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RESEARCH ARTICLE

JOURNEY OF ARTIFICIAL INTELLIGENCE (AI) IN HEALTHCARE: AN ANALYSIS

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ABSTRACT

Artificial Intelligence (AI) is revolutionising healthcare by enhancing patient care, diagnosis, treatment, and management. This paper explores the diverse applications of AI in health systems, highlighting its potential to improve efficiency, accuracy, and patient outcomes while addressing the associated challenges. AI technologies such as machine learning, natural language processing, and computer vision enable the analysis of vast healthcare data for predictive analytics, personalised medicine, and disease prevention. These tools support clinicians in diagnosing and predicting diseases swiftly and accurately.Applications like virtual health assistants and predictive modelling are fostering more patient-centred care across various healthcare settings. Beyond clinical care, AI is accelerating medical research and drug development by analysing genomic data, identifying biomarkers, and modelling drug interactions, including repurposing existing drugs to address emerging health threats. Despite its promise, AI implementation faces ethical, legal, and data privacy challenges. Ensuring reliability and safety demands ongoing interdisciplinary collaboration, transparency, and rigorous evaluation of AI systems. Addressing these barriers is critical to harnessing AI's full potential and integrating it responsibly into healthcare.

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INTRODUCTION

What is already known on this topic**:** AI is transforming healthcare by improving diagnostics, treatment personalization, and operational efficiency. However, challenges such as data privacy, ethical concerns, and regulatory gaps limit its full integration. What this study adds**:** This study identifies AI's role in enhancing clinical decision-making and drug discovery while highlighting critical barriers such as technological limitations and workforce readiness.
How this study might affect research, practice, or policy**:** Findings underscore the need for strong regulations, ethical frameworks, and improved digital infrastructure. Policymakers should ensure equitable AI adoption, while research should address algorithm bias, data security, and public trust.

Objectives

- To explore the applications of AI in healthcare.
- To understand the trends of AI in Healthcare.
- To identify the challenges encountered in incorporation of AI in healthcare

The rationale for conducting this study stems from its transformative potential in enhancing diagnostic accuracy, personalizing treatments, and optimizing operational efficiency. While AI has demonstrated significant benefits, its full integration into healthcare systems remains limited due to various challenges. Existing research predominantly focuses on AI's advantages, with comparatively less emphasis on the barriers hindering its widespread adoption.

Addressing these obstacles is crucial to ensuring the effective and equitable use of AI in clinical practice. Furthermore, AI raises critical policy and ethical concerns, including data privacy, algorithmic bias, and regulatory frameworks, which must be carefully navigated to build trust and transparency in AI-driven healthcare. Additionally, AI has the potential to improve healthcare systems by streamlining administrative tasks, optimizing resource allocation, and supporting medical decision-making, ultimately leading to better patient outcomes and cost effective care. By systematically analysing AI's role in healthcare, this study aims to provide a balanced perspective on both its opportunities and challenges, offering insights that can guide policymakers, healthcare professionals, and researchers in fostering AI-driven innovations for a more efficient and inclusive healthcare system

METHODOLOGY

This research employed a systematic literature review methodology to explore the current landscape of AI in healthcare.

Data Sources: We primarily focused on three reputable academic databases:

Scopus: A comprehensive database indexing peer-reviewed journals across various disciplines, including medicine and health sciences.

PubMed: A bibliographic database maintained by the National Institutes of Health (NIH), providing access to biomedical and life sciences literature.

Springer Link: A platform offering access to journals and books published by Springer, a leading publisher in scientific and technical fields.

Search Strategy: A comprehensive search string was developed using relevant keywords and Boolean operators (AND, OR, NOT) to identify pertinent literature. The search terms included:

"Artificial intelligence" OR "AI"
"Machine learning" OR "Deep learning"
"Healthcare" OR "Medicine" OR "Clinical"
"Diagnosis" OR "Treatment" OR "Prognosis"

We limited the search to articles published in English within a specific timeframe (e.g., past five years) to ensure the most current information.

Inclusion and Exclusion Criteria

Articles were included if they

- Presented original research or comprehensive reviews on AI applications in healthcare.
- Were published in peer-reviewed journals indexed by the aforementioned databases.
- Were written in English and published within the defined timeframe.

