided by AI's ability to gather clinical insights and integrate them into validated, well-trained systems.

For example, the FDA has approved diagnostic software for detecting wrist fractures in adult patients (1). Furthermore, in a study of 1,634 lung tissue photos, AI correctly detected both healthy and cancerous cases and differentiated between two common forms of lung cancer, matching the diagnostic performance of three pathologists (2). In the United States, where more than 6% of the adult population suffers from depression, AI has shown a 74% accuracy rate in detecting major depressive illness using picture heatmap pattern recognition (3).

Several research have demonstrated AI's potential for quick and precise disease diagnosis. Supervised learning approaches have proven to be good at capturing complicated, nonlinear interactions, making them useful tools for multifactorial illness classification. For example, a cohort study of 260 patients found that an artificial intelligence model could detect acute cerebral ischemia more accurately than qualified emergency medical workers (4). Despite constraints, such as noisy data, deep learning approaches can address these issues by lowering data dimensionality via layered auto-encoding methods. For example, AI was successfully used to evaluate over 1,400 histopathology photos of skin tissue in order to detect basal cell carcinoma, with an accuracy greater than 90% when compared to expert diagnosis (5). Similarly, a deep learning model analyzed over 41,000 breast mammograms and correctly classified dense vs. non-dense tissue in 94% of cases, with interpretations that matched radiologists (6).

These advancements illustrate how AI is optimizing clinical practice through enhanced diagnostic precision and facilitating early disease detection, which results in better patient outcomes.

**The development of artificial intelligence.**

Artificial intelligence (AI) has come a long way since its inception, from being an academic niche idea to a transformational force across numerous industries. Siri Essentially, AI aims to create machines with the ability to accomplish tasks traditionally needing human intelligence. These are the domains of natural language processing (NLP), deep learning (DL), and machine learning (ML). The development of Large Language Models (LLMs), which use deep learning methods and enormous datasets to understand, condense, produce, and forecast text-based content, is one notable advancement in this area [7–9].Text generation, translation, summarization, rewriting, classification, categorization, and sentiment analysis are just a few of the NLP tasks that LLMs are made to manage. NLP, which includes methods like text mining, sentiment analysis, speech recognition, and machine translation, is primarily concerned with how computers and human language interact. AI has evolved over time from rule-based systems to the present day, when ML and DL algorithms predominate [7–9].

The beginnings of artificial intelligence (AI) are in 1951 when Christopher Strachey created the first AI program. Until then, AI was mostly an academic endeavor. Modern AI didn't start until 1956, when John McCarthy called the Dartmouth Conference and coined the term "Artificial Intelligence." The majority of AI research in the 1960s and 1970s focused on rule-based and expert systems, which were limited by the available data and processing power. Neural networks and machine learning gained popularity in the 1980s and 1990s, allowing machines to learn from data and gradually get better at what they do. Some notable turning points occurred between 1970 and 1999, such as the 1997 victory of IBM's Deep Blue over world chess champion Garry Kasparov. Computer vision and natural language processing advanced further in the 2000s, leading to the creation of virtual assistants that can understand natural language and react to user inquiries, such as Apple's Siri and Amazon's Alexa [9, 10].

AI has changed sectors such as healthcare, finance, and transport today. AI has made intelligent tutoring systems in education possible, which are attentive to the particular needs of students, improving math and science learning. In research, AI operates on large sets of data to identify patterns outside human reach, leading to genomics and drug discovery breakthroughs. AI finds application in medicine in assisting with diagnosis and tailoring treatments. As AI technology evolves further, it is important that its development is done responsibly and for the good of all [11–14].

### **Trust in Medical AI**

Even as the short-term outlook for Artificial Intelligence (AI) tends to be overly optimistic, long-term possibilities are still staggeringly bright. Significant advances, especially in deep learning and machine learning, are propelling the adoption of AI across many spheres, such as e-commerce, aviation, war, and more importantly medical diagnosis. These have been fueled by unprecedented investment and desire to go beyond narrow AI to Artificial General Intelligence capable of passing the Turing Test for everyday human jobs.

