

## Artificial Intelligence Application in the pharmaceutical industry

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### ABSTRACT:

Pharmaceutical industry is one of the first to benefit from artificial intelligence (AI), which has just begun to be used in many areas of society. This review focuses on drug discovery and development, drug recycling, drug product development, clinical trials, etc., to reduce human labor and achieve goals quickly. It highlights the benefits of intellectual property in various areas of the pharmaceutical industry, including cross-talk also covers the future of AI in the pharmaceutical industry, challenges and solutions, and tools and strategies for implementing AI. It helps to discover novel compounds. To create medications and new, efficient ways to treat uncommon disease, it can conduct research and compare published scientific information with other sources, including the outcomes of clinical trials.

**Keywords:** Artificial intelligence; Drug Discovery; quality assurance; manufacturing; Clinical trials.

### I. INTRODUCTION:

Artificial intelligence is the process of simulating human intellect in robots so that they can think and act like people. These characteristics of AI give it a unique capacity to reason and choose behaviors that have the greatest likelihood of achieving a particular aim. AI is the branch of research that deals with creating devices that can do cognitive tasks including logic, reasoning, planning, learning and perception. [1]. New treatments for diseases are found through a process called drug discovery. It calls for the application of many different technologies and specializations. Generally speaking, finding and creating a drug production typically costs US\$2.8 billion and years. [2]. Specifically created conceptual frameworks called artificial neural networks (ANN) are used to carry out AI algorithms. They are an exact replica of the

human brain, which is a network of connected neurons made of weighted neural pathways for communication. [3]. Although the idea of artificial intelligence (AI) was introduced in 1956, considerable advancements have been made during the past twelve years. In order to give treatments more quickly and with better results, evaluating thousands of medical records is helpful. Artificial intelligence (AI) mimics human qualities. Employing computer systems that resemble machines, intelligence, and procedures. This technology can fast learn, forecast, analyze, draw conclusions, and even self-correction. It was intended to address a variety of medical issues related to planning, imaging, speech recognition, and learning a certain attribute. AI systems offer training on a given amount of data to forecast better results and assist in accurately resolving complicated challenges [4]. The reproduction of human intellectual processes by machines, particularly computer systems, is known as artificial intelligence (AI). These include knowledge (the acquisition of information and the rules for utilizing it), reasoning (the application of rules to arrive at potential conclusions), and self-correction. John McCarthy, who worked in the Stanford University Department of Computer Science, provided the first definition of artificial intelligence. In 1955, he coined the phrase and gave it the definition "the science and engineering of making brilliant and cunning machines" [5].

### AI in drug discovery:

The huge chemical location contains >1060 atoms, encouraging the development of numerous chemical molecules. Be that as it may, the need of innovation has restricted the advancement of medication, making it time-consuming and costly, which can be ascribed to the utilization of counterfeit strategies. AI can recognize compounds and precious stones, give speedier medication utilize

plans and way better medicate definitions for Section[6]. In show disdain toward of its inclinations, AI faces a couple of vital data challenges, such as the scale, advancement, contrasting qualities, and uncertainty of the data. The data sets available for cure progression in pharmaceutical companies can involve millions of compounds, and ordinary ML rebellious might not be able to deal with these sorts of data. Quantitative structure-activity relationship (QSAR)-based computational appearance can quickly expect sweeping numbers of compounds or clear physicochemical parameters, such as log P or log D. In any case, these models are some ways from the predictions of complex normal properties, such as the reasonability and adversarial impacts of compounds. In extension, QSARbased models as well stand up to issues such as small planning sets, and exploratory data bumble in planning sets, and require experimental validations. To overcome these challenges, as of late made AI approaches, such as DL and relevant modeling considers around, can be actualized for security and practicality evaluations of steady particles based on gigantic data modeling and examination. In 2012, Merck maintained a QSAR ML challenge to observe the inclinations of DL inside the drug, discovery handle inside the pharmaceutical industry. DL models showed up critical predictivity compared with traditional ML approaches for 15 maintenance, scattering, absorption framework, excretion, and noxious quality (ADMET) data sets of drug candidates [7].

#### **AI in pharmaceutical manufacturing:**

Modern manufacturing systems are attempting to impart human knowledge to machines as a result of the growing complexity of manufacturing processes, as well as the growing desire for efficiency and greater product quality. This is continually altering the production process [8]. The pharmaceutical business may benefit from the application of AI in production. Utilizing the automation of many pharmaceutical activities, tools like CFD employ Reynolds-Averaged Navier-Stokes solvers technology to examine the effects of agitation and stress levels in various pieces of equipment (such stirred tanks). Similar systems, including big eddy simulations and direct numerical simulations, use sophisticated techniques to address challenging flow problems in the industrial industry[9]. The innovative Computer platform, which uses a scripting language called Chemical Assembly and incorporates multiple

chemical codes, aids digital automation for the synthesis and manufacture of molecules. Sildenafil, diphenhydramine hydrochloride, and rufinamide have all been successfully manufactured with it, and the yield and purity are noticeably similar to those obtained by manual synthesis [10].