Exclusion criteria included

- Articles focusing on non-healthcare applications of AI.
- Editorials, commentaries, or letters to the editor.
- Conference proceedings or abstracts without full papers.

Data Extraction and Analysis

Using a pre-defined data extraction form, relevant information was extracted from the selected articles. This included:

- Author(s) and publication year
- Study type (e.g., case study, randomised controlled trial)
- Specific AI application (e.g., image analysis, drug discovery)
- Reported outcomes and findings

The extracted data was then analysed thematically to identify key trends, emerging applications, and potential challenges related to AI in healthcare. This may involve qualitative coding techniques to categorize the findings and identify recurring themes across the studies.

Introduction to artificial intelligence: AI, or artificial intelligence, encompasses the discipline and practice dedicated to crafting intelligent systems. Its essence lies in crafting algorithms or rule sets that empower computers to mimic human cognitive functions, including learning and problem-solving. “AI, or artificial intelligence, encompasses the capacity of computers to engage in cognitive activities such as thinking, perceiving, learning, problem solving, and decision making.” The power of artificial intelligence (AI) resides in its ability to discern patterns and connections within extensive, multidimensional, and multimodal data sets. As an example, AI systems can condense a patient's entire medical history into a singular value, indicating a likely diagnosis.[1]Fundamentally, artificial intelligence (AI) seeks to replicate human cognitive processes and use them for a variety of tasks, such as data processing and robotics. The idea of artificial intelligence (AI) has its roots in ancient myths and folklore, which describe artificial creatures with intelligence like to that of humans. The current era of artificial intelligence, however, started in the middle of the 20th century thanks to the ground-breaking work of innovators like John McCarthy, who first used the phrase "artificial intelligence" in 1956, and Alan Turing, who suggested the Turing Test as a gauge of a machine's intelligence. Since then, advances in computing power, algorithms, and data availability have led to a considerable evolution in artificial intelligence.[2]

Types AI relevant to healthcare:

Machine learning: Is a statistical technique employed to educate models using data. in order to fit them to the data and acquire knowledge. Machine learning is a prevalent type of artificial intelligence. ML is a widely applicable technology which forms the foundation of various AI systems, with numerous variations available. In healthcare, conventional machine learning is predominantly employed for precision medicine applications. Precision medicine entails forecasting the optimal treatment strategies for patients by considering their individual characteristics and treatment circumstances. Most applications of machine learning in precision medicine depend on a training dataset in which the resultant factor, like the onset of an illness, is pre-established. This form of machine learning is termed supervised learning.[2]

Natural Language Processing (NLP) systems have the capability to examine unstructured clinical records of patients, create reports (like those concerning radiological tests), transcribe patient interactions, and enable conversational AI. Within healthcare field, NLP is mostly used for tasks like as generating, comprehending, and categorizing clinical records and published scientific studies.[2]

Surgical robots initially approved in USA occurred in 2000.These robots enhance surgeons' capabilities by allowing them to have improved vision, perform precise and minimally invasive incisions, and suture wounds, among other functions. Nevertheless, crucial determinations are still carried out by human surgeons. Robotic surgery is commonly employed for gynaecologic surgery, prostate surgery, and head and neck surgery.[3]

Artificial intelligence holds the capacity to greatly enhance patient care while simultaneously reducing medical costs. As the population increases, there is an expected increase in the need for health services. In order to enhance the efficacy and efficiency of the healthcare industry without incurring additional costs, novel approaches are required.[3]

History of Artificial intelligence?

Global history: In the 1980s, the healthcare field saw the birth of expert systems, which intended to duplicate the decision-making powers of human specialists in specific domains. These systems came into prominence in the decade. These systems served Diagnostic purposes, which provided insights and recommendations based on the data sent to them. Although the phrase "artificial intelligence" was first used in 1955, the use of AI in medicine began to appear in the early 1970s.In the early 1970s, several groups created computational models to aid clinical decision-making and problem-solving. At Stanford, the MYCIN rule based system was developed to assist with infectious disease therapy. Rutgers introduced the CASNET Causal Associational NETwork model for glaucoma consultations. Pittsburgh's DIALOG (later renamed INTERNIST) system was designed for differential diagnosis in internal medicine. Meanwhile, MIT and Tufts developed the PIP (Present Illness Program) to facilitate diagnosis-driven clinical data acquisition. AI has been employed in the medical field from as early as the 1950s, when doctors first began using computer-aided programs to improve their diagnostic processes. This is not surprising considering the extensive, ever-evolving, and rapidly expanding capabilities of AI. [4]
In 1986, the University of Massachusetts introduced DXplain, a decision support system.This tool utilises user-inputted symptoms to build a comprehensive list of potential diagnoses, known as a differential diagnosis. Furthermore, it functions as a digital medical textbook, offering comprehensive explanations of illnesses and supplementary sources. Upon its initial version, DXplain had the capability to furnish information regarding roughly 500 ailments. Since then, it has grown to encompass more than 2400 disorders. In the later period of 1990s, there was a renewed enthusiasm for machine learning,predominantly in the domain of healthcare. This

coupled with the aforementioned advances in technology, laid foundation for the current area of AI. .[5]

History in Indian context: The advancement of artificial intelligence inside India's health system has been characterized by a fragmented and disjointed approach. Under the Digital India Initiative, the Government of India plans to grant funds for the advancement of newly developing technologies such as Artificial Intelligence. Aravind Eye Hospital, located in Madurai, Tamil Nadu, was the first to introduce artificial intelligence (AI) in Indian healthcare. They utilised AI-powered tools to detect eye disorders such as diabetic retinopathy at an early stage. Machine learning algorithms were employed to analyse retinal pictures and detect indications of diabetic retinopathy, facilitating prompt intervention and treatment. Then, Indian Institute of system Bombay supported the development of a start-up called Matra Technology. This start-up created a mobile-based artificial intelligence system called Naima, which helps to decrease the chance of pregnancy.[20]The utilization of smartphone-based technologies for anthropometry assessments has the potential to enhance the health of mothers, newborns, and children. This device enhances the ability of frontline health workers to accurately detect low birth weight infants. [6] LiveHealth is a firm based in Pune that was founded in 2013. The system provides a Management Information System (MIS) specifically designed for healthcare professionals. The process involves collecting samples, arranging and examining patient data, producing reports, managing billing, and maintaining inventory records. Artificial intelligence enhances the process by making it intelligent and efficient, as it has the capability to manage large volumes of data and ERP transactions. [6] In 2016, Niramai Health Analytics, a company located in Bangalore, created a cost-effective and non-invasive method for detecting early-stage breast cancer. This method involves using artificial intelligence to analyse body heat patterns.

Another device is the Keyar, a non-invasive tool used for keeping a track of heart rhythms of foetus and measures contractions of uterus in expectant mothers. This compact, user-friendly device requires no surgical procedures, making it ideal for use in remote rural areas.[6]
SigTuple, a firm based in Bangalore, specializes in developing intelligent solutions that utilize Artificial Intelligence to analyse visual medical data and assist in diagnosis.(http://sigtuple.com/)
The application of artificial intelligence (AI) has proven to be advantageous in tackling the COVID-19 situation in India. This emerging technology is valuable for surveillance of the pandemic, identification of COVID-19 cases, containment of the virus, identification of contacts, enforcement of social distancing and quarantines, tracking of individuals under suspicion, treatment and remote monitoring of COVID-19 patients, development of vaccines and medications, and various other applications. According to PwC India's global study, India had a significant surge in the adoption of artificial intelligence during the COVID-19 pandemic.[7] In order to raise awareness of COVID-19 and give people access to real-time updates, the Government of India launched MyGov, the largest citizen engagement platform in the world, in collaboration with a firm called Amplify.ai that specializes in conversational AI technology. Inquiries about pertinent matters and clarifications on COVID-19 can also be made by residents through the Chabot or virtual assistant. Watson Assistant is an AI-powered query answering system that the Indian Council of Medical Research (ICMR) and tech giant IBM have integrated into their portal. In testing and diagnostic centres around India, front-line staff and data entry operators ask questions about COVID-19, and the Watson Assistant answers
them. [7]

Opportunities to use AI in the healthcare are as follows: Presently, artificial intelligence systems do not possess the capacity to engage in thinking at a comparable level to doctors, who can depend on their "clinical intuition and experience" or "common sense." Artificial intelligence utilizes algorithms to identify and analyse patterns within datasets, much like a signal translator. Healthcare firms are increasingly adopting AI solutions to streamline time-consuming and repetitive tasks. Furthermore, significant efforts have been dedicated to demonstrating the potential of AI in achieving accurate diagnoses, particularly in the fields of radiotherapy planning and diabetic retinopathy.[7] The healthcare industry in India has a lot of potential for artificial intelligence (AI), which is expected to boost the country's GDP by USD 957 billion by 2035.In addition, the Government of India (GOI) is offering incentives to encourage the growth of artificial intelligence (AI) in the medical sector. In addition, state governments are offering financial assistance to entrepreneurs. The government of Karnataka, an Indian state, has initiated a campaign to generate INR 2000 crore (about $300 million USD) by 2020 to support the healthcare industry in using artificial intelligence. The Karnataka government has previously endorsed a comprehensive program specifically designed for AI start-ups.India's healthcare industry has significantly improved as a result of the incorporation of AI. It has made a significant contribution to cost, efficiency, quality, and other areas. AI-integrated healthcare efforts are being sincerely promoted by several stakeholders in India, including the Prime Minister's Office and FICCI.[8] The TCS worldwide survey report (TCS, 2017) emphasizes that while AI may lead to job reductions, the introduction of new AI integrated healthcare initiatives in organizations could also result in the creation of new job opportunities. [32] According to a survey conducted by Accenture, the implementation of artificial intelligence in health industry is projected to result in cost savings of USD 150 billion in the United States. Additionally, it is expected to contribute to a sector growth of USD 6.6 billion by 2021 in the United States. (Accenture, 2017).

In contemporary healthcare settings, healthcare professionals must engage in collaborative teamwork, necessitating effective communication, collective decision-making, coordinated efforts, and ongoing assessment of progress. AI chatbots can effectively handle tasks related to scheduling and coordinating medical visits, sending reminders, and updating healthcare practitioners on a patient's condition based on symptoms. The medical services sector gained significant advantages as a result of the widespread use of AI-driven technologies, resulting in a multitude of fresh opportunities. In this context, we shall examine a few of the noteworthy ones:

- The introduction of Watson by IBM marked a key achievement in the age of driven by data medical studies, sparking broad curiosity about the possibilities of cutting-edge computers to improve public wellness and enhance the standards of care given to patients. [9]
- Active patient engagement in the healthcare process is crucial for accurate diagnosis of illnesses and preserving patient safety. In addition, people perceive their active participation in discussions with healthcare providers as advantageous and pleasurable for their own advantage. Boulding et al. found that patients who have a positive experience of their involvement in the treatment process had a beneficial effect on the treatment outcome and the safety of the patients. Hence, in order to enhance the quality of care, healthcare professionals should prioritize patient involvement and participation as a strategic objective to enhance the patient experience.[9]
- Enhanced Physician Error Reduction and Quality of service:

In China, doctors who employed artificial intelligence (AI) during colonoscopy examinations identified an additional 20% of polyps compared to their counterparts who did not apply AI. The AI-assisted method can identify minute (5 mm or less) or initial-stage polyps that are frequently missed by GI specialists during colonoscopy procedures.It is highly anticipated that AI will predominantly replace radiologists, who are widely recognized as the medical professionals most susceptible to being displaced. This prognosis is based on the observation that although a radiologist can interpret 50-100 X-rays every day, an AI-assisted system has the ability to evaluate a significantly larger number of photos, ranging from 10 to 100 times more. Moreover, the AI system demonstrates superior accuracy in comparison to radiologists. Thus, when the AI system improves the job of radiologists, doctors can utilize the time saved by the AI system to participate in more congenial and meaningful discussions with patients, thereby enhancing the quality of treatment delivered. In

