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ADVANCEMENT OF ARTIFICIAL INTELLIGENCE IN HOSPITAL PHARMACY: A REVIEW

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ABSTRACT:

The goal of artificial intelligence (AI) is to create intelligent modeling that aids in knowledge envisioning, problem-solving, and decision-making. Artificial intelligence (AI) was previously only used in the field of engineering, but in recent years, it has become increasingly essential in many areas of pharmacy, including drug discovery, the development of drug delivery formulations, management, marketing, quality assurance, hospital pharmacy, personalized medicine, patient monitoring and care, etc. Different Artificial Neural Networks (ANNs), such as Deep Neural Networks (DNNs) or Recurrent Neural Networks (RNNs), are used in the creation of drug delivery formulations. The effectiveness of the technique in quantitative structure-property relationships (QSPR) or quantitative structure-activity relationships (QSAR) has been demonstrated in many drug discovery implementations that have recently undergone analysis. AI is a branch of research and engineering that focuses on creating fascinations that mimic cautious behavior and artificially appreciating what is typically referred to as prudent behavior. The broad idea of artificial intelligence (AI) encompasses several innovations that are anticipated to solve issues with human-like insight. The implementation of the notion of artificial intelligence is allegedly going to change the healthcare industry as the next industry. Critical illnesses like neurology, cancer, diabetes, and cardiology are treated

with AI technology. Health-related AI applications' main goal is to examine the connections between prevention or treatment methods and patient outcomes.

Keywords: Artificial intelligence, drug discovery, hospital pharmacy, artificial Neural Networks, quantitative structure-property relationships, healthcare industry

INTRODUCTION:

The term "artificial intelligence" (AI) refers to a collection of varied intelligent processes and behaviors that have been established using computer models, algorithms, or a set of rules to help machines emulate human cognitive abilities like learning and problem-solving [1,2]. The idea of artificial intelligence has a lengthy history. Since the 1950s, there have been a few forward-looking assurances that artificial intelligence will eventually replace human labor. In any case, it became out that knowledge at the human level was more muddled than previously thought. This led to a few "artificial intelligence winters," during which interest in AI waned. A wise specialist in artificial intelligence is a system that is aware of its surroundings and engages in actions that increase the likelihood of its development. Man-made consciousness essentially refers to machine learning and the area of software engineering that is meant to produce it [3]. Organizations are becoming more involved in and integrated with academic efforts. IBM has created Watson for a few medical science applications, such as Watson for Oncology and Watson for Genomics, and numerous new companies are catering to every imaginable aspect of the healthcare industry [4]. Numerous applications of AI are now being studied, with open and private speculation and premium being widely used. Significant innovation corporations are investing heavily in the development of AI for medical services and research, including Google, Microsoft, and IBM. The number of new AI enterprises has also been steadily increasing. AI may be able to better arrange patient courses or treatment plans and provide clinicians with all the information they require to make excellent medical and medication decisions [5].

Most medicines cost billions of dollars and take ten years or more to reach the market for pharmaceuticals. The traditional pharmaceutical system is primarily reliant on manual tasks and human judgment, which can result in inefficiencies, mistakes, and delays. The process of filling a prescription, for instance, entails several manual procedures, including reading the prescription, dispensing the medication, and confirming the dosage and frequency [6-8]. Drug

development is therefore more expensive, time-consuming, and prone to mistakes. Additionally, the traditional pharmacy system does not allow for the customization of medication regimens for specific individuals, which may reduce the effectiveness of drug therapy. However, pharmacists can improve their operations and get beyond these restrictions by utilizing AI-powered solutions like AI**.** The concept of AI appears to be more promising in overcoming these drawbacks and should result in successful drug development programs [9]. AI is being used in new technologies such as drugs, prosthetics, and evolving and advanced robotics. Additional benefits of AI in the drug development process include identifying drug targets, suggesting molecules from data libraries with chemical modifications, and sometimes repurposing the drug [10, 11]. From prescription interpretation to medicine delivery, AI can help automate different areas of the pharmacy workflow, lowering the chance of errors and increasing productivity. AI can also help pharmacists create customized medicine regimens that are suited to the patient's particular needs and medical background by evaluating vast volumes of patient data. The traditional pharmacy system has been successful in giving patients the necessary medications, but it has limitations due to its manual procedures and lack of customization. Clinical decision-making, disease detection, and automation are all significantly impacted by AI's rapid entry into the healthcare industry [12]. Because AI can examine vast amounts of data from numerous modalities, there are opportunities for it to be further investigated in the pharmaceutical and healthcare fields [13].

Several recent studies go into detail about how AI is used in the healthcare industry and other industries. Machine learning (ML), natural language processing (NLP), physical robotics, robotic process automation, and other AI technologies are used in the healthcare sector [14]. In machine learning (ML), neural network models and deep learning with different features are applied to imaging data to detect clinically relevant elements at the early stages, particularly in cancer-related diagnoses [15, 16]. NLP makes use of computational methods to understand and interpret spoken language. Recently, ML techniques have been widely adopted in NLP to explore unstructured data in databases and records such as doctor's notes, lab reports, etc. by mapping the critical information from various imagery and textual data that aid in decision-making regarding diagnosis and treatment options [17]. Patients now have a route to a speedy and accurate diagnostic as well as specialized therapeutic strategies thanks to ongoing disruptive innovation [18]. Platforms that may use several data types, including patient-reported symptoms, biometrics, imaging, biomarkers, etc., have been identified as AI-based solutions. The development of AI has made it feasible to anticipate potential illnesses,

increasing the likelihood that they can be prevented as a result of early detection. Several areas of healthcare, such as nursing, telemedicine, cleaning, imaging, surgery, rehabilitation, etc., use physical robots [19, 20]. Robotic process automation makes use of technology that is low-cost, simple to develop, and capable of carrying out structured digital chores for administrative needs while acting as a semi-intelligent system user. Using this along with image recognition is another option. This technology can be used in the healthