International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 30, Issue 9, September 2024 **ijppr.humanjournals.com** ISSN: 2349-7203

Artificial Intelligence in Healthcare System

Saloni C. Rajpurohit*, Mrs. Swati Pingale

1. A C Patil Institute of Pharmacy, Navi Mumbai, Maharashtra. India.

Received: 2024-09-05 Revised: 2024-09-12 Accepted: 2024-09-17

ABSTRACT

Artificial Intelligence is advancing rapidly within the healthcare sector. This review article outlines the emerging innovations that are set to radically change the role of physicians and transform medical practice. It details how various software applications are employing AI in healthcare, providing numerous examples. These innovations have already begun to impact the treatment and diagnostics of diseases, thereby supporting healthcare professionals. The article also highlights different branches of AI, emphasizing that the combination of deep learning and machine learning holds significant promise for the future, alongside other areas like natural language processing, robotics automation, physical robotics, and rule-based expert systems. Additionally, the review discusses the history of patents in AI, noting that leading healthcare companies such as Siemens, Philips, and GE Healthcare have filed most of these patents. The growing success of AI can also be linked to advancements in diagnostics and medical imaging technologies. This review provides a global perspective on artificial intelligence in healthcare and explores its future potential and application.

Keywords: Artificial Intelligence, Machine Learning (ML), Deep Learning (DL), Natural Language Processing (NLP)

1.1 INTRODUCTION

Artificial intelligence (AI) and its related technologies are increasingly becoming integral to both business and society, with applications emerging in healthcare. These advancements have the potential to transform various aspects of patient care and operational processes within pharmaceutical organizations.(1,12) Currently, there is no universally accepted definition of AI. Generally, the term refers to computational models that simulate human-like cognitive functions, such as reasoning, learning, adaptation, knowledge acquisition, and interaction. Most existing AI applications are limited to performing specific tasks or solving defined problems.(9) Artificial intelligence (AI) AI is rapidly transforming the medical field, with significant growth seen in medical AI over the past few decades. These intelligent systems are now being employed in diagnostic, treatment, and drug development processes. (7).Healthcare has long been viewed as a promising area for AI technologies. AI applications have the potential to enhance communication in clinical settings, contributing positively to health outcomes and quality of life. AI systems are currently being utilized to help healthcare professionals manage large volumes of patient data, offer guidance and decision support, and streamline clinical workflows.

However, despite these advancements, such systems still require active monitoring and updates from clinicians.(15)

1.2 Objectives of AI in Healthcare(6)

- To identify leading medical companies and research institutions engaged in the AI field. To evaluate the potential of AI technologies in supporting healthcare personnel.
- To recognize the types of diseases that AI tools can help diagnose, treat, or predict.
- To assess the risks and challenges associated with implementing AI systems for clinical use.
- To estimate future growth and prospects for AI within the healthcare sector.

1.3 Artificial Intelligence in Medicine

AI in medicine involves the application of computer algorithms and automated processes in the diagnosis and treatment of patients. While the steps of diagnosis and treatment may seem straightforward, numerous backend processes must take place to ensure proper patient care, including:

- Collecting data through patient consultations and tests Processing and analyzing results
- Utilizing various sources of information to reach an accurate diagnosis Developing an appropriate treatment plan (often providing options) Preparing and administering the chosen treatment
- Monitoring the patient
- Conducting aftercare and follow-up appointments

1.4 Artificial intelligence in technologies

Technology and automation have already been widely adopted in medicine, often without our awareness. Medical records are now digital, appointments can be made online, and patients can check in at healthcare facilities through their computers or mobile devices. Currently, significant innovation and digital integration are essential to the healthcare sector. For example, Futurism highlights various AI applications that are currently utilized in medicine:

Decision Support Systems: DX plain provides potential diagnoses based on given symptoms.

Laboratory Information Systems: Germ watcher tracks and analyzes syndromes in hospitalized patients.