#### **AI in quality control and quality assurance:**

A balance of several criteria must be struck during the production of the desired product from raw materials. It takes human intervention to maintain batch-to-batch uniformity and conduct quality control testing on the products. This illustrates the necessity for AI implementation at this level and how it might not always be the best course of action. The FDA revised Current Good Manufacturing Practices (cGMP) by adopting a "Quality by Design" method to comprehend the crucial process and particular standards that determine the pharmaceutical product's ultimate quality [11]. Gams et al. used a combination of human efforts and AI, wherein preliminary data from production batches were analyzed and decision trees developed. These were further translated into rules and analyzed by the operators to guide the production cycle in the future. Goh et al. studied the dissolution profile, an indicator of batch-to-batch consistency of theophylline pellets with the aid of ANN, which correctly predicted the dissolution of the tested formulation with an error of <8% [12].

#### **AI in clinical trial design:**

Clinical trials take around 6-7 years to complete and include a substantial financial outlay in order to determine the safety and effectiveness of a medicinal product in people for a specific illness condition. Only one out of every ten molecules that undergo these trials, though, are cleared successfully, which is a huge loss for the industry. These failures may be the consequence of bad infrastructure, poor technological requirements, and poor patient selection.

However, with the abundance of digital medical data available, these errors may be minimised with the use of AI[13]. One-third of the time required for a clinical study is spent on patient enrollment. The enrollment of eligible patients can assure the success of a clinical study, since doing so would prevent the 86% of failure instances that would otherwise occur [102]. By applying patient-specific genome-exposome profile analysis, AI may help to choose just a certain sick population for recruitment in Phase II and III of clinical trials,

which can aid in the early prediction of the available therapeutic targets in the selected patients [19,101]. Prior to the beginning of clinical trials, preclinical molecule discovery as well as the early prediction of lead compounds using other aspects of AI, such as predictive ML and other reasoning techniques, aid in the selection of the lead molecules that would pass clinical trials [14].

### AI in pharmaceutical product management:

AI in Market positioning:

Market positioning is the process of giving a product a distinct identity in the marketplace to entice customers to purchase it, making it a crucial component of nearly all business strategies for enterprises to forge their own distinctive brand[15]. Using this strategy, the business promoted the original brand of Viagra, targeting it not just for the treatment of men's erectile dysfunction but also for other issues that had a negative impact on quality of life[16]. Technology and e-commerce as a platform have made it simpler for businesses to establish a brand's natural awareness in the public sphere. As revealed by the Internet Advertising Bureau, businesses use search engines as one of the technology platforms to hold a prominent place in online marketing and aid in the positioning of the product in the market. Companies regularly work to rank their websites higher than those of rivals in order to quickly boost brand recognition[17].

### AI in the monitoring of patient:

In patient monitoring, which entails computer-aided data collecting, transmission, and processing, AI is essential. Additionally, this aids in exchanging the high level of quality. The development and integration of new technology and communication standards are also aided by computerization and data exchange. Health practitioners get benefits from not relying on local knowledge and equipment for illness diagnosis. At the remote site, the patient's various reports and graphic representations may be made available. Patient monitoring and handling quantitative patient data may be done using multivariate statistical process monitoring for data processing and intelligent instruments. Additionally, IF/THEN decision rules may be used to process patient data.

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### III. CONCLUSION:

The use of AI and ANNs in the pharmaceutical and healthcare industries, from drug discovery through clinical trials to patient care, is now being extensively researched. The pharmaceutical industry has demonstrated the potential benefits of AI, and it can potentially be utilised in conjunction with robotics. By promoting healthy living and reducing the need for hospitalization, physical robots have the potential to transform life care services. In order to maintain the mental sharpness of elderly patients, it is also utilized for talks and social engagement. The use of AI in pharmaceutical manufacturing will assist to save costs, speed up production, and enhance yield and purity. Although AI has so far shown potential progress in the pharmaceutical industry, there are still certain restrictions. There was given to the AI virtually all of the data accessible, yet that level of precision is still not attained. It's likely that AI requires more data or better algorithms to function at a higher level. In order to function at their best, ML algorithms usually need millions of data points. In the healthcare industry, AI may enable researchers to execute AI-assisted randomization schemes employing a high-dimensional collection of factors, forecast outcomes earlier while perhaps injuring fewer individuals. Businesses that operate on technological platforms like AI have also aided in the analysis of client needs based on past consumer behavior.

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