Review Article

Artificial Intelligence In Healthcare: A Review

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ABSTRACT

The goal of artificial intelligence (AI) is to imitate human cognitive processes. The healthcare industry is undergoing a paradigm shift due to the rapid advancement of analytics techniques and the increased availability of healthcare data. The industry has seen a positive change as a result of the development of artificial intelligence, which offers precise data-driven decisions. AI is crucial to many pharmacy domains, including polypharmacology, hospital pharmacy, drug delivery formulation development, and drug discovery. Different Artificial Neural Networks (ANNs), such as Deep Neural Networks (DNNs) or Recurrent Neural Networks (RNNs), are being used in drug discovery and drug delivery formulation development. In the current Review article, the various applications of AI in healthcare including the role of AI in pharmacy, drug discovery and drug design, disease diagnosis etc are discussed.

INTRODUCTION

Artificial intelligence or machine learning is an intelligence of machine where they mimic human minds in learning and analysis and work in problem solving as opposed to the intelligence of humans.AI usually refers to a system that is comprised of hardware and software. In terms of software, AI is especially focused on algorithms. A conceptual framework for implementing AI algorithms is called an artificial neural network (ANN). Similar to how the human brain responds to various environmental changes, a neural network (NN) is capable of producing outputs in response to environmental stimuli. NNs are usually composed of layers in different configurations.[1] AI methods have recently caused enormous waves in the healthcare industry, sparking a lively debate on whether AI doctors will eventually take the place of human doctors. Though AI can help doctors make better clinical decisions or even take the place of human judgment in some functional areas of healthcare, we do not think that robots will ever replace doctors as practitioners. In order to provide patients with the best care possible, AI systems can help doctors by supplying current medical information from textbooks, journals, and clinical practices. An AI system can assist in lowering

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diagnostic and the unavoidable therapeutic mistakes in the therapeutic treatment of people. Further, an AI system gathers relevant data from a patient base to support decision-making assumptions made for health risk alerts.[2]

AI helps in enhancing and increasing the efficiency of healthcare. AI is frequently used in healthcare settings as clinical decision support systems (CDSS), which help doctors diagnose patients and choose the best course of therapy.[3]. In the healthcare industry, machine learning is being used more and more in a variety of ways, including clinical decision support, medical billing automation and developing clinical care standards. Researchers have developed the first medical machine learning method to identify acute toxicities in patients receiving radiation therapy for head and neck cancers. In radiology, deep learning in healthcare automatically identifies complex patterns and helps radiologists make defensible decisions while examining images such as those from conventional radiography, CT, MRI, PET scans, and radiology reports. It has been shown that machine learning-based automated detection and diagnostic systems can function just as well as a board-certified radiologist.[4]

AI is now being used in fields formerly dominated by human expertise thanks to the use of medical imaging diagnosis systems. This field of study is still growing and extending into other branches of medicine including clinical practice. In contrast to the initial AI systems, which depended on the development of strong decision criteria and the curation of medical knowledge by specialists, current AI research has used machine learning techniques, which can take into account complicated relationships, to extract patterns from the data.[5] Artificial Intelligence (AI) has been used in many fields over the past ten years, including machine translation, search engines, and intelligent personal assistants. Along with the increasing use of electronic health records (EHRs)

and the quick advancement of the life sciences, particularly neurosciences, artificial intelligence (AI) has found many applications in the medical field. Virtual, physical, and hybrid AI (robots working together in virtual reality) are the three main categories into which AI in medicine can be broadly divided. These branches have all demonstrated exceptional benefits and/or potentials in research and clinical work. Nowadays, interaction algorithms or direct discovery are the common methods used to identify therapeutic targets and diagnosis biomarkers. AI techniques could also be used to predict clinical outcomes, simplify process management, reduce complexity and cost, and optimize clinical trials of novel drugs and therapies through data-driven, precise treatment planning.[6] Every stakeholder in the healthcare sector is fighting from the front lines during a global health emergency such as the corona virus. In many nations, including India, the pandemic has been referred to as a structural shift for digital healthcare. Numerous healthcare sectors in India are in need of automation for a range of tasks, and they are utilizing artificial intelligence to support their operations. The field of artificial intelligence (AI) is quickly evolving to transform the healthcare industry. Big Data, robotics, and artificial intelligence (AI) transformed the world and created previously unheard-of possibilities and opportunities in the healthcare industry. The healthcare industry is knowledge-intensive, and as such, data and analytics play a critical role in enhancing treatments and procedures. The breadth of medical data that is gathered has greatly expanded in recent years, encompassing clinical, genetic, behavioural, and environmental information. Large volumes of data are produced daily by patients, medical professionals, and biological researchers using a variety of devices. Application of AI in healthcare includes diagnosis,

treatment planning, training, research, and decision-making for patient wellness.[7]