addition, via the use of artificial intelligence (AI) to extract more accurate data, medical professionals can take pre-emptive measures to prevent potential medical errors.[10] 4. AI-powered health tracking technologies can provide timely care for the elderly. It allows healthcare professionals to provide patient care outside of normal office hours and promotes self-care. For instance, the utilization of sensor technology can streamline the process of self monitoring for those suffering from heart failure by employing user-friendly hardware.Various health-related technologies have the ability to oversee lab tests for healthcare providers and learners. Inexperienced surgeons might employ a virtual reality simulator to train and refine their techniques in a controlled and secure setting. This simulator allows individuals to anticipate and consider all potential results, leading to the creation of precise and safe surgical techniques. Furthermore, AI is employed for the purpose of overseeing processes, scrutinizing photographs, executing robotic surgery, aiding virtual assistants, and offering assistance in clinical decision-making.[11]

Artificial intelligence is employed in customized health care and statistical analysis to identify illnesses at their infancy and monitor their progression, resulting in enhanced patient outcomes and reduced healthcare costs. Furthermore, AI can assist in the advancement of healthcare research and innovation by facilitating the development of novel treatments. Artificial intelligence (AI) has the potential to greatly enhance the efficiency and effectiveness of patient care, offering numerous unique opportunities for deployment. For instance, predictive analytics can be employed to identify patients who are susceptible to developing issues and forecast the probability of deterioration in the patient. [12]

Pharmaceutical manufacturing: Intelligent technology has the potential to greatly enhance the productivity and efficacy of the pharmaceutical manufacturing process. One specific approach is virtual screening, which is a method that can evaluate large amounts of data on medication interactions and identify new treatment targets.
Artificial intelligence is being employed to improve the overall satisfaction of patients. Alder Hey youngsters' Hospital in Liverpool is partnering with IBM Watson to create a 'cognitive hospital' that will include an application to improve communication with youngsters. The app's objective is to identify patient concerns before a visit, provide relevant information as necessary, and equip clinicians with the essential data to deliver appropriate treatments. [11]
NITI Aayog is partnering with Microsoft and Forus Health to conduct a pilot project that aims to explore the use of artificial intelligence (AI) for the early detection of diabetic retinopathy. A proposal is made to include artificial intelligence (AI) capabilities into Forus Health's portable device '3Nethra' by employing Microsoft's retinal imaging application programming interfaces (APIs). This integration aims to provide AI-driven insights in rural and remote areas with restricted access to cloud services. [12]

Applications of AI in healthcare: Artificial intellect (AI) has the potential to completely transform the medical field in various ways. It possesses the capacity to convert large amounts of medical records into useful information, improve the surveillance of public health, accelerate health treatments, and offer more efficient, faster, and more targeted development and research. AI applications have assisted doctors and healthcare providers in several domains, including electronic health records, the geocoding information about health, pandemic and syndromic surveillance, model based prediction and support of decisions, and medical imaging, due to their sophisticated algorithms and deep learning abilities. An AI system has the capability to continuously offer health professionals with up-to-date medical knowledge from a variety of sources, such as journals, textbooks, clinical practices, and patient data. This information can be used to enhance the quality of patient care and facilitate accurate deductions for health risk notification and health outcome forecasting. The application of AI techniques is prevalent in three primary medical specialties: cardiology, neurology, and oncology. Out of all medical specializations, radiology and radiation are the fields that can utilize AI technology at the most sophisticated level. AI-based Radiomics is a developing discipline that involves the thorough measurement of tumour properties by employing many quantifiable imaging characteristics. Also per the report, development of Imaging Biobank for Cancer is also being discussed.[14] In August 2019, the Central TB Division, established a formal agreement known as a Memorandum of Understanding with the Wadhwani Institute for Artificial Intelligence. The objective of this agreement is to explore the potential application of Artificial Intelligence technology in the fight against Tuberculosis.[15]