Robotic Surgical Systems: The da Vinci robotic system allows for precise surgeries that are difficult to perform manually.

Therapy: AI Therapy provides an online course for individuals suffering from social anxiety.

The increasing use of AI in medicine not only reduces manual workload and saves doctors' time, but it also facilitates more precise medical practices.(4)

The main objective of implementing AI in healthcare is to improve diagnosis, treatment, and care for critical patient conditions. To achieve this, intelligent systems must incorporate automated learning algorithms and methods utilizing fuzzy set theory, Bayesian networks, and artificial neural networks. These sophisticated systems assist in early cancer detection, recommending effective treatment strategies, predicting future health risks, and evaluating the dangers associated with surgical procedures and health record management.

1.5 Types of AI Relevant to Healthcare Artificial intelligence

It encompasses a variety of technologies rather than being a singular entity. Many of these advancements hold significant relevance in healthcare, though the specific applications and roles can vary widely.

Below, we outline and detail several key AI innovations that are particularly important to the medical field.

1.5.1 Machine Learning(8,14)

Neural Networks and Deep Learning Machine learning is a statistical approach used to fit models to data and is among the most prominent forms of artificial intelligence (AI). It encompasses a wide range of techniques and applications. In healthcare, one of the primary uses of machine learning is in precision medicine, where it predicts which treatment protocols are most likely to be effective for patients based on various factors related to the patient and treatment conditions. Neural networks, an advanced type of machine learning technology available since the 1960s, are now well-established in medical research. They are utilized to assess the likelihood of a patient developing specific diseases. Deep learning, a more complex form of machine learning characterized by multiple layers of features, is particularly unpredictable. It is increasingly used in radiomics to identify potentially cancerous lesions in radiological images. Both radiomics and deep learning are frequently applied in oncology-related image analysis, where their combination tends to provide greater diagnostic accuracy compared to computer-aided detection (CAD) systems. Additionally, deep

learning is being increasingly employed for speech recognition and is a component of natural language processing as discussed below.

1.5.2 Natural Language Processing (NLP)

Since the 1950s, one of the main goals of AI researchers has been to understand human language. This area, known as NLP, involves various applications such as speech recognition, text analysis, translation, and other language-related tasks. NLP can be approached in two primary ways: statistical and semantic. Statistical NLP is closely linked to machine learning, particularly deep learning neural networks, which have significantly improved the accuracy of speech recognition. In healthcare, NLP's key applications include the creation, comprehension, and categorization of medical records and published literature. These systems can recognize unstructured clinical notes about patients, generate reports (like those for radiology examinations), interpret patient interactions, and facilitate conversational AI.

1.5.3 Rule-Based Expert Systems(8)

Expert system technology has been widely used in healthcare for clinical decision support over the past few decades, and it remains prevalent today. Many electronic health record (EHR) providers now offer a set of guidelines within their systems. Creating an expert system requires collaboration between human specialists and programmers to establish norms in a specific knowledge domain. While these systems are generally effective and easy to understand, they can struggle when the number of rules becomes too large (often exceeding a few thousand), especially when conflicts arise among them. Moreover, adapting the rules can be challenging and labor-intensive if the information domain evolves. As a result, healthcare is gradually shifting towards methods based on data and machine learning algorithms.

1.5.4 Physical Robots(8)

Physical robots have become quite prominent, with over 200,000 mechanical robots being deployed globally each year. They perform specific tasks such as lifting, moving, welding, and collecting items in settings like industrial locations and warehouses, as well as delivering supplies in healthcare facilities. These robots are increasingly collaborative with humans and can be easily trained by guiding them through designated tasks. Furthermore, their intelligence is improving due to the integration of additional AI capabilities. Common applications of automated surgical procedures include gynecological surgery, prostate surgery, and surgeries involving the head and neck.