Even though neural networks perform exceptionally well, they frequently function as "black boxes." For example, even though they use gradient descent to optimize weights and biases in each iteration, the details of such detailed adjustments are often obscured by the complexity of understanding how these algorithms operate.

Such transparency is particularly required in healthcare, where decisions on treatment have a direct impact on patient outcomes. Errors in diagnosis or AI system treatment recommendations can be lethal. To address such challenges, Explainable Artificial Intelligence (XAI) has emerged as a specialized field that aims to interpret and justify AI model behavior.

Explainable Artificial Intelligence (XAI) introduces algorithms and frameworks that provide explanations into AI model reasoning. Transparency of this sort in healthcare is necessary to enhance trust among clinicians. Local Interpretable Model-Agnostic Explanations (LIME) and SHapley Additive exPlanations (SHAP) are some of the tools that have been part of this initiative. These models serve to explain which input features contributed most significantly to a specific prediction, therefore making AI outputs more interpretable and trustworthy [15-18].

### **The purpose of the study**

This systematic review seeks to offer a comprehensive outline of artificial intelligence applications in healthcare and clinical practice. It synthesizes and examines studies from the past fifteen years to gain insight into the application of AI, the benefits it offers, and the problems that persist. The goal is to assist healthcare professionals, researchers, and policymakers in gaining a deeper insight into the state of AI in medicine and how it may influence the future of patient care.

## **Materials and Methods**

According to the Preferred Reporting Items for PRISMA (Systematic Reviews and Meta-Analyses) guidelines this review was conducted. In order to ensure transparency and reproducibility in the selection and analysis of studies (19). The objective of this review was to compile peer-reviewed research on the applications, impacts, and challenges of artificial intelligence (AI) in clinical practice and healthcare settings.

### **Search Strategy**

Using electronic databases such as PubMed, The LANCET, and Scopus, a thorough literature search was conducted. The search covered articles published from 2010 to 2025.

### **Eligibility Criteria**

Inclusion criteria consisted of Peer-reviewed journal articles and studies published in English, mainly focusing on the application of AI technologies in healthcare settings or clinical practice.

Exclusion criteria involved non-peer-reviewed literature, publications written in languages other than English, and any research not specifically related to healthcare or the clinical use of AI.

### **Study Selection and Data Extraction**

Abstracts and titles were independently screened by two reviewers. Articles with potentially pertinent full texts were evaluated for eligibility. Data extracted included: author(s), year of publication, study design, AI technique used, healthcare application.

## **Artificial Intelligence assistance in diagnostics**

**Effective diagnosis**

Effective disease diagnosis is still seen as a difficulty globally, despite all of the advancements in medicine. The intricacy of the different disease mechanisms and the underlying symptoms makes the development of early diagnostic tools a constant challenge. AI has the potential to transform many facets of healthcare, including diagnosis. Machine learning (ML) is a branch of artificial intelligence that employs data as an input resource. It can overcome some of the difficulties and complexity of diagnosis because accuracy depends heavily on the quantity and quality of the input data (20).

In healthcare systems, machine learning and deep learning are very useful for disease, diagnosis, prediction and classification. To put it briefly, ML can help with decision-making, workflow management, and timely and economical task automation. In order to help find patterns in the data, deep learning also added layers using Convolutional Neural Networks (CNN) and data mining techniques. These are quite useful for finding important patterns in large datasets for illness identification (21).

In a South Korean study, researchers compared AI and radiologists' diagnoses of breast cancer. Compared to radiologists, the AI-utilized diagnosis had a 90% sensitivity rate for detecting breast cancer with mass, compared to 78% for radiologists. Additionally, AI detected early breast cancer 91% more accurately than radiologists 74% (22).

In addition, one study used deep learning to identify skin cancer and suggest possible treatments. This study showed that, in comparison to dermatologists, an AI utilizing CNN correctly diagnosed cases of melanoma (23, 24). Clinicians and radiologists can diagnose pneumonia with the use of computer-aided diagnostic (CAD) techniques. Numerous studies have examined deep learning (DL)-based techniques as an underlying CAD technology for the diagnosis of pneumonia (25, 26).

### **AI role in Clinical Practices**

### **AI assistance in precision medicine & clinical decision support**

Precision medicine, also known as personalized treatment, adjusts medical care for each patient according to their particular genetics, environment, lifestyle, and biomarkers (27).

By using safe, efficient, and focused interventions, this customized approach seeks to enhance patient outcomes. By evaluating intricate datasets, forecasting results, and refining tactics, AI facilitates individualized care (27, 28). It demonstrates precision medicine's broad potential [29]. Real-time suggestions, however, depend on sophisticated machine learning algorithms that forecast drug requirements using genomic information. Preemptive genotyping is necessary to customize medications and dosages [29, 30]. The response to chemotherapy was accurately predicted in a study by Huang et al. that used patient gene expression data to construct a support machine learning model (31).

The authors used the gene-expression patterns of 175 cancer patients in this study to forecast how the patients would react to different standard-of-care chemotherapy treatments. Interestingly, the study produced promising results, with a prediction accuracy of more than 80% for a variety of medications. These results show how promising AI is for predicting therapy response. In a different study, Sheu et al. used AI and 17,556 patients' electronic health records (EHR) to forecast how each patient would react to various antidepressant classes (32).

### **Therapeutic drug monitoring & Dose optimization**

In order to improve patient safety and treatment results, AI is essential for dose optimization and adverse medication event prediction (33). Healthcare professionals can lower risks and enhance patient care by using AI algorithms to forecast possible adverse drug events and optimize medicine dosages for specific patients. In a study that sought to create a decision support system for optimizing the dosage of warfarin maintenance and an AI-based prediction model for the prothrombin time international normalized ratio (PT/INR) (34). The algorithm led experienced physicians with significant differences in forecasting future PT/INRs, and the generated personalized warfarin dose was reliable, according to the authors' study of data from 19,719 inpatients across three institutions. In contrast, a new dose optimization technology called CURATE. AI is an artificial intelligence-powered tool that leverages patient data to dynamically tailor chemotherapy dosing (35). In order to validate this method as an open-label, prospective trial, three distinct chemotherapy regimens were administered to patients with advanced solid tumors. Based on the relationship between tumor marker readouts and variations in chemotherapy dosage, CURATE.AI produced customized dosages for ensuing cycles. In comparison to the standard of care, the successful integration of CURATE.AI into the clinical workflow demonstrated potential advantages in terms of lowering chemotherapy dosage and enhancing patient response rates and durations.

### **AI role in population health management**

Predictive analytics are being used more and more in population health management to pinpoint and direct health interventions. Predictive analytics is a branch of data analytics that makes extensive use of AI, ML, data mining, and modelling. It examines both recent and historical data to predict the future (36, 37).

To enhance patient outcomes and minimize expenses, data is analyzed, and predictive models are created using machine learning algorithms and other technologies. Finding people who are at risk of acquiring chronic illnesses like heart or endocrine disorders is one area where predictive analytics can be very helpful. Predictive models can identify individuals who are more likely to develop these disorders and target actions to prevent or treat them by analyzing data such as medical history, demographics, and lifestyle factors (36).

Predicting hospital readmissions is another area where predictive analytics can be applied. By analyzing patient demographics, medical history, and social health factors, predictive models can identify patients at higher risk of hospital readmissions and target interventions to prevent readmissions (Fig. 1) [38–39].



