

Short Communication

ARTIFICIAL INTELLIGENCE: A PROMISING TOOL FOR TRANSFORMING THE HEALTHCARE SYSTEM

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1. BACKGROUND

The pioneer works in the field of Artificial Intelligence (AI) date back to the early 1950s, where researchers in the field of computer sciences postulated a theory of building machines which can mimic the human intelligence of reasoning and analyzing. The Classical work by McCulloch and Pitts in 1943 laid the foundations for Artificial Neural Networks which form the basis of present day acumen in the field of AI. During the past two decades, the field of AI has witnessed rapid advancements in terms of computer processing power, development of advanced algorithms and availability of large data sets etc. Today, AI and related technologies are prevalent in transforming the business and society. In the field of healthcare, AI is playing a crucial role in many aspects of patient care as well as administrative processes within pharmaceutical companies, healthcare setups and consumer support [1,2].

Artificial Intelligence is a cluster of several technologies; all of these have instant relevance with the healthcare industry. Based on the complexity of programming, these technologies may be grouped as the machine learning, neural networks and deep learning, respectively. Added to this, there are advancements of AI such as; Natural Language Processing, Robotic Process Automation and Rule-based Experts Systems which have demonstrated promising benefits in revolutionizing the healthcare industry [3,4,5].

2. EMERGENCE OF AI IN HEALTHCARE AS DIAGNOSTIC SUPPORT

The economy involved in healthcare and support, burdens governments with a huge cost. This is because, there are constantly changing demographics, workforce shortages,

administrative needs, increasing morbidity and advancements in information technology demands and expectations [6,7]. Early diagnosis and treatment of chronic diseases is one of the main aims of clinical practice, AI has been introduced in this field in the early 1970s, when the Stanford University developed MYCIN for diagnosis of blood-borne microbial infections. IBM based Watson was then introduced as an Application Programme Interface (API) for diagnosis of cancer metastasis and its treatment. However, these preliminary breakthroughs were not capable of getting along with the advancements in medical fraternity and were inefficient to knob the pile of data related to genomic, proteomic, metabolomic and other 'omic-based' approaches. During the beginning of 21st century, sensing the trends of treatment approaches, organizations have changed their focus on designing AI-based tools involving Evidence and Precision based approaches for identifying treatment recommendations such as; identifying high-risk conditions like sepsis and heart failure, patient's response to treatment protocols, genetic profiling of cancers, Electronic Health Records (EHR), etc [8,9].

Patient compliance and adherence has been one of the widely discussed issues in ensuring good health outcomes. The available literature on clinical validation of several AI tools like watches, sensors and other instruments involving patients has also advocated better outcomes for patient adherence and compliance [6].

3. AI REVOLUTIONIZING DRUG DISCOVERY

The process of pharmaceutical research and drug development is complex and costly, for the development of a successful drug candidate a huge amount of approx. \$161 million to \$2 billion

is invested between phase I trials and regulatory approval [10]. It is of particular interest for a Pharmaceutical Company to accelerate drug discovery vis-à-vis lessening the costs of operations. To address this, several AI tools have been promising in speeding-up the drug development, identifying the leads and targets and guarding the treatment costs. The machine learning algorithms used by several pharmaceutical industries are able to identify and assemble potential lead compounds, optimize of a cluster of leads and sieve the biologically active leads. In line with the advancements for the drug discovery process, there are similar deep learning approaches which exhort programmed data gathering and investigation of human genomics to generate answers for the most complex diseases known today, including Alzheimer's disease, Amyotrophic Lateral Sclerosis (ALS) and Cancers. The huge pile of data requires a much larger space for storage; hence the upbringing of cloud-based platforms paved the ways for speedy screening of potential drug candidates. One of such tool is Ligand Express which using the cloud-based AI networking system can investigate the potential of small-molecule drug candidates against a repository of protein target to identify their pharmacological profiles. Further, the same system plots the drug-response curve to quantitatively measure the effective dose of candidate molecules. Another such network-based AI application use the machine learning techniques to investigate the potential of an approved medicine for repurposing it in rare disease by screening available data for that medicine through scientific literature, patents, clinical trials, mutiomics data and structural profiling [10, 11].