1.5.5 Robotic Process Automation (8)

This technology automates digital processes for administrative purposes, particularly involving computer systems. Compared to other forms of AI, robotic process automation (RPA) is cost-effective, easy to program, and operates simply. RPA doesn’t operate with physical machines; rather, it utilizes computer programs on servers. In healthcare, RPA is employed for repetitive tasks such as prior authorizations, updating patient records, and billing. When paired with other technologies like image recognition, it can be used to extract data, such as retrieving images for entry into value-based systems. While we've described these technologies separately, they are increasingly being combined. Robots are being endowed with AI capabilities, and image recognition is being integrated with RPA .

1.6. History of artificial intelligence

The development of artificial intelligence (AI) in healthcare has progressed over many years,

characterized by key milestones that have shaped its current applications. Here’s a concise overview:

1. Initial Development (1950s-1970s):

- In **1956**, the term "artificial intelligence" was coined during the Dartmouth Conference. - The **1960s**marked the start of healthcare-related AI research with early systems like **Dendral, which focused on chemical analysis, and MYCIN**, developed in the 1970s at Stanford University for diagnosing bacterial infections and recommending antibiotic treatments. MYCIN was one of the pioneering rule-based AI systems in medicine.

2. Advancement of Expert Systems (1980s-1990s):

- AI projects such as **Internist-1** and **CASNET** (designed for glaucoma diagnosis) emerged, aiming to replicate human decision-making in medical diagnostics. - Despite encountering limitations in generalization and uncertainty management in the **1980s**, these expert systems paved the way for future AI developments.

3. Rise of Machine Learning and Data-Focused Models (2000s):

- The advent of machine learning redirected attention from rule-based systems to data-driven models that could learn from large datasets. - In the **2000s**, AI applications expanded to include predictive analytics, imaging diagnostics (like early cancer detection in radiology), and personalized medicine.

4. Impact of Deep Learning and Modern AI (2010s-Present)

- During the **2010s** deep learning revolutionized AI in healthcare, leading to significant advancements in medical imaging, genomics, drug discovery, and natural language processing (NLP) for examining electronic health records. - AI platforms like **IBM Watson Health** and **Google DeepMind's AlphaFold.**

Show cased AI's capability to comprehend complex biological systems and support clinical decisions. - AI is increasingly incorporated into clinical settings, applied in telemedicine, robotic surgery, and patient monitoring.

5. Current Trends and Future Prospects

- AI development continues to evolve, focusing on ethical concerns, reducing bias, improving explainability, and achieving regulatory approvals. - Ongoing research aims to enhance AI's contributions to precision medicine, genomics, and immediate patient care, highlighting the partnership between AI technology and healthcare providers. This timeline highlights the growing impact of AI on healthcare, illustrating its journey from early expert systems to the advanced applications that are transforming medical practices today.

Ongoing initiatives by industry participants will certainly contribute positively to the growth of the sector. In 2015, the hospital workflow segment represented a significant portion of revenue and is expected to show a compound annual growth rate (CAGR) of 40.9% throughout the forecast period. The increasing use of artificial intelligence for gathering patient data to support decision-making in hospital workflows has greatly enhanced outcomes, reduced wait times, and lowered costs, all of which will drive growth in this segment in the future. Other notable segments with substantial shares include medical imaging and diagnostics, therapy planning, and virtual assistance.

6. Recent Advances in AI(2)

Medicine, Diagnostics, and Bioinformatics In 2015, IBM launched Watson Health, aiming to partner with healthcare professionals to develop innovative technologies in the medical field. Similarly, Google has recently unveiled DeepMind Health, a division that follows a comparable collaborative approach with clinical experts and healthcare practitioners. Additionally, numerous smaller artificial intelligence companies are emerging, focusing on healthcare technology advancements in personalized health and medicine, as well as medical imaging and diagnostics. Enclitic, a small startup based in Silicon Valley, leverages deep learning to analyze radiographs and other imaging data like CT and MRI scans. TwoXAR employs its DUMA Drug Discovery platform to sift through large public and proprietary datasets to identify and prioritize potential drug-disease connections. Atom wise uses its Atom Net deep learning technology to screen numerous molecules for drug candidacy and assess their potential effectiveness in inhibiting pathogen mechanisms. Canadian startup Deep Genomics is working with deep learning techniques to analyze vast datasets of genetic information, hereditary mutations, and clinical records to find connections between them. Verb Surgical, collaboration between Alphabet and Johnson & Johnson, is developing an AI-driven surgical robot, promising significant advancements compared to existing surgical robots like the da Vinci system.

