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Review Article

Artificial Intelligence in Pharmaceutical Industry: A Paradigm Shift

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Artificial Intelligence (AI), a branch within computer science, enables machines to work efficiently and analyze complex data. AI focuses on producing intelligent modelling , which helps in improving knowledge, cracking problems and decision makings, its applications in pharmaceutical industry helps in enhancing workflow efficiency, cutting operational expenses and fostering safety, precision , productivity by tackling intricate data processing tasks , it might also help to save money and time. The future of AI seems to be promising, with ongoing research aimed at addressing existing gaps and enhancing the integration of AI tools into day to day pharmacy practice. This short narrative review is presenting to understand the importance of Artificial Intelligence in various aspects in medicine and surgery in the form of drug discovery, formulation development along with the advance techniques and vision of the AI.

Keywords: Artificial Intelligence, Drug Discovery, E- Therapy, Advance Techniques.

INTRODUCTION

In India, in last few decades technology has drastically changed human existence, affecting all facets of business, manufacturing, communication, transportation in medical and pharmaceutical sectors. The main objective of Artificial Intelligence is mainly concerned about problem solving with the help of programming in symbols which significantly improved the disease diagnosis. Now a days, AI is rapidly making its way in the pharmaceutical industry. It seems to be playing "a key supporting role in the fight to treat and stop" the virus and perhaps will "contribute to a solution coming faster than we would have otherwise" in the biotech sector[1]. In pharmacy drug discovery, drug delivery formulation, and development are among the emerging initiatives embracing AI technology that has already moved past hype to hope. Predicting *in-vivo* reactions, pharmacokinetics and other parameters is made possible y application of AI models along with therapeutic efficacy and suitable dose etc. As per the importance of pharmacokinetic prediction in drug research, the use of *in-silico* models facilitate their drug and cost effectiveness in research[2]. The development of AI technology comes in two main categories; the first one is made up of traditional computing approaches such as Expert systems, which can mimic human experiences and provide conclusions[3]. The second one that use artificial neural networks (ANNs) to simulate how the brain responds.

History of Artificial Intelligence: A person who coined the term "Artificial Intelligence" is John McCarthy, an American computer scientist pioneer and inventer, was also called as the "Father of Artificial Intelligence'[4]. The first work which is now recognized as AI was done by Warren McCulloch and Walter pits in 1943 in which they proposed a model of artificial neurons. In 1950, Alan Turning and English Mathematician and pioneered machine learning publishes "Computing machinery and intelligence" to proposed a test to check the machine ability to exhibit intelligent behavior equivalent to human intelligence called as Turing Test. In 1955, Allen Newell and Herbert A. Simon created the first

artificial intelligence program which was named as "Logic theorist". In the year 1956, the word AI was first adopted by American computer scientist John McCarthy at Dartmouth conference[5]. In early enthusiasm in 1966, researchers emphasized developing algorithms which can solve mathematical problems the first Chabot created by Joseph Weizenbaum, which was named as ELIZA. Later in 1972 the first intelligent humanoid robot was built in Japan named as WABOT-1. The first AI Winer 1974 to 1980, a period where computer scientist dealt with a severe shortage of funding from government for AI research which reduced the interest of publicity[6]. Then a period of Boom of AI came in 1980 came back with "Expert Systems" at the first national conference of American association at Stanford University. In 1997, IBM deep blue beats world chess champion, Gary Kasparov and became first computer to beat a world chess champion. The $ 1 million Jeopardy prize of Quiz Show was successfully won by IBM's brand-new Watson supercomputer in US in 2011, where it had solved complex questions as well as riddles. Since then, Watson has expanded into the pharmaceutical and healthcare industry. In 2016, the company collaberated with pfizer to expedite the creation of novel immune-oncology medications[7].

Types of Artificial Intelligence:

A. According to caliber and their presence:

1. Weak AI or Artifiical Narrow Intelligence
2. Strong AI or Artificial General Intelligence
3. Artificial Super Intelligence

B. According to the presence (Four Primary Artificial Intelligence Type)

1. Type 1 Reactive Machine
2. Type 2 Limited Memory System
3. Type 3 Based on the Theory of Mind
4. Type 4 Self-awareness