ARTIFICIAL INTELLIGENCE IN DRUG DESIGN

Everyday life is significantly impacted by artificial intelligence (AI). Prominent advancements have been made in a variety of fields, including speech and picture recognition, natural language processing, etc. Clinical candidate molecules in drug discovery need to fulfil a variety of requirements. In addition to having the appropriate potency for the biological target, the compound should have good physicochemical and ADMET (absorption, distribution, metabolism, excretion, and toxicity properties) qualities as well as be fairly selective against undesirable targets. Compound optimization is therefore a multifaceted problem. Throughout the optimization process for effective compound design, a variety of in-silico prediction techniques are used.[8] Despite tremendous technological advancements and advances in our understanding of disease biology, the process of bringing new drugs to market is still time-consuming and costly, in large part because of the significant expenses related to the high rate of clinical trial failures. Small molecule medication design with computer assistance has long been viewed as a promising field. But due to developments in data processing power and the creation of new "artificial intelligence" (AI) tools, the field is currently experiencing a surge in interest. In order to achieve long-term success, AI drug design must address a number of issues, which can be summed up as five "grand challenges" such as

➢ Creating and acquiring relevant datasets,
➢ Developing fresh conjectures,
➢ Using multiple objectives for optimization,
➢ Cutting cycle times, as well as
➢ Developing a suitable mindset and altering the research culture.[9]

AI IN REMOTE MONITORING & TELEMEDICINE

Telemedicine is the practice of performing consultations, medical examinations and procedures, and professional medical collaborations at a distance by means of interactive digital communication with the transfer of medical information. Reducing delays and logistics costs are the primary goals of telemedicine, which also aims to bridge the communication and accessibility gaps in the medical field. Over the last ten years, wireless technology has been used in sensors, case studies involving electronic patient records, and home monitoring. Research has also been conducted on the technology's affordability and the medical community's acceptance of it. One of the first and most popular uses of telemedicine is patient monitoring. This makes it possible to conduct routine doctor-patient consultations more quickly and affordably while still evaluating the patient's present condition and clinical outcomes remotely. In comparison to in-person patient monitoring, the goal of this trend is to provide accessibility, ease of use, efficiency, and lower costs. An additional popular aspect of robotic technology is the incorporation of assistive mechanical components and the utilization of gathered medical data and findings to facilitate intelligent diagnosis. In order to support the current hospital system, both features are designed to help patients—either physically or by analysing the initial patient evaluation. By connecting medical professionals from different nations through technology, cooperation on medical data will be promoted in addition to viewpoints and diagnosis-related information. Pharmaceutical research will be conducted in a completely new way as a result, using big data analytics to combine clinical test results and genetic neural networks to identify patterns and analyse data.[10]

ARTIFICIAL INTELLIGENCE IN PHARMACY

AI is used in hospital pharmacy-based health care systems in a variety of ways, such as selecting appropriate or practical administration routes, organizing dosage forms for specific patients, and establishing treatment guidelines.

Updating medical records: It can be difficult to keep up with patients' medical records. The AI system's implementation makes data collection, storage, normalization, and tracing simple.

Treatment plan design: An AI system is required to take control of the situation when a patient develops a critical condition and choosing an appropriate treatment plan becomes challenging.

