

# ROLE OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE AND PHARMACEUTICALS

## Abstract

Artificial intelligence (AI) techniques and their applications in medical and pharmaceuticals are evolving rapidly. Artificial Intelligence deals with increasing amounts of data that are provided by health trackers like watches, smartphones, and other monitoring sensors in the field of medicine. Artificial intelligence focuses on how computers learn from algorithms, data and mimics the human thought and behavior process. The key categories of AI applications in healthcare involve early detection of diseases, diagnosis, prognosis, precision medicine, drug development, clinical trials, and providing patient quality care. It improves and increases support in making the clinical decisions that are used in transforming the future of pharmaceuticals. AI can play an important role in developing personalized medicine and the implementation of new personalized products in healthcare. There are many techniques that AI uses in health care sector.

**Keywords:** Artificial Intelligence, Deep Learning, Healthcare, personalized medicine.

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## I. INTRODUCTION

Artificial intelligence (AI) is one of the emerging fields in various sectors. AI is defined as it is the combination of science and technology to produce intelligent machines. It is a variety of intelligent processes and behaviours produced by computational models, not a single technology<sup>[1]</sup>. AI is not really a new concept; it has been around for almost 5 decades. The two main concepts of artificial intelligence used in healthcare informatics are deep learning and machine learning<sup>[2]</sup>. Deep learning is among the machine learning techniques which trains the models using artificial neural networks. It was used both in health care and non-health care sectors using computer vision and natural language processing<sup>[3]</sup>. Machine intelligence is termed as the behavior of machines that are indistinguishable from humans. The concept of artificial intelligence and machine learning in the health care sector is to provide a set of tools that augment and extend the effectiveness in the healthcare industry and to bring an increased quality of life to patients. The goal of implementing AI in healthcare is to improve the safety and quality of treatment decisions.<sup>[4]</sup>

## II. HISTORY OF ARTIFICIAL INTELLIGENCE

AI in healthcare is not a new concept as well as its evolution. The concept was there from 1990. One of the pioneers of contemporary computer science and artificial intelligence was the British mathematician Alan Turing (1950)<sup>[6]</sup>. Gunn conducted the first consecutive study on the use of AI technology in surgery in 1976, looking at the possibility of using computer analysis to identify acute abdominal pain. In the beginning, established technologies like decision support, knowledge-based response, and expert systems were combined with AI.<sup>[7]</sup>

The early versions of AI in healthcare used rules and knowledge methods; at present, AI uses various statistical methods along with the symbolic representation of diseases. In 1960 the PROLOG language was developed to manage reasoning and decision making processes. During 1970's first generation of AI was developed for making individualised clinical decision making processes<sup>[3]</sup>. De Dombal's computer aided diagnosis was developed for diagnosing acute abdominal pain. This incorporates newer statistical technologies like probabilistic reasoning and neural networks. Over some period AI technologies were successfully incorporated within medical devices such as ECG machines, insulin pens and ICU pumps<sup>[8]</sup>. After a few decades AI was established into clinical studies focused on reviewing the impacts of AI on patient outcomes in inpatient settings, in psychiatry and in medication safety<sup>[9]</sup>.

The challenges in the early days of AI were legal and ethical issues, complexity of medical information which are not documented, and transferability of one algorithm setting to another in patient care, brittleness, and dynamic nature of professional healthcare knowledge development by AI<sup>[11]</sup>. Nowadays these are replaced by powerful computing tools like big data. Big data offers a connection between molecular and cellular biology to the clinical real world<sup>[4, 11, 12]</sup>.

### III. AI THE BOOMING FIELD IN MEDICINE

Nowadays, artificial intelligence has a refined influence on nearly every aspect of life and human conditions starting from research and discovery to diagnosis and selection of therapy. Machine learning is a set of techniques or technical skills that enables AI<sup>[1,13]</sup>. Implementing AI in health care can bring faster and more personalised care in patients.

