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APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN PHARMACEUTICAL INDUSTRY

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ABSTRACT

Over the last several decades, advanced engineering is come up with great inventions that have contributed to varied areas of the pharmaceutical sector, which is among the far-reaching automation systems is Artificial Intelligence. This technology was developed to research critical circumstances more readily than the human mind, with fewer inaccuracies and mistakes. The utilization of artificial intelligence technologies has shown immeasurable growth in pharmaceuticals and other healthcare sectors. It shoots up productivity and brings down drug development expenditure within the pharmaceutical field, whereas technologies and networks have shown promising outcomes to satisfy the present necessity. Advanced analytics technologies are common lately in pharmaceuticals both within commercial and regulation aspects. This present review depicts the use of Artificial Intelligence within the pharmaceutical market such that it reduces burdens while achieving the specified end within a short period of time, the tools of Artificial Intelligence, principles, Artificial Intelligence and the Pharma Industry and its future perspectives.

Keywords: artificial intelligence, machine learning, tools of AI, applications of AI, future perspective

INTRODUCTION

Artificial intelligence is an area of technology that deals with conflict through the medium of symbolic programming **[1]**, also cope with the pretence of intelligent

behaviour in a computer as compared to human intellect **[2]**. Artificial Intelligence is a self automation technique that involves different tools and networks to ideally impersonate human thinking ability without any misconceptions **[3, 4]**. The focus is to pick out the applicable details, get to the bottom of any complication issues, and give an outline statement in terms to figure it in the requisite period of time **[5]**. AI has to lead the way to the remarkable uprising in pharmaceutical industries hence, it is being intently utilized in each respective discipline of medicine. In present days, many pharmaceutical companies are facing a major obstacle in the discovery and development of medications due to a complete lack of resources and skills. Consequently, Machine learning would be an asset for drug development and other known necessity in the pharmaceutical sector **[6]**.

The Principles of AI and Machine Learning

In the year 1956, John McCarthy came up with the term "artificial intelligence" first at Dartmouth conference **[7]**. Likewise, AI has success cycles referred to as "AI winters" **[8]**. In the recent past, it has played a significant impact in the fields of healthcare **[9]**, engineering **[10]**, and transportation **[11]**. Machine learning has been a well-known AI computer approach, precisely alters or revises the operations, supervised learning and unsupervised learning are the two sorts of algorithms **[12]**. Furthermore, it is being implemented across different healthcare sectors, which includes disease detection, assessment along with radiotherapy **[13]**.

Tools and Network of AI

Many technologies emerge to satisfy the demand of pharma needs, addition to a wide range of tools which have demonstrated and optimistic end products and attain immense acceptance inside the world of medicines, as noted below:

IBM Watson for oncology: A supercomputer has been developed by IBM and named Watson, designed to answer questions with the fusion of AI and analytical software **[14]**. This supercomputer lends a hand to oncologists in making the best and possible choice concerning cancer treatment. It write and collects all the detailed history of the patient in the English language, which helps them come up with the right treatment strategy for the patient's speedy recovery. It merges all the crucial aspects of a patient's file with external clinical research, and data **[15]**.

Robot pharmacy: UCSF Medical Centre deployed robotic technology and termed it "Robot pharmacy" to create and manage the supply chain of pharmaceuticals while also improving patient safety criteria. It is often used in the production of oral and

injectable drugs. Providing little relief to nurses and pharmacists who might placed their degree to good use by relying on direct clinical services including negotiating with physicians. Consequently, it proved being more sophisticated than humans in terms of both knowledge and ability to distribute precise medications. It consists of a pair of pharmacy data warehousing, one refrigerated together with two non-refrigerated, and perhaps an inventory management system enabling tracking medical supplies across its distribution chain **[16]**.

MEDi Robot: "Medicine and engineering designing intelligence" is yet another term for MEDi. Tanya Beran, professor, was in charge of the operation. After working in a hospital where kids developed the habit of screaming throughout medical procedures, inspired her to create MEDi **[17]**. MEDi initially establishes empathy with kids, subsequently notifies them about what to expect throughout the process, directs them through it, and trains them about what to do and how not to do it, along with respiration techniques, even how to react with them. It already has crafted facial detection and recognition technology but also can communicate 20 multiple accents **[18]**.