Fig:1 Using AI-Powered Predictive Analytics to Unlock the Potential of Patient Data

### **Assistance with AI in virtual healthcare**

In environments with limited resources, digital health technologies and mHealth platforms are being embraced more and more as innovative ways to maximize resource use and enhance healthcare access. (40). Through the use of AI-powered technologies like chatbots, voice interfaces, and mobile applications, virtual health assistants (VHAs) are revolutionizing healthcare by assisting experts (41). In order to provide individualized care, these assistants mimic human communication by monitoring vital signs, assisting patients with identifying symptoms, giving medical advice, scheduling appointments, reminding patients of their medications, and gathering and sharing daily health data with doctors, which reduces the workload of healthcare providers and improves patient outcomes (42). AI-driven apps can also evaluate patients based on symptoms; for example, the NHS tried one in North London, and 1.2 million people use this currently as an alternative to contacting the non-emergency number. VHAs provide 24/7 accessibility and enhance access to healthcare (43).

## **Results**

A total of 3,476 articles were initially identified through database searches. After removing duplicates and screening titles and abstracts, 256 full-text articles were assessed for eligibility. Following detailed evaluation, 14 studies met the inclusion criteria and were included in this review. The findings have been grouped into several key areas based on how AI is used in practice.

**1. AI in Diagnostics**

AI technologies, especially machine learning (ML) and deep learning (DL), have shown significant potential in enhancing diagnostic accuracy. For example, in a study conducted in South Korea, AI demonstrated a higher sensitivity (90%) in detecting breast cancer compared to radiologists (78%) (22). Similarly, early breast cancer was identified more accurately by AI (91%) than by radiologists (74%).

Other studies demonstrated the ability of deep learning models, such as Convolutional Neural Networks (CNNs), to detect skin cancer (melanoma) with accuracy comparable to experienced dermatologists (23, 24). Numerous studies have examined deep learning (DL)-based techniques as an underlying CAD technology for the diagnosis of pneumonia (25, 26). These findings support AI's ability to improve diagnostic accuracy, particularly in image-based assessments.

**Table 1: Diagnostic Performance of AI vs. Radiologists**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Condition** | **Diagnostic Method** | **Sensitivity (%)** | **Specificity (%)** | **Reference** |
| **Breast Cancer (Mass)** | AI | 90 | - | 4 |
| **Breast Cancer (Mass)** | Radiologists | 78 | - | 4 |
| **Early Breast Cancer** | AI | 91 | - | 4 |
| **Early Breast Cancer** | Radiologists | 74 | - | 4 |
| **Skin Cancer (Melanoma)** | AI (CNN) | Comparable to dermatologists | - | 5, 6 |

**2. AI in Precision Medicine and Decision Support**

AI tools are being applied to develop personalized treatment strategies by analyzing patient genetics, biomarkers, and lifestyle data. In one study, researchers used gene expression data from 175 cancer patients to predict responses to chemotherapy using a support vector machine, achieving over 80% accuracy for several medications (31).

Another study by Sheu et al. analyzed the electronic health records (EHR) of 17,556 patients to predict individual responses to different classes of antidepressants, demonstrating AI’s capability in personalized therapy planning (32).

**3. Drug Monitoring and Dose Optimization**

AI also plays a key role in drug monitoring and dosage customization. A study focused on warfarin dosage optimization using AI-based prediction models for PT/INR values showed that the AI system could reliably guide dose adjustments across data from 19,719 inpatients helping physicians adjust to doses more accurately (34). Similarly, CURATE.AI, an AI-driven platform, was successfully used in a clinical trial to personalize chemotherapy doses for patients with advanced solid tumors. The system optimized doses in real-time based on tumor marker trends, improving patient response and reducing drug toxicity (35).

**4. Population Health Management**

In the field of population health, AI-driven predictive analytics was used to identify individuals at risk for chronic conditions such as cardiovascular and endocrine disorders. By analyzing historical and demographic data, these tools can identify patients at high risk of conditions like cardiovascular disease and type 2 diabetes and enable early interventions (36, 37).

AI also helped predict hospital readmissions by incorporating factors like patient history, medical records, and social determinants of health, aiding in the development of preventive strategies and also help healthcare providers to initiate early interventions. (38, 39).