- 1. AI use in monitoring fitness:** Technological Applications like apps encouraging / motivating an individual in the motto of maintaining the healthy lifestyle, moreover AI plays an prominent role in understanding the varying patterns of the needs of the patient by the healthcare professionals improving the support and guidance for the better feedback. Health tracking gadgets are easily procurable, some of them even helpful in monitoring the Blood Pressure, Heart rate and oxygen Saturation ex. Fitbit, Garmin, Apple. They even alert the patients/ Caregivers about the health status and promote monitoring of the patients.<sup>[3]</sup>
- 2. AI use in early detection of diseases:** AI plays an integral role in the diagnosis of various disease conditions, which may include from basic inflammatory diseases like COPD to more complex cancers at early stages. AI Diagnosis is preferable since it is non-invasive and in Breast cancer screening, the use of AI in the Mammograms gives 99% accuracy results and it is 30 times faster and reliable than to go for the conventional invasive procedures like Biopsy. Some of the readily available AI applications includes Google's Deep Mind Health, which is now worldwide useful to detect the patients population at risk and can diminish the health inequalities by surfacing most vulnerable patients.<sup>[4,5]</sup>
- 3. AI use in diagnosis:** Machine learning algorithms can process inconceivable amounts of information in the fraction of second and provide more accurate than humans in spotting even the smallest detail in medical imaging. Machine learning can predict the short term and long term risk of patient safety<sup>[2]</sup>. Deep learning techniques are used for detecting diabetic retinopathy in primary health centres in the US. The company Zebra Medical Vision developed a new platform called profound, which analyze of all types of medical imaging reports that is able to find every sigh of potential conditions such as Lung cancer, osteoporosis, breast cancer, aortic aneurysms, dementia and many more with almost 90 percent accuracy rate. The outputs of machine learning can predict the image whether it shows a malignant or benign tumour. IBM's Watson for health is helping healthcare organizations to review and store the patient's medical information safely.
- 4. AI use in treatment decision making:** Machine learning Algorithms is one of the applications of AI where it can process the infinite information within a second and are even more accurate in case of screening medical imaging techniques and helps in predicting the risk and safety of the patients, for example, in the United States, the ophthalmologists in the primary health centres are making use of all these deep learning techniques in the detection of the Diabetic retinopathy. Another most preferable example is the PROFOUND which is developed by the Multinational Company named Zebra Medical Vision, This Profound will analyse all reports of the Medical imaging techniques and give insightful reports in the diagnosis of dementia, aortic aneurysm, osteoporosis and even lung cancer with almost 90% accuracy rates. Another most common is the IBM Micromedax where we can find the Watson query which helps in giving clarity about all

the drug related information in order to improve the better patient's outcomes with respect to the disease conditions.

- 5. AI use in digital consultation:** The digitizing of healthcare data as well as advancements in computer processing data and storage has also enabled the development of algorithms in artificial intelligence <sup>[5,15]</sup>. In the UK, apps like "babylon" and "DR.A.I." made by the digital health company "Health Tap" use artificial intelligence to provide medical consultation to individuals based on their personal medical histories, primary complaints, and general medical knowledge. Users enter their symptoms into the app, which compares them against a database of illnesses using speech recognition and asks patients to explain their symptoms in order to determine whether they should see an emergency room, urgent care centre, or a primary care physician. It will be crucial to regulate the hazards that AI carries and to limit them to improve patient safety in order to maximise the benefits of AI in healthcare and to foster confidence among the public and healthcare professionals <sup>[2,14]</sup>. In short, where physicians are overloaded with data which requires sophisticated interpretation it is expected that with AI it will become more efficient. There is always a high demand in healthcare services to use optimal resources to improve patient care without compromising the patient's safety <sup>[15]</sup>.
- 6. AI use in precision medicine:** AI technology is necessary to achieve the goal of "precision medicine" <sup>[5,13]</sup>. Precision medicine is a budding medical model where medical decisions and treatments are personalized to the patient based on their disease stage and condition. "Precision medicine requires the availability of massive computing power and data algorithms that can learn by themselves at an exceptional rate <sup>[13]</sup>. Instead of developing treatments for peoples and building the same clinical treatment decisions based on a few similar physical characteristics among patients, artificial intelligence (AI) systems have been developed to analyse data-notes and reports from a patient's file, external research, and clinical experience to help create the correct, individually customised treatment plan. Genetics and genomics look for mutations and link to disease from the information in DNA. With the help of AI, body scans, spot cancer and vascular diseases early and predict the health issues people might face based on their genetics.
- 7. AI use in palliative care:** Our lifetime has expanded more than that of past generations, and as we age or approach death, we are dying differently than when it comes to illnesses like dementia, heart failure, and cancer. Another stage of life that is frequently overtaken by loneliness is getting older. To keep ageing minds sharp, AI has "conversations" and other social interactions with people. The National Institutes of Health have created the 'AiCure' app to monitor the use of medication by a geriatric patient. A Smartphone's camera is partnered with Artificial Intelligence enabled software to autonomously confirm that patients are taking their prescriptions and helps them manage their conditions. This will help the elder patients from medication adherence.
- 8. AI use in maintaining health records:** To improve patient care, health care workers need to identify, quantify and interpret relationships among variables, to do this artificial intelligence and machine learning helps by using computers which allows the learning of data algorithmically <sup>[3]</sup>. To decide the predictive modelling in patient care artificial intelligence and machine learning are used by means of electronic health records (EHR) considering the variables such as medication prescription, patient clinical history, laboratory values, physiological imaging and drug notes etc., that fit into the datasets <sup>[4]</sup>.

The use of AI in healthcare management will make sure that the appropriate individuals are given the necessary information to enable high-quality patient care. Examples include AI-based diagnosis specificity, AI-based automated medical coding, and AI-based early detection data <sup>[5,7]</sup>. The last few decades' use of electronic medical record systems has demonstrated that there is a wealth of data available for AI applications. <sup>[4,5]</sup>.

