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Review Article

Role of artificial intelligence in health sector: review of literature

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ABSTRACT

Artificial Intelligence will play a significant role in various health sectors in near future. AI technologies like machine learning, deep learning, natural language processing and robotics help to analyse large and complex datasets. This analysis leads to early disease detection, personalised treatment and predictive risk assessment. AI supports public health efforts by predicting outbreak, monitoring health parameters and allocating resources. Despite its benefits and challenges, integrating AI into healthcare system remains crucial. This paper explores Evolution of AI in healthcare, the technologies involved, its benefits, challenges and ethical considerations and future prospects.

Keywords: Artificial intelligence, Machine learning, Personalised medicine, Benefits, Ethical issues, Challenges, Health sector

INTRODUCTION

Artificial Intelligence refers to the computer systems that can perform tasks typically requiring human intelligence like learning, problem solving and reasoning. AI in health care applies artificial intelligence to analyses and understand the complexity of medical and health data.[1-4] It works like a smart assistant that processes large amounts of data, identify patterns and provide insights or predictions. It can significantly change healthcare by improving how clinicians working boost their productivity. This enables health professionals to assist more patients, which improves patient outcomes and reduces health disparities.[5] Globally, the healthcare system is facing many challenges. These include a growing burden of non-communicable diseases (NCDs), an ageing population, rising healthcare costs, a shortage of workers and unequal access to health care services. AI technologies, especially machine learning and deep learning algorithms, have shown the ability to analyse large datasets. They can identify hidden patterns and support evidence-based decision making in real time.[6] The integration of AI in the health sector has shown positive results in personalised medicine, early disease detection, predictive analysis and optimisation of health care resources.[7] AI assisted diagnostic tools have achieved accuracy comparable to and some cases exceeding that of human experts in areas such as radiology, pathology and dermatology.[8] AI enabled digital health platforms and telemedicine services especially in underserved and remote areas and hence supporting the goals of Universal Health Coverage.[9]

Primary care, as the first point of contact in healthcare, is crucial for prevention, chronic disease management, and personalised advice. AI tools in primary care can assist in early screening for conditions like diabetes, hypertension and mental health issues. This enables timely management and slows down the progression of these diseases.[10] For managing chronic illnesses, AI systems can offer personalised recommendations based on real-time patient data. This helps healthcare providers to create customised lifestyle and treatment plans.[11] Using AI in developing nations that do not have the resources, can reduce outsourcing and can improve patient care. AI can help to diagnose patients in areas, where healthcare is

scarce. It can also enhance patient experience by organising files to find the best treatment options for individuals.[12] So far, AI has not eliminated any healthcare jobs. If AI were to replace healthcare related jobs, the positions most at risk would include those involving digital information, radiology, and pathology. Jobs that require direct patient interaction would be less affected.[13] The adoption of AI in healthcare brings important ethical, legal and social concerns along with issues about data privacy, algorithmic base, transparency, accountability. Therefore, it is vital for policy makers, health care professionals and public health practitioners to understand both the opportunities and challenges that come with AI.[14]

This article aims to explore the role of artificial intelligence in health sector, highlighting its evolution, technologies involved, its benefits, challenges, ethical considerations and future prospects.

EVOLUTION OF AI IN HEALTH CARE

The idea of AI first emerged at Dartmouth Summer Research Project in 1956, where Scientists looked into machines that could simulate human intelligence. Turing test proposed by Alan Turing in 1950, provided a theoretical basis for AI.[15]

1970s-1990s

The focus was on Expert systems. It aimed to imitate human reasoning such as MYCIN, which helps to identify bacteria and suggests treatment.[16] INTERNIST-1 and CASNET are two key AI systems developed during the 1970s for medical expert systems and decision support. INTERNIST-1 acts as a computer-based research tool that extends physician's abilities.

It uses a Heuristic rule-based approach while CASNET centres on pathophysiological reasoning. CASNET has a three-level hierarchical model that includes Observations, Pathophysiological states and Diseases. These programmes can expand a clinician's knowledge and help with diagnosing and treating illnesses.[17]

2000s-2010s

IBM Watson introduced in 2011, is a computing system created by IBM to mimic human reasoning using Artificial Intelligence. It combines Natural Language Processing, Machine learning, Knowledge representation and Information retrieval to analyse large amount of unstructured data.