**5. AI in Virtual Healthcare**

Virtual health assistants (VHAs), powered by AI, are increasingly supporting both patients and healthcare providers. These systems can interact with users through chatbots and mobile apps to provide medical advice, symptom tracking, appointment scheduling, and medication reminders (41, 42). For instance, the NHS in North London piloted an AI chatbot that is now used by over 1.2 million people as an alternative to the traditional non-emergency helpline (43). VHAs not only improve access to care but also reduce the administrative burden on clinical staff, allowing human resources to focus on more complex cases.

**The results** of the study show that artificial intelligence (AI) is having a significant impact on healthcare by allowing doctors to diagnose diseases better and more quickly. For example, AI outdid radiologists at detecting breast cancer and pneumonia from medical images. It also helped patients personalize their treatments by predicting how they would respond to specific drugs based on their genetics and health information. AI tools were useful for safely adjusting medication doses, identifying people at risk of chronic diseases, and even providing virtual healthcare via chatbots and apps. Overall, AI is proving to be an effective tool for assisting healthcare workers and improving patient outcomes.

## **Discussion**

This systematic review highlights the growing impact of artificial intelligence (AI) in healthcare and clinical practices over the past 15 years. The findings suggest that AI technologies, especially machine learning (ML) and deep learning (DL), are becoming increasingly reliable tools in supporting clinical decision-making and improving patient outcomes.

AI has shown impressive performance in diagnostic applications, with multiple studies reporting accuracy levels that meet or even exceed those of experienced clinicians. From detecting breast cancer with higher sensitivity to accurately identifying conditions like melanoma, diabetic retinopathy, and pneumonia, AI is clearly transforming the way diseases are diagnosed. These technologies not only improve diagnostic precision but also speed up the process, which is critical in time-sensitive medical scenarios.

Beyond diagnosis, AI plays a pivotal role in advancing personalized medicine. Studies included in this review demonstrated how AI can analyze genomic data and electronic health records to predict individual responses to treatments such as chemotherapy or antidepressants. This has the potential to reduce trial-and-error in treatment plans and improve patient outcomes.

In therapeutic monitoring, AI helps to tailor drug dosages, minimize adverse effects, and optimize overall treatment strategies. Tools like CURATE.AI and AI-based warfarin dosing systems have shown encouraging results in clinical settings, suggesting a move toward safer and more effective treatment planning.

Moreover, AI-powered predictive analytics are making it possible to identify individuals at risk of chronic diseases or hospital readmission. This proactive approach can reduce long-term healthcare costs and enable earlier interventions. Similarly, virtual health assistants (VHAs) are becoming valuable in extending access to healthcare, especially in resource-limited settings, by providing 24/7 patient support and easing the burden on healthcare providers.

Despite the many benefits, this review also recognizes ongoing challenges. Data privacy, ethical concerns, algorithmic transparency, and integration into existing clinical workflows remain key obstacles. According to the WHO, the integration of AI in healthcare must prioritize transparency, data governance, and accountability to ensure ethical use and public trust. (44) There is also a need for standardized regulations and training for healthcare professionals to ensure AI is used responsibly and effectively. Regulatory bodies like the FDA have started creating frameworks to guide the safe and effective use of AI-based tools in medicine, emphasizing continuous learning and monitoring. (45)

This review has a few limitations, first of all only 14 studies were included which doesn’t represent the full range of AI applications. It focuses mainly on published English articles. It excludes articles from other languages. Another limitation is that the study did not conduct a meta-analysis, which could have given statistical support to the findings.

## **Conclusion**

Artificial intelligence is changing the face of modern healthcare by improving diagnostics, allowing for individualized therapy, optimizing medication regimens, and boosting virtual care. The research in this review supports the concept that AI may supplement and improve clinical practice rather than replace it. However, to fully realize its potential, challenges around implementation, data governance, and clinician readiness must be addressed. As AI continues to evolve, its thoughtful integration into healthcare systems will be essential for building a more efficient, accurate, and patient-centered future in medicine. ‘As Topol (2019) emphasized, AI in healthcare should augment human capabilities, making care more compassionate, personalized, and effective rather than depersonalizing it.’ (46)

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