Health support and medication assistance: In recent times, artificial intelligence (AI) has been acknowledged as an effective tool for both medication assistance and health support services. Its goal is to support patients with chronic conditions in between doctor visits and to assist patients in directing their own treatment. People in the healthcare system benefit from artificial intelligence (AI) because it can gather and compare data from social awareness algorithms. The healthcare system records a vast amount of information about patients, including their medical history, treatment history, profile from birth, habits, and lifestyle choices.[11] Robots are now more dependable for physicians due to the introduction of big data and AI, and many organizations are today using robots under human supervision in addition to their own undertakings that were previously carried out by people. Pharmaceutical companies have access to a vast array of compounds that may be able to treat a wide range of particular diseases. Nevertheless, the companies lack the resources necessary to identify themselves as such. Artificial Intelligence (AI) streamlines the drug development process, resulting in shorter development times, lower costs, higher returns on investment, and potentially lower end-user costs. The main advantage of artificial intelligence (AI) is that it can analyse vast amounts of data that would not typically fit into any conventional computer, making it far more superior to humans in this regard.[12]

ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS

AI techniques, ranging from machine learning to deep learning, play a critical role in many areas related to health, such as developing new clinical systems, managing patient data and records, and curing various diseases. The most effective methods for diagnosing various diseases are those utilizing artificial intelligence. There are previously unheard-of opportunities to repeat patient and clinical group outcomes thanks to the application of artificial intelligence (AI) in healthcare. Researchers have employed a range of AI-based methods, including deep learning and machine learning models, to identify diseases that require early diagnosis, including those of the skin, liver, heart, and Alzheimer's disease. Real-world information gathered from the dermatology department was used by the writers. Ansari et al. (2011) diagnosed hepatitis virus-related liver disease with a recurrent neural network (RNN) and got 97.59% accuracy, compared to 100% accuracy with a feed-forward neural network. In their 2019 study, Owasis et al. used long short-term memory and residual neural network to diagnose gastrointestinal disease, achieving 97.057 area under the curve. The term "clinical imaging" refers to the set of procedures used to create images of an internal body part. The process and cycles are employed to obtain images of the human body for medical purposes, like locating, examining, or analysing an injury. Over several years, the symptoms of dementia worsen with Alzheimer's disease. It causes memory loss in the early stages, but ultimately it loses the capacity to carry out conservation and react to the surroundings. The Alzheimer's Disease Neuroimaging Initiative Convention, which uses T1 weighted magnetic

resonance information, was employed by them to make their findings.[13]

Many medical fields have made extensive use of artificial intelligence. Artificial intelligence (AI) technologies have aided in the clinical diagnosis of both acute and chronic diseases, including acute appendicitis and Alzheimer disease. The detection of malignant cells is greatly enhanced by integrative AI, which uses multiple algorithms instead of a single algorithm, leading to higher diagnostic accuracy. The prediction of breast cancer recurrence is also aided by the development of various AI techniques. Instead of doctors, in-home AI systems may be in charge of patients with insulin irregularities and swallowing issues.[14]

PROMISES OF ARTIFICIAL INTELLIGENCE

AI has a wide range of potential uses in medicine that have been proposed. These include better pathology classification, such as classifying scans in radiology or defining electrocardiogram features in cardiology; anticipating disease patterns and epidemiology; and helping with the detection of disease, such as in the detection of skin cancers in dermatology or diabetic retinopathy in ophthalmology.

BENEFITS OF AI

➢ Relieving workload

 AI can ease the extremely heavy workload that healthcare workers bear. While the introduction of information technology, such as electronic health records, was intended to streamline and integrate patient care, many doctors have experienced burnout symptoms as a result of it. These symptoms include trouble utilizing the technological systems and being overburdened by their bureaucracy.

AI has the potential to reduce workload in fields that interpret and diagnose medical images. DL has proven to be highly effective in identifying a number of illnesses, such as diabetes, tuberculosis, and breast cancer and erratic cardiac rhythms. In order to bring the attention of the doctor to critical situations more quickly, AI could function as an initial screening tool in scan interpretation, prioritizing those of concern. This would also save money by reducing the need for time and resources.

➢ Splitting of tasks

The efforts of human workers would be streamlined if healthcare practitioners' workloads were divided up using ML algorithms. In order to prevent needless hospital admissions before they happen, AI may be utilized to lower hospital admission rates. In addition to national initiatives, there are numerous smartphone applications that provide patients with personalized health advice while they're not in a hospital. These apps include those that help identify symptoms, recommend additional care, or help manage long-term conditions like diabetes or asthma so that hospital admission is avoided.

➢ Improving clinical practice

Above all, AI has enormous potential to improve patient care and clinical practice. Here, artificial intelligence (AI) not only enhances the work of healthcare professionals but may even broaden their scope of practice. AI can offer quantitative expertise that goes beyond what higher-level humans are capable of accuracy and specificity.