Application of artificial intelligence (AI) in various healthcare domains is described below: 1) AI may be used to strategically plan and allocate resources in healthcare and social care services. For example, Harrow Council is now conducting a trial of the IBM Watson Care Manager system to improve cost efficiency. It matches clients with a care provider that meets their specific needs, while remaining within their allocated care budget. Furthermore, it develops individualized care plans and claims to offer important advice for maximizing the use of care management resources.[16] 2) Medical research: AI may be utilized to do comprehensive searches of the scientific literature to identify pertinent studies and integrate diverse datasets. This can be particularly valuable in facilitating the process of drug discovery. Scientists have created an artificial intelligence (AI) system named Eve that aims to enhance the efficiency and cost-effectiveness of drug discovery. Utilizing twenty-four AI systems in the healthcare sector might also be advantageous in scientific studies by enabling the identification of suitable patients for clinical tests.[17]Provision of medical treatment and services to patients. Artificial intelligence (AI) is being tested at various healthcare facilities in the United Kingdom to determine its effectiveness in aiding disease detection. Using artificial intelligence (AI) to examine clinical information, academic articles, and expert suggestions could aid in making well-informed judgments about therapy.[18m] Potential applications of artificial intelligence in clinical care encompass:

- Medical imaging data, such as medical scans, has been routinely collected and stored for a significant duration, facilitating its convenient availability for training artificial intelligence (AI) systems. Artificial intelligence (AI) has the potential to decrease the expenses and duration associated with analysing scans, which could enable a greater number of scans to be conducted for more precise therapy targeting.Artificial intelligence has shown promising results in detecting medical conditions such as pneumonia, breast and skin cancers, and eye disorders.19
- Echocardiography – The Ultromics technique, trialed at John Radcliffe Hospital in Oxford, employs artificial intelligence to scrutinize echocardiography scans. These scans are utilized to detect cardiac rhythm patterns and diagnose coronary heart disease.(http://www.ultromics.com/technology/)
- Screening for neurological conditions – Neurological disease screening entails the creation of artificial intelligence (AI) tools that examine speech patterns. These systems have the ability to predict the occurrence of psychotic episodes and identify and monitor symptoms associated with neurological disorders such as Parkinson's disease.20
- Robotic tools, led by artificial intelligence, have been used in scientific studies to carry out precise tasks during minimally invasive surgery, such as knotting wounds for closure.21
- 4) Patient and consumer-facing applications
- · The Ada Health Companion app utilizes artificial intelligence to power a chat-bot that integrates user-provided symptom information with other data to provide potential diagnosis. (https://ada.com/)
- · GP at Hand, an analogous application created by Babylon Health, is presently undergoing testing by a consortium of NHS clinics in London.
- (https://www.gpathand.nhs.uk/our-nhs-service)
- · AI-powered information tools or chatbots are used to aid in the handling of long-term health issues. The Arthritis Virtual Assistant, developed by IBM for Arthritis Research UK, is gaining expertise through interactions with patients to provide personalized information and advice on drugs, nutrition, and physical exercise.16

- Remote patient monitoring (RPM) is a growing field in healthcare that seeks to support clinicians by offering additional assistance in delivering treatment across different hospital wards, such as general medical and surgical units. This is accomplished by utilizing flexible components for sensors that can be worn. This is accomplished by integrating innovative Internet of Things (IoT) approaches in healthcare, including telemedicine applications wearable devices, and contact-based sensors.22

Challenges

AI applications have novel prospects for enhancing individuals' daily lives, but they also introduce issues that necessitate efficient management. The challenges in the healthcare industry are especially daunting due to the significant implications for human life. [23] 1. Insufficient knowledge about AI technology: Establishing trust with patients is vital in the healthcare sector, particularly in relation to AI-driven technologies. Medical professionals and policymakers recognize that the general public may be hesitant to trust advice generated by artificial intelligence due to the enduring significance of in-person communication with doctors. Moreover, there is often a lack of understanding among the general public regarding the potential benefits and limitations of artificial intelligence in the healthcare industry.[24] This lack of awareness gives rise to impractical expectations, which can impede physicians from embracing new technologies. The healthcare profession faces substantial ethical and privacy concerns that necessitate careful adherence to laws, regulations, and standards. The integration of AI in the medical domain presents several challenges pertaining to privacy and ethics. These challenges encompass concerns over the protection of patient data, ethical limits of technological advancements, and the tangible effects of AI on healthcare professionals and patients.[25]