7. Market Growth Analysis(10)

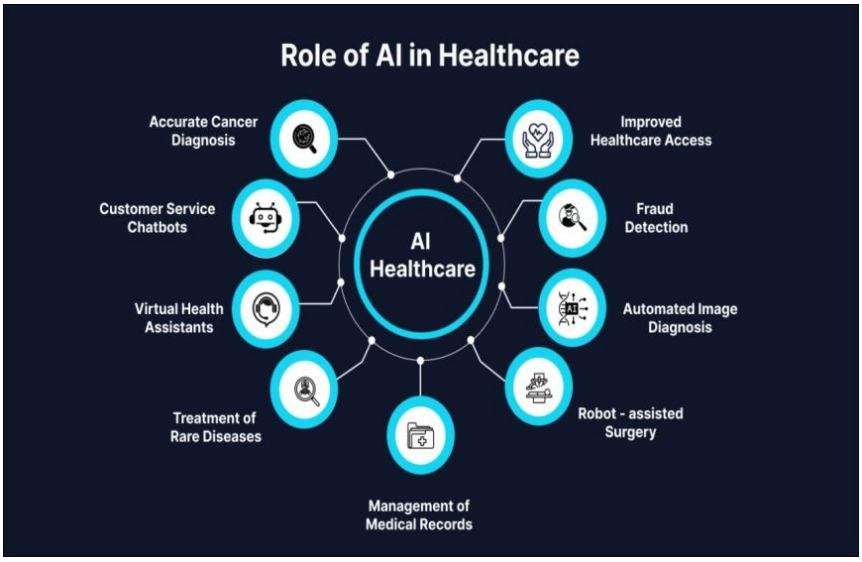
The advancement of artificial intelligence (AI) in drug discovery, medical imaging, personalized medicine, and genomics, along with the increasing demand for tailored treatments that cater to individual patient needs, is expected to drive global market growth. The rising need for AI technologies to expedite data mining, enhance healthcare service delivery, and support innovative applications for disease diagnosis and monitoring will further contribute to market expansion in the coming years.

Improvements in data analytics within the healthcare AI sector are anticipated to boost market growth during the analysis period. Each year, the healthcare industry generates vast amounts of data, leading to a growing necessity for AI technologies to manage this information more efficiently. AI is revolutionizing healthcare by enabling the design of treatment plans, assisting with repetitive tasks, optimizing medication management, and facilitating drug discovery. It is also effective in managing healthcare data through collection, storage, and normalization processes. Recently, Google's AI research division launched the Google DeepMind Health initiative to analyze medical records for improved and faster medical care. The advancement of innovative data software and solutions is expected to spur industrial growth; however, high capital requirements may raise affordability issues and potentially hinder this growth. In 2018, the drug discovery segment generated USD 345.0 million and is projected to experience significant growth during the forecast period. Drug discovery represents one of AI's most recent applications, fundamentally transforming the drug development process and offering the potential to reduce production costs for new medications. AstraZeneca has recently partnered with Berg, a Boston based specialist in AI for drug delivery.