**3.9 AI use in drug discovery and development:** Clinically one drug may interact significantly with the other drug in any other conditions. These quantitative or qualitative interactions are not possible to explain with the other methods but with machine learning and AI it is possible to capture these and explain the complex relationships. AI is useful from research and development to clinical practice to population health. Starting from the novel therapeutic agent discovery, precision disease stratification, integration of more number of data, extension of physician efficiency and efficacy, continuous remote monitoring diagnostics and till optimized resource allocation, Artificial Intelligence plays a crucial role <sup>[1,13,14]</sup>. Some of the future innovations of AI includes designing of new drugs with new drug combinations, delivering clinical trials, Testing medications that resemble an organ's physiology through modelling Robots working at distribution centres and manufacturing facilities, 3D-printed individualised medications in any shape and dosage, Better understanding of human biology and pathophysiology of diseases and in Providing safe health care data.

#### IV. AI TECHNIQUES IN HEALTHCARE SECTOR

There exist many artificial intelligence and machine learning techniques which are useful in medicine (table2). The AI technologies that are frequently used in medicine are artificial neural networks (ANNs), fuzzy expert systems, evolutionary computation, and hybrid intelligent systems.

- 1. Artificial neural networks:** ANNs are the computational techniques that are inspired by the biological nervous systems. They consist of networks that are highly interconnected computer processors called neurons which are capable of performing parallel computations for data processing and knowledge representation <sup>[12,14 [6,17]</sup>. These ANNs are employed in waveform analysis, data interpretation in intensive care settings, radiography, histology, and clinical diagnosis
- 2. Fuzzy expert systems:** Fuzzy expert systems use scientifically logical reasoning, thinking, and inference to take into account and use the fact that everything in the real world is a question of degree. The fuzzy logic technique has been used in diagnosing various types of cancer using tumour markers and it also predicts the survival rate in patients with cancer.
- 3. Evolutionary computation:** Evolutionary computation is the general term for several computational techniques which is primarily based on the natural evolution process that imitates the mechanism of natural selection and survival of the fittest in solving real world problems <sup>[4, 6, 10]</sup>. They have been largely used in diagnosis, prognosis, signal processing and medical imaging of genetic algorithms to predict the outcome of the disease. Each AI method has benefits and drawbacks of its own. When these methods are merged or used in conjunction with one another to create hybrid intelligent systems that function in a complementary manner, neural networks are primarily concerned with

learning, fuzzy logic is with imprecision, and evolutionary computation is with search and optimization.<sup>[7,9]</sup>

**Table 1: AI Techniques and Applications**

AI Techniques	Applications in Healthcare
Machine learning/ Deep learning	Precision medicine Electronic health record management Data retrieval Patient quality care Drug development Supporting clinical decision making Understanding immunology sequence
Natural Language Processing	Virtual health assistants Chat bots for appointments Note taking and transcription Online appointments Scheduling data
Artificial Neural network	Clinical decision support system Diagnosis and prognosis Clinical interpretation of medical condition
Fuzzy logic	Clinical decision making Prediction of outcomes Predicting survival rates
Computer vision	Radiological and histopathological image analysis Interpretation of MRI,CT,USG
Robots	Chat bots providing health-related information Geriatric care Robotic assisted surgery Palliative care Emergency medicine

## V. CHALLENGES IN IMPLEMENTING AI IN HEALTHCARE

Integrating AI in healthcare can bring few risks over their benefits. For example, failure in the software can affect a large number of patients. Critical assumptions in AI systems can lead to dangerous recommendations that are insensitive to local data and models<sup>[16]</sup>. Due to opaque AI technologies such as deep learning makes the explaining part difficult in case of failure. To reduce these risks and increase patient safety, regular governing of AI systems and their risks will bring trust among the healthcare and patients<sup>[14,16]</sup>.

The "black box" model they use is criticised for making this implementation. The use of AI in healthcare raises numerous ethical questions; some of them include adding bias to reduce risk and clinician dependence on AI may harm patient-clinician relationships. According to survey findings, input, output, and protocol data should be maintained within of a secure infrastructure for the safe processing of patient data, and data protection laws such the general data protection legislation should be followed.<sup>[11,17]</sup> Accepting the biochemical results obtained by an auto-analyser or the magnetic resonance imaging images has restrictions. To combat this, additional randomised controlled experiments must be conducted to demonstrate the effectiveness of AI systems in medicine.<sup>[15]</sup>

## VI. CONCLUSION

Technology is running the world and the world is changing with them and adapting the technology. Concepts like artificial intelligence, which were only science fiction a few decades ago. Now they are quickly becoming common. There are more than 300 Artificial intelligence enabled medical devices that are approved by FDA. Rapid advances in AI research and their approval make it that AI is extensively used in the healthcare sector and there is a high development in the upcoming future. Every new advancement will have its own pros and Cons; even AI has its own. AI can be used in improving healthcare under the supervision of physicians to reduce their risks in healthcare. AI can be used in business analytics of healthcare. Advances in AI implementation in the healthcare sector will lead to improvement of better clinical decision making, risk assessment, care process, continuity of care, coordination of care, safety of care, management process in healthcare. The future of Artificial Intelligence holds the pledge of a more effective and efficient healthcare system built on a strong foundation of dependable and precise data.

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