4. ROLE OF AI IN CLINICAL TRIALS AND REGULATORY PROCESS

Clinical trials involve a huge amount of expertise in making a successful regulatory approval. AI is greatly capable of transforming the conduct and outcome of clinical trials using its various technological tools. AI tools make it possible to seamlessly support clinical operations by examining outcomes of early trials (Phase I & II), characterizing primary and secondary endpoints based on individual trial participants along with comparing the retrospective data.

Phase I and II of clinical trials, developing new patient-centered endpoints, and collecting and analyzing real world data. Advanced AI algorithms utilize data-driven protocols for processing data collected from several sources like electronic and administrative health records, smart-phones etc. This approach helps in achieving improved data quality, enhanced patient compliance, improved treatment efficacy and reliability [12].

5. AI-ACCELERATING PHARMACOVIGILANCE ACTIVITIES

Besides providing amicable solutions for clinical trials, AI has also revamped the field of drug safety. Ensuring the drug safety throughout the lifecycle of a medical product is the responsibility of a pharmaceutical company. Pharmacovigilance (PV) is the science of detection, assessment, understanding and prevention of Adverse Drug Reaction (ADR) [13]. Monitoring ADRs through

PV is a tedious task which involves several modalities of data collection, collation and processing and analyzing. Individual Case Safety Reports (ICSRs) are the primary source of capturing ADRs. Voluminous ICSR data is difficult to mine and analyze through traditional methods hence, effectiveness of AI can enable reducing the case processing costs and improving PV activities [14]. AI applications in the field of PV utilize cognitive services which incorporate a combination of both natural language processing and machine learning algorithms. These cognitive services provide benefits to the end users within receipt, triage, data entry and assessment steps of ICSRs processing. Thus, the value of AI may generate innovative solutions for PV operations like ICSR validity service, identifying duplicity, classification of ICSRs based on seriousness, unlabeled-ADRs, type of reporter, causality etc. [15].

6. ROLE OF AI IN CLINICAL DECISION MAKING

One of the most reciting contributions of AI in the healthcare is the support rendered to the medical surgeons in terms of providing a pool of data from identical surgeries and combining medical records with real-time data during surgeries. The use of robotics in surgeries is growing continuously and it may support surgeons in making precise incisions by using smaller robotic-assisted tools. Also, virtual nursing assistants are capable of assisting patients with their daily routines, reminders for medications/appointments with clinicians, helping answer medical queries etc [16].

7. AI RENDERING ADMINISTRATIVE SUPPORT IN HEALTHCARE SETUP

All the healthcare setups function in a regulatory environment where lots of administrative procedures necessitate documentation, this ultimately burdens the healthcare workforce to spend more of the work time on regulatory and administrative activities [17]. AI utility in this domain has not been extensively explored but may be very promising in reducing human work load for processing insurance claims, managing trial documents, controlling and processing inventory in supply chain and clinical documentation, revenue cycle management and organizing health records [18]. Machine learning as a tool of AI is gaining momentum and can be promising to save costs of operations and time for stakeholders in healthcare using probability statistics for network-based data retrieval and analysis.

8. FUTURE IMPLICATIONS

It is indeed the fact that innovations in the field of AI technologies are leveraging the healthcare offerings with most promising services and products. Tailoring of health interventions for individuals and sub-groups of populations is now possible with the use of AI. New algorithmic approaches using transfer learning, contextual analysis, knowledge injection and knowledge distillation have been proposed to address these issues. The challenges in the field lie in widespread adaption of the AI technologies, regulatory approvals, integration with EHR systems, standardization of products and timely system updates.

The drive for innovative technologies must continue in order to sustain the advancements in the health profession and strive for augmenting efforts of healthcare providers to care for patients.

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