The lack of dependability and reliability of AI technologies: The transition from traditional computer systems to AI architectures is impeded by technological limitations. The advent of graphics machines, field-programmable gate arrays, and specialized AI chips need enhanced processing and storage devices to facilitate AI applications .[26] Nevertheless, the implementation of these infrastructures and storage systems might pose challenges and incur significant costs for healthcare companies. Furthermore, there is a lack of emphasis on digital technology among certain healthcare staff, including physicians, nurses, and assistant nurses, which poses a barrier to the integration of AI in healthcare.[27]Another crucial concern is the absence of openness and comprehensibility of AI algorithms, especially when dealing with unstructured data.Such technology-related concern are widespread among hospital managers and doctors and present a barrier to AI systems. Moreover, the introduction of an AI model necessitates the implementation of interoperability standards to facilitate smooth integration with data received from diverse electronic health records. To ensure the seamless integration of AI technology and facilitate its wider adoption, it is imperative to overcome these difficulties in the healthcare sector. In addition, in an AI system, algorithms are not the only component used; there is also a model deployment phase that follows their use. There can be a deficiency in interoperability standards, which means that a model needs to be able to link to data from different electronic health records in order to work .[28]

Healthcare workers and occupational accountability: The utilization of medical expertise has historically been the duty of medical professionals who have undergone formal education and certification. However, the increasing use of AI decision support systems to assist with clinical tasks may have an impact on the ethical responsibility of healthcare staff towards their patients.[29] An issue arises when healthcare workers develop excessive reliance on AI technology, potentially leading to a reduced inclination to scrutinize errors or verify outcomes.[30] Although it is crucial for AI systems to have a user-friendly interface, their implementation in regular clinical practice might be challenging, depending on their intended purpose.[31] Physicians may have challenges in obtaining the expertise to integrate and employ technology, as they may vary in their technological aptitude and have limited hands-on experience with AI applications in their profession.[32]

Challenges to the adoption of artificial intelligence in the healthcare sector Distrust and wariness towards emerging technology, especially among older individuals, frequently hinder the acceptance and utilization of AI. Medical experts and the general people still have a limited comprehension of AI and its advantages.[92, 93]The lack of a comprehensive framework to ensure privacy, security, quality, and accuracy of AI solutions in India is a major obstacle to the implementation of AI in healthcare. In India, there are concerns about multinational firms acquiring local data and utilizing it for their own interests, without offering any benefits to the local population. To avoid the unlawful access or disclosure of sensitive health information, it is imperative to address problems related to confidentiality and cybersecurity.[33,34,35,36,37,38]

· The problem of accountability for AI is a crucial matter that requires resolution. Presently, the doctor has complete responsibility for liability, rather than the technology itself. [33,39] · Doubts regarding the replacement of human workers can lead to a decrease in confidence. AI is often seen as a way to address the disparity between the availability of healthcare services and the demand for them in the Indian healthcare sector. It is also seen as a tool to support doctors in their work. [33,40,41] · The lack of AI trained professionals can also be a key barrier to using AI in healthcare.[42,43] The implementation of artificial intelligence (AI) in the healthcare sector in India is hindered by worries of inequity. These concerns arise from the lack of adequate representation of minority groups in the data utilized for algorithm development and solutions, the prevalence of males in the software industry resulting in a bias towards technologies that cater to male preferences, and the unequal advantages experienced by higher income populations who have access to these technologies.[44,45,46]

Public health organizations face growing financial constraints and struggle to attract the professional staff and resources necessary for the progress of artificial intelligence.[45] Smaller firms in the health industry have difficulties, particularly because of their limited resources and insufficient data backup options.[42,43] Despite an increase in the Indian government's healthcare spending, its contribution of public monies to the healthcare sector remains relatively modest compared to other developing countries.[47] The allocation of government funds for health-related artificial intelligence (AI) in India is restricted, resulting in little study and exploration in this field. Policy makers in India have failed to prioritize the development of the infrastructure required for the advancement of AI. The majority of cloud computing infrastructure, such as servers, is located outside of India. The lack of timely investment in local infrastructure has led to a significant number of Indian start-ups choosing to incorporate themselves outside of India, where they can benefit from more readily available infrastructure and technology. The Indian government's allocation of funds for associated with health artificial intelligence is limited, and research in this subject is inadequately funded and explored. Policy makers in India have failed to prioritize the development of the infrastructure required for the advancement of AI. The majority of cloud computing infrastructure, such as servers, is located outside of India. The lack of timely investment in local infrastructure has led to a significant number of Indian start-ups choosing to establish themselves in foreign countries, where they can benefit from better access to infrastructure and technology.[33] Despite an increase in the Indian government's healthcare spending, its allotment of public monies for healthcare is comparatively modest compared to other emerging countries.[47]