WEAKNESS OF AI

➢ Data Challenges

The availability of data is the first obstacle. Large datasets are necessary for ML and deep learning models to reliably classify or predict various tasks. On the other hand, data availability in healthcare is a complicated problem. Health data is costly for organizations overall, and sharing it amongst hospitals is viewed with reluctance because each hospital views it as its own property, with the purpose of managing its own patients. As artificial intelligence (AI) advances, people may start mistaking artificial systems for humans, leading to

more unintentional data collection. This raises additional privacy concerns.[15]

➢ **Ethical Concerns**

Since artificial intelligence was first proposed, ethical questions have been raised about it. Accountability is the primary issue, not the previously mentioned data security and privacy concerns. When bad decisions are made, particularly in the medical field, the current system mandates that someone be held accountable due to the seriousness of the consequences. Artificial intelligence (AI) is often perceived as a "black box" by many, as researchers fear it will be difficult to figure out how an algorithm arrived at a particular result.

Some have argued that algorithms used in lower-stakes applications—like those that aren't medical—that prioritize efficiency or improved operation are less vulnerable to the "black-box" problem.

➢ **Social Concerns**

People have always worried that employment in the healthcare industry could be eliminated by artificial intelligence (AI). Due to the fear of being replaced, some people have negative attitudes toward and are even antagonistic toward AI-based projects. But a lot of this viewpoint is predicated on a misreading of artificial intelligence in all of its forms. Inadequate knowledge about artificial intelligence can result in exaggerated expectations about its capabilities and efficacy. The public might be misinformed about AI's current capabilities, which would disappoint them and make them reluctant to trust the technology. [16]

CHALLENGES IN ARTIFICIAL INTELLIGENCE

Researchers and corporate executives will need to handle the issues raised by artificial intelligence as it permeates more aspects of daily life and the workplace.

The fundamental challenge faced by businesses integrating AI technologies is that AI applications frequently operate on completely different architectures than do conventional enterprise applications. Data must pass through several protocols in order to move between servers and storage, which is another problem. By developing more effective methods for enabling data locality, which allows one server to process larger amounts of data without having to wait for others, data engineers can lessen these. Improved storage and GPU integration has shown to result in some cost savings. Concerns about information security and privacy present another obstacle for AI in healthcare. AI is taught using data from medical histories; thus, precautions must be taken to ensure that this data does not end up in the wrong hands. Additionally, trustworthy defence against cyberattacks is imperative; it's a crucial issue in any industry, but in the healthcare industry it's become even more urgent since the field has a direct bearing on people's lives, and cyberattacks have the potential to be fatal.[17]

The development of new medications with increased efficacy and fewer side effects, combined with an environment that fosters greater development, success rates, lower discovery costs, and more direct access to patients in need, present further challenges for pharmaceutical companies.

➢ **Growing demands from customers**

They seek new treatments that outperform current options both clinically and financially, along with concrete evidence from actual patient outcomes to support any assertions that medicine is superior.

➢ **Low scientific productivity**

Over the last ten years, Pharma's output has remained steady. There's little reason to believe that productivity will suddenly decline when using the same processes for discovering and developing.[18]

CONCLUSION

AI has intriguing uses in numerous other biomedical fields as well. It is evident that artificial intelligence (AI) is becoming more and

more relevant in the field of biomedicine. This is due to the complexity of biomedical problems and AI's ability to address them, in addition to AI's ongoing advancement. The role of explainable AI in clinical decision support systems was examined in this paper from the viewpoints of technology, law, medicine, and patients. The field of healthcare has demonstrated the immense advantages of artificial intelligence. Even though initial deployments

are expensive, it is possible that in the long run, benefits will outweigh costs and make the technology accessible to all. Therefore, it follows that AI is most frequently used in healthcare to carry out the following tasks: a) Assistance with diagnosis; b) Management of healthcare organizations. Over the past few years, there has been a noticeable increase in interest in the applications of AI technology for the analysis and interpretation of several significant pharmacy fields, including drug discovery, dosage form designing, hospital pharmacy, etc. These applications of AI technological approaches are based on the idea that humans are capable of imagining knowledge, solving problems, and making decisions. It has been demonstrated that automated databases and workflows can be used to conduct efficient analyses using AI techniques.

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