Erica Robot: Hiroshi Ishiguro, the Japan Science and Technology Agency, the Advanced Telecommunications Research Institute International, and Kyoto University collaborated on the project. Erica's face is a fusion of European and Asian human attributes, and has a great command of the Japanese language **[19]**. It is often considered to as the "most beautiful and intelligent" robot, with the way of answering questions and the aspects over 30 beautiful women integrated in **[20]**.

TUG Robots: Created to work all alone, independently throughout the hospital and transport medications, meals, pieces of stuff, and loads, with two types of layout: the exchange platform is often used to move items which can be piled on separate racks, while the fixed and secured trolleys are being used to handle trays, bin, transporting prescriptions, and some other samples. It is operated using a user-friendly touchscreen, and it uses sensor-based technology to detect low-lying obstacles with 180-degree coverage. TUG provides unwavering services to enhance output while ensuring patient security **[21]**.

Berg: It is indeed a biotech startup based in Boston that aims to hasten drug discovery process and bring down the expense during an AI operation. Berg incorporates an immense databank of patients to detect the diverse biomarkers liable for inducing disease, and then selects which treatments should be used in accordance with the statistics acquired. Collection of sequenced data from tissue samples, research about metabolites,

protein formation, and data processing via algorithms are the next elements in determining the specific cause of ailment **[22]**.

Application of Artificial Intelligence in the pharmaceutical market

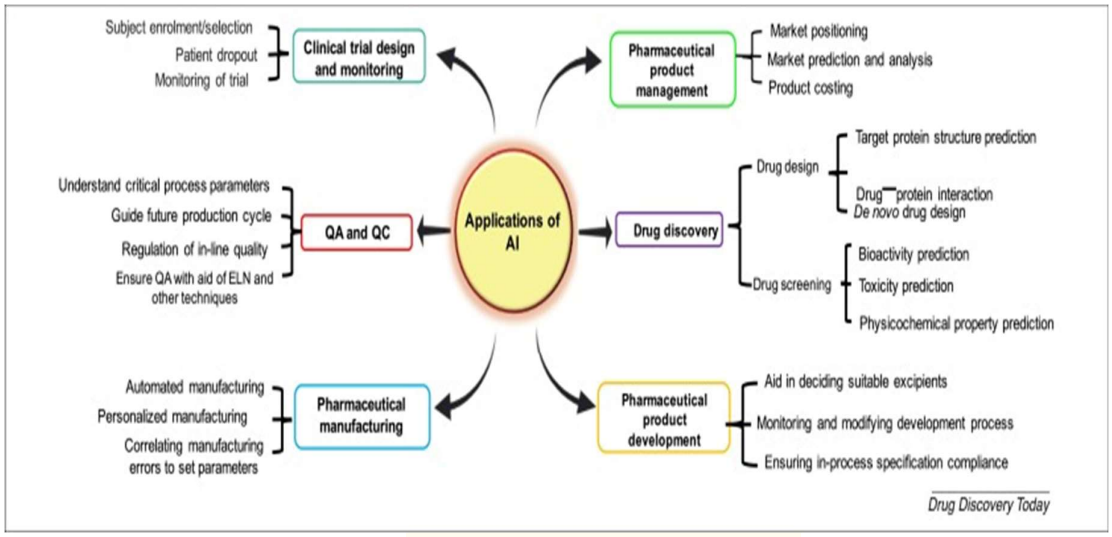

Figure 1: Applications of artificial intelligence (AI)