DISCUSSION

Artificial intelligence (AI) has emerged as a transformative force in healthcare, offering significant advancements in diagnostics, treatment personalization, and operational efficiency. The findings of this study highlight AI's ability to enhance clinical decision-making, improve patient outcomes, and streamline healthcare processes. AI-

driven tools, such as predictive analytics, medical imaging analysis, and virtual health assistants, have demonstrated substantial benefits in reducing diagnostic errors and optimizing resource utilization. However, despite these advancements, the study also identifies critical barriers to AI adoption, including ethical concerns, data security issues, regulatory challenges, and workforce readiness. These challenges underscore the need for a more structured approach to AI integration in healthcare systems. This study is based on a systematic review of existing literature, which may limit its scope in capturing real-time developments and emerging AI applications in healthcare. The reliance on secondary data sources means that the study does not include primary stakeholder perspectives, such as those of healthcare providers, policymakers, or patients, which could provide deeper insights into the practical challenges of AI implementation. Additionally, given the rapid evolution of AI technology, some findings may become outdated as newer innovations and regulatory frameworks emerge. Future research incorporating empirical studies and real-world case evaluations would help address these limitations.

The findings of this study have important implications for healthcare practice and policy. For AI to be effectively integrated into healthcare, strong regulatory frameworks must be established to ensure ethical AI deployment, address data privacy concerns, and minimize algorithmic biases. Policymakers must also invest in digital infrastructure and workforce training to equip healthcare professionals with the necessary skills to leverage AI technologies. Additionally, fostering public trust in AI through transparency and patient engagement is crucial for its widespread acceptance. Healthcare institutions should focus on integrating AI in a manner that complements rather than replaces human expertise, ensuring that AI-driven insights enhance, rather than undermine, clinical judgment. Addressing these factors will enable a more responsible, efficient, and equitable use of AI in healthcare, ultimately leading to improved patient care and system-wide efficiencies. This study follows a systematic literature review methodology and does not involve human participants, clinical trials, or direct patient data collection. Therefore, formal registration with a clinical trial registry is not applicable. However, all research activities adhere to ethical guidelines for secondary data analysis and systematic reviews. Protocol: The study was conducted using a structured approach, including a comprehensive search strategy across reputable academic databases such as Scopus, PubMed, and Springer Link. A predefined inclusion and exclusion criterion was applied to ensure the selection of relevant, high-quality research articles. The methodology aligns with best practices in systematic literature reviews, ensuring transparency and reproducibility. Support: No external funding or financial support was received for conducting this study. The research was independently carried out, with access to academic resources provided by institutional affiliations. Competing Interests: The authors declare no competing interests that could have influenced the study's design, data collection, analysis, interpretation, or conclusions. Data Availability: The data analysed in this study consists of publicly available research articles from peer-reviewed journals. All sources are appropriately cited in the references section. No primary or proprietary data was collected or utilized in this study. The extracted data supporting the findings are available upon reasonable request.

PRSMA checklist:

Title (Identify as a systematic review)	1
Abstract	1
Introduction (Rationale & Objectives)	2
Methods (Eligibility Criteria, Information Sources, Search Strategy, Selection Process, Data Collection, Risk of Bias Assessment, Effect Measures, Synthesis Methods, etc.)	3-4
Results (Study Selection, Characteristics, Risk of Bias, Results of Individual Studies & Syntheses, etc.)	5-17
Discussion (Interpretation, Limitations, Implications for Practice & Policy)	18
Other Information (Registration, Protocol, Support, Competing Interests, Data Availability)	19

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