Artificial Intelligence (AI) in the following areas plays an important role in Disease Diagnosis, Digitial therapy or personalized treatment, Radiation therapy, retina, carcinoma, drug discovery, prediction of bioactivity and toxicity, clinical trials, designing clinical trials, identifying patients, recruiting and enrolling them, Monitoring trial, patient adherence and end point detection, other chronic disorders, and forecasting of an epidemic or pandemic[8]. The devices worked on Artificial intelligence were online adds network, banking finance, Navigation and travel, video games, music and media streaming services, social media like facebook, twitter and Instagram, Alexa and Tesla etc[9]. Artificial Intelligence mostly utilized in pharmaceutical industry for Drug discovery, Disease diagnosis, Novel Medication, Clinical Research and Predictions of the disease. In every phase of medication design process using AI technology which significantly reduces the cost and lowers the risks or side effects associated with preclinical trials[10]. Drug Discovery takes a long duration of time to test compounds against samples of diseased cells. Klopman introduced a new program to study the structure activity relationship (SAR) of organic molecules[11]. In Drug Discovery Cycle, compound collections is of two types or in two ways Primary (high through – put *in vitro*) or Secondary Assays (Counter screen, Bioavailability, toxicity, metabolism, etc.) Historically, drugs were discovered by identifying the active ingredient from traditional remedies, as with Penicillin. Recently, chemical libraries of synthetic small molecules, natural products or extracts were screened in intact cells or whole organisms to identify substances that had a desirable therapeutic effect in a process known as classical pharmacology.

Artificial Intelligence in Telepsychology (E - Therapy):

There are so many recent methods utilized in this emerging field of computational understanding have the potential to be applied in nearly all ranches of medical science. The challenge of learning, analyzing and applying a wealth of knowledge must be overcome in order to solve the complex clinical problems. The advancement of AI in pharmacy and medicine has aided clinicians and pharmacist to solve complex issues. Systems like Evolutionary computational models, artificial neural network (ANNs), fuzzy expert systems and hybrid intelligent systems can help healthcare workers with data manipulation. The biological nervous system serves as the foundation for artificial neural network (ANN). In 1974, Paul Werbos, introduced a novel method known as "Backpropagation learning" featuring an

effective learning algorithm. Artificial Neural networks have found applications in fields like image diagnosis, data interpretation and waveform analysis. Fuzzy logic is a discipline concerned with reasoning, thinking, and inference that can be comprehend and apply real world phenomena. It primarily relies on a continuous membership range from 0 to 1, where 0 represents false and 1 signifies true. Fuzzy controllers have also been employed for the management of vasodilators and anesthetics in surgical settings.

Artificial Intelligence in Radiooncolgy:

Automated treatment planning, a recent technological advancement, and offer significant advantages in radiotherapy treatment planning. It effectively enhances plan quality, consistency, and reduces error rates. The treatment process can be categorized into three segments: automated rule application, modeling of previous clinical knowledge and multi-criteria optimization. A basic computer program with predefined structures can implement clinical guidelines. The treatment planning system can analyze a patient's anatomy and physiology and replicate the reasoning process typically used in manual treatment planning. Radiomics can be applied to predict outcomes and assess toxicity in individual patients receiving radiation therapy[12].

Artificial Intelligence in Ophthalmology:

Retinal high-resolution imaging has made it possible to assess human health in a remarkable way. An Ophthalmologist or retina specialist can create a personalized therapy plan and implement an ever-improving learning healthcare system using just one retinal photograph and high definition medications[9].

Artificial Intelligence in Oncology:

Artificial Intelligence has become increasingly important in the fields of cancer diagnosis and treatment due to its wide range of applications. A multilayer perception neural network was trained with gene expression data to predict the lymphoma subtypes on Non-Hodgkin lymphoma. Artificial Intelligence has made assays for classification and further clinical application more economical, efficient and repeatable. In Gastrointestnal cancer, colorectal cancer, screening technology is used to assess the patient's level of malignancy and visual nocturnal imaging plays a critical role in predicting the progression of gastric cancer by detecting Helicoacter pylori infection. AI is a flexible clinical tool for screening and early lung cancer detection which reduces time while maintaining high accuracy in the diagnosis of cancer[13].

Artificial Intelligence in Chronic Pain Management:

According to computer programming techniques, various computerized therapies are available. The patient may follow recommendations for one medication and perform their own biopsy. Regular monitoring is necessary for chronic diseases and AI can be used to create virtual medical assistants to help with this monitoring. The automated system recognizes issues and retains the most efficient fix for each patient. Insulin therapy in type II diabetes mellitus, machine learning based technologies such as clinical decision support can also predict the short and long term HbA1c response, it can control with more advanced methods such as web based apps for smartphones and tablets[14].

Artificial Intelligence – Enhanced Drug Screening:

Testing compounds against samples of diseased cells is a common step in the lengthy drug discovery process. New and efficient medications can be made available sooner thanks to computers significantly faster discovery of new data sets than traditional human analysis and laboratory experiments**.**

Machine learning tools of Artificial Intelligence:

1. **Robot Pharmacy:** Robotic technology is used by UCSF Medical Center to track and prepare medications with the goal of enhancing patient safety. They claim that the technology has flawlessly prepared 3,50,000 doses of medications[15].