1.7 Market Dynamics(11)

Maintaining a balance between healthcare personnel and patients is a significant challenge faced by both developed and developing countries, including the US, UK, Germany, and India. Artificial intelligence (AI) and cognitive mobility are offering medical professional tools to fulfill their roles more efficiently with less human intervention. Innovations in deep learning for medical imaging support various diagnostic tests, such as blood analysis, X-ray interpretation, and cancer cell detection. AI systems also assist in medication management through natural language processing and mindset training technologies. As the doctor-patient ratio declines, AI presents new solutions to connect the healthcare workforce with patients. The AI healthcare market was valued at approximately USD 2.09 billion in 2018 and is projected to grow to USD 36.15 billion by 2025, with a compound annual growth rate (CAGR) of 50.2% during this period. Machine learning technology is expected to capture the majority of the AI market share in healthcare in 2018. Among machine learning methods, deep learning is anticipated to command the largest segment of the AI healthcare market. The growing availability of extensive data and the need to reduce healthcare costs have fueled the expansion of the market in healthcare.

1.8. ROLE OF AI IN HEATHCARE



1.9 Future Scope of AI in Healthcare(8)

We believe that AI will play a significant role in the future of healthcare. The potential for improving precision medicine through machine learning represents a crucial advancement in this field. Although initial attempts to provide diagnostic and treatment suggestions have faced challenges, it is reasonable to expect that AI will eventually excel in this area as well. Rapid advancements in AI for imaging analysis suggest that radiology and pathology images will soon be routinely examined by machines. Current applications of speech and text recognition for patient communication are increasing, with further growth likely. The main hurdle for AI in these healthcare domains is not whether these innovations can be effective, but rather ensuring their integration into everyday clinical practice. For widespread adoption, AI systems must gain regulatory approvals, be compatible with electronic health record (EHR) systems, meet standardized benchmarks to ensure interoperability, be adopted by clinicians, be financed by public or private payers, and be regularly updated in practice. While these substantial, they are surmountable over time. AI systems

are not expected to replace physicians broadly but will instead enhance their capabilities in patient care. Ultimately, those medical professionals who resist incorporating artificial intelligence into their work may be the ones at risk of becoming obsolete.

1.10 SUMMARY

Artificial Intelligence heralds a significant shift that has the potential to alleviate the strain on an overstressed healthcare system. Given the considerable shortage of medical professionals, AI can be both vital and beneficial. The primary objective of incorporating AI into healthcare is to expand the capacity of hospitals and physicians exponentially, aiming to enhance doctors' efficiency by three to four times in the near future, allowing them to attend to more patients. Achieving this goal requires technology to overcome the challenges of distance and time; with AI integrated into the healthcare system, anyone with a smartphone can access a doctor. In the upcoming years, further innovations in AI are expected to provide major advantages to the healthcare sector, particularly in improving the accuracy of medical dosage administration, thereby reducing unexpected fatalities and increasing patient trust in this technology.

1.11 REFERENCES

1. https://new.siemens.com/global/en/company/stories/industry/intelligentrobotics-siemens- aucma.html
2. https://www.gestalt.law/insights/artificial-intelligence-patents-for-healthcare
3.https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new- health/transforminghealthcare.html
4.https://hbr.org/2018/12/using-ai-to-improve-electronic-health-records
5.https://plato.stanford.edu/entries/artificial-intelligence/
6. Artifical intelligence in healthcare, minefields grow for tomorrow 2018
7. Artificial intelligence in medicine, Mendely, 2018
8. Thomas D, Ravi k, The potential for artificial intelligence in healthcare, future healthcare journal, 2019 vol6 No 2:94-8
9. Nuffied council on bioethics, Artificial intelligence in healthcare and research 2028:1 10.WIPO technology trends, Artificial intelligence 2019,
10. Marketsandmarkets, artificial intelligence in healthcare market, 2018,SW5225
11 . https://searchrio.techtarget.com/defination/Ai
12. NITI Aayog, National strategy for Artificial intelligence, GS SCORE-An institute for civil services.
13. Lynch, CJ Liston C.2018.
14.Shortliffe. E.H. & Cumino, 11 2013

How to cite this article:
Saloni C. Rajpurohit et al. Ijppr.Human, 2024; Vol. 30 (9): 149-154.
Conflict of Interest Statement: All authors have nothing else to disclose.