In Drug Development

Klopman proposed it for analysis of structures and to evaluate the structure-activity relationship (SAR) of organic molecules. It recognises, aggregates, and examines biophores, also overlook the components of KLN code. The strategy was applied to examine polycyclic aromatic hydrocarbons' carcinogenicity, the action of ketoxime carbamates, and the carcinogenicity of N-nitrosamine **[23]**. By randomly preparing two enormous databases of 9-amino-acid peptides, Cherkasov *et al*. were capable to synthesise short peptides having broad-spectrum antibiotic properties. These models were proven to be considerably successful in predicting action although to be fairly active against a broad array of multidrug-resistant "Superbugs," with activity comparable to that of other regularly used antibiotics. They were demonstrated to become much easier to create than any advanced clinical candidate, an antimicrobial peptide, and they were equally potent against Staphylococcus aureus infections in animal models **[24, 25]**. Aliper *et al*. revealed a unique approach that used deep neural networks (DNNs) to predict the pharmacological activity of a range of drugs. Given training by a team of scientists such that they might be utilised to forecast the therapeutic usage of many prescription medicines, utilising information from organic phenomena.

These results were obtained by experiments on human cell lines **[26]**.

In Formulation:

Controlled release tablets: Hussain and coworkers modelled in vitro release parameters, a range of medicines distributed in matrices derived from different hydrophilic polymers, with neural networks in variety of studies **[27]**. In such a study conducted to examine various formulations of Voltaren from such a matrix tablet composed of cetyl alcohol, researchers used computational models to anticipate drug release rates and optimize it using two and three-dimensional response surface analysis **[28]**.

Immediate-release tablets: Turkoglu and coworkers looked into it and utilised neural networks models and statistics to analyse hydrochlorothiazide tablet formulations. The created networks seek to provide three-dimensional plots of massing duration, compression pressure, and crushing strength, or drug release, massing time, and compression pressure, to maximise tablet strength. It was observed that the ideal formulation is defined by the limits placed on the constituent amounts to be employed within the formulation. Hence, the output requirement suffers greatly by the comparative consequences. Only at the expense of disintegration time could a low friability and a high tablet strength be achieved **[29]**.

In Product Development: The primary and foremost feature of artificial neural networks is their potential to make things more widely used and applicable. It is engaged with the improvement of several production parameters aspects. These attributes builds it apt to figure out the difficulties while they are already in the method of resolving them **[30]**.

AI and Pharma Industry

AI accomplishes more or less in every feature for developing drugs, possesses a beneficial and dominant impact on the pharma sector **[31]**. To attenuate the financial expenses and chance of failure, companies are shifting towards Intelligent machines. During the last few years, the pace of start-ups leading to AI has shown interesting outcomes in terms of study and development **[32]**. Several pharmaceutical companies are planning to collaborate towards Intelligence in terms of improving healthcare tools **[33]**. The achievement of AI rely upon the supply regarding immense knowledge**,** since data are utilized as forthcoming practices stated to the system. Leading to a lack of competent personnel, but also safety and regulatory hurdles, AI is not being utilized to its full potential **[34]**.

AI and Machine Learning's Future Outlook

The advantages of Automation in pharma sciences are apparent. It does not only boost up the end outcomes in a short interval of time, but also facilitates seeking out more organised solutions concerning sustaining productivity levels with swift yield **[35]**. One significant key merit of deep learning would be that no constraints are faced while executing machine learning algorithms. Distinct sorts of data, like classification tasks, multidimensional groups, including persistent data, are all examined by machine learning **[36]**. Hence, utilising these approaches on medical datasets may necessitate directed, and every learning algorithm must execute "task specifically" **[37]**.

CONCLUSION

Artificial Intelligence serves as an eminent platform within the expansion of the pharmaceutical sector and is slowly becoming an indispensable part of other health care sectors associated with safety and accuracy outlook. The availability of modern innovations shows a very promising outcome and gives value-producing opportunities. Advanced analytics are better qualified for performing operations much more quickly. Hence, the chance of delusion is of no consequence. This suggests that the world goes to depend fully on intelligence or its forthcoming projects. It diminishes fault and lapses that occur often periodical when human manages routine duties, which escalates the efficiency rate. Sequentially, in order to attain higher net profit, better quality for the firm. As a consequence, it often illustrates why the pharmaceutical sector is becoming increasingly reliant on this technology, which will emerge as a valuable resource shortly.

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Conflict of interests

Authors declare no conflict of interest amongst themselves.

Ethical approval

Since this work does not involve any animal studies it does not require Ethical approval.

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