2. **MEDi Robot:** MEDi is medical and engineering designing intelligence oversaw the project that resulted in the development of pain management robot by Tanya Beran, an Albertan professor of community health sciences at the University of Calary. After creating a rapport with kids, the

robot explains to them what to expect during a medical procedure[16].

3. **TUG Robots:** Aethon TUG roots are made to move through hospitals on their own and deliver supplies, meals, medications, specimens, and heavy items like trash and linen. It comes in two configurations; one an exchange baseplatform that can be used to move racks, bins, carts and other fixed and secured carts.

4. **Erica Robot:** Professor Hiroshi Ishiguro of Osaka University of Japan is the inventor of newcare robot Erica. It was created in cooperation with Kyoto University, the Advanced Telecommunications Research Institute International (ATR) and the Japan Science and Technology Agency.

Benefits of Artificial Intelligence Technology:

1. **Accuracy Improvement:** AI helps in reducing mistakes and enhancing precision, resulting in increased Accuracy

2. **Challenging Expedition:** AI has a capability to explore the ocean by overcoming human – induced errors[17].

3. **Routine Implementations:** GPS systems are widely employed during extended journeysnand the integration of artificial android devices helps in predicting user input and rectifying spelling errors[18].

4. **Artificial Intelligence Assistants:** AI systems like "avatars" or models of digital assistants, are being used by sophisticated organizations these days to reduce the need for human labor[19].

5. **Clinical Applications:** With the help of AI programs, doctors can generally evaluate their patient's conditions and analyse any side effects or other health risks related to their medications. With the use of AI applications, such as different artificial surgery simulators, trainee surgeons can learnt a lot[20].

6. **Enhanced Technological Progress Rate:** The world's cutting-edge technological advancements use AI technology it strives to create newer molecules and is capable of generating various computational modelling programs[21].

7. **Assistant and Relief:** AI technology serves individuals of all ages, both children and elderly round the clock, taking on roles as educational resources for teaching and learning.

8. **Infinite Possibilities:** Machine operate without limitations and devoid of emotions. These emotionless machines can outperform humans in various tasks executing them with greater efficiency and precision.

9. **No risks and Limitless functions:** Working in very critical areas like fire stations, there are huge chances of causing harm to the personnel engaged. Machines are not restricted to any boundaries; the emotionless machines can do everything more efficiently and produce more accurately than the human beings.

Drawbacks of Artificial Intelligence:

1. **Expensive:** AI causes huge money consumption, complex designing of machine maintenance and repairing are highly cost effective. AI machine needs updating the programs regularly. The reinstallations as well as recovery of the machine consume longer time and huge money.

2. **No Original Creativity:** Machines with AI technology have neither sensitivity nor the emotional intelligence. Humans have the ability to hear, see, feel, and think. These features are not achievable by the uses of machines.

3. **No Improvement with Experience:** Human resource can be improved with experiences. In Contrast, machines with AI technology cannot be enhanced with experience. They are unable to identify which individual is hard working and which one is nonworking[22].

4. **No Replicating Humans:** Robots with the AI technology are associated with the power of thinking like human and being emotionless as these add some advantages to perform the given task more accurately without any judgement. If

unfamiliar problems arise, robots cannot take decision and provide false report.

5. **Unemployment:** The widespread uses of AI technology in all the sectors may cause large scale unemployment. As because of undesirable unemployment, human workers may lose their working habits and creativity[23,24].

Vision of Artificial Intelligence:

In the Healthcare sector, day to day revolution is taking place, a Johnson and Johnson representative said that "Artificial Intelligence is giving us the ability to discover new treatments and techniques faster than we would have thought possible just a decade ago". This is an exciting moment to work in this field as well. They went on the market for healthcare AI is expanding quickly and is generating lucrative and fulfilling careers[25]. AI is being employed to proactively avoid medical mistakes and lower the frequency of hospital readmissions.

CONCLUSION:

In few last years, a considerable amount of increasing interest towards the uses of AI technology has been identified for analyzing as well as interpreting drug discovery, dosage form designing, etc. Errors could impede the progress of combating the virus, so many factors need to be taken into account for effective use in real world application to guarantee the solutions meet the needs of the business. The human rain is a highly successful machine that strives to create something that is far more efficient than a human being at any given task. The field has undergone significant change as a result of AI tools like robotic pharmacy, tug robot, and Watson for oncology. As a result of the uses of AI approaches, the designing of the new hypotheses, strategies, prediction and analyses of various associated factors can easily done with the facility of less time consumption and inexpensiveness. The creation and implementation of algorithms for data interpretation and learning analysis is known as Artificial Intelligence.

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