Watson generates evidence-based responses with confidence scores. It has been applied in areas like Oncology decision support, Personalised cancer treatment recommendations, radiology and imaging analysis, drug discovery research and clinical trial matching.[18]

2015-2020s

The focus shifted to neural networks, which allowed for deeper analysis of medical images. FDA in 2017 approved the first cloud based deep learning tool, confirming the use of AI for clinical settings. IDx-DR in 2018, became the first AI system approved to make diagnoses without physician confirmation for Diabetic Retinopathy.[19]

2020-present

AI advanced rapidly during the COVID-19 pandemic, impacting diagnostics, vaccine development and telemedicine. Deep Mind's Alpha Fold (2021), which predicts 3D protein structures, generative AI in antibody design (2023), AI discovered molecules entering clinical trials, are the recent advancements. In 2022, introduction of ChatGPT globally, signalled the arrival of a new generation of powerful generative artificial intelligence tools.[20,21]

TECHNOLOGIES IN HEALTH CARE

Machine learning

It is the backbone of modern AI. Enables computers to learn from medical data to recognise patterns and make predictions. These systems help clinicians to detect diseases earlier, offer personalised treatment recommendations and anticipating patient risk.[8]

Deep learning

A subset of Machine learning that uses multi-layer neural networks to analyse complex datasets like medical images. These methods have advanced speech recognition, visual object recognition, object detection and many other fields like drug discovery and genomics.[22]

Natural language processing

Helps computers to understand, interpret, analyse and generate human language. NLP combines linguistics, computer science and machine learning to process text and speech data. Also serves as a foundation for technologies like translation systems, text analytics, speech recognition and chatbots.

Its advantages include improved human-computer interaction, real time language translation, automated large scale text processing and support for data-driven decision making. It is widely applied in health care, finance, education and public administration.[23]

Robotics

Healthcare robotics refers to design, development and deployment of robotic system to assist in medical care,

rehabilitation, patient support and healthcare delivery. Its benefits include reduced clinician work load, improved surgical precision, enhanced rehabilitation outcomes, infection control and increased healthcare access.

Robots in healthcare must be safe, ethical, human aware and should be designed with patient dignity in mind. They are not meant to replace healthcare professionals but to enhance their work.[24]

Predictive analysis

The process of extracting information from existing datasets in order to identify patterns and predict future outcomes and trends. It uses historical data, statistical algorithms, data mining and machine learning techniques to forecast health outcomes such as disease risk or hospital admission, optimize resources and improve decision making processes.[25]

BENEFITS OF AI IN HEALTH SECTOR

Diagnosis of disease

AI uses medical imaging like X rays, CT scans and MRIs to find diseases like cancer, pneumonia and cardiovascular conditions. Algorithms achieve diagnostic accuracy nearly equal to that of human experts. For example: AI models can identify early signs of diabetic retinopathy or breast cancer with high precision.[26,27] ML models can also forecast populations at risk of specific diseases or accidents.[28,29]

Predictive analysis and personalized medicine

ML models of AI can analyze patient data including clinical history, biomarkers and genomics to predict disease onset, progression, response to treatment. AI based tools also aid in chronic disease profiling.[30]

Electronic health record management

AI improves Electronic Health Record management by automating documentation, extracting important clinical information, offering real time clinical decision support with actionable insights at the point of care. This reduces the workload on clinicians and minimise errors.[30]

Telemedicine

AI powered wearables and cloud systems monitor vital signs and identify anomalies. They alert caregivers and allow for continuous patient care outside traditional clinical settings.[31]

Drug discovery and development

AI speeds up drug discovery by stimulating biological interactions and screening chemical compounds. This method greatly reduces cost and time compared to conventional approaches.[31]

CHALLENGES AND ETHICAL CONSIDERATIONS

Bias and interpretability

AI models can carry biases from their training data. This may lead to unfair clinical outcomes for different groups. Many deep learning models are hard to understand, operating like “Black boxes.” More research is needed for interpretable AI to build trust among clinicians.[31]

Integration into clinical practice

To use AI tools effectively, we must think about current workflows, healthcare protocols, clinician training and the readiness of infrastructure.[30]

Data privacy and security

Health care data is sensitive and often spread out. AI models need large datasets, which raises concerns about privacy, security and compliance.[32]

FUTURE DIRECTIONS

Public health and population level insights

AI can help forecast outbreaks, support public health decisions and improve resource allocation by analyzing large datasets. This ability is crucial for managing future pandemics and chronic disease trends.[33]

Ethical, regulatory and trust frameworks

Future AI research emphasizes the need for fair, easy to understand and unbiased models to prevent disparities in treatment outcomes. Diverse datasets and thorough validation are key research priorities.[31] As AI role in clinical decision support increases, new policies and evidence standards will help ensure patient safety and trust especially in AI tools that affect diagnoses or treatment choices.[34]

AI for emerging domains

AI applications in the fields such as physiotherapy, speech therapy, remote monitoring and digital biomarkers, offer choices for ongoing monitoring in areas that require more investigation.[35]

Interdisciplinary collaborations

Collaborative research involving clinicians, data scientists, ethicist and policy makers is vital to ensure AI solutions to meet patient needs and reflect societal values.[30]

Explainable and trustworthy AI

Future research should focus on the methods that help clinicians to understand AI better and build trust in AI recommendations. Open AI systems are more likely to gain regulatory approval and be adopted in clinical practice.[36]

CONCLUSION

AI should be seen as a helpful tool in health coverage, not a replacement for human judgement in healthcare. When used responsibly and fairly, AI has great potential to promote universal health coverage, strengthening health systems and improving population health outcomes. Future efforts should focus on evidence-based practices, using technology ethically and integrating AI technologies into existing healthcare systems to ensure sustainable and inclusive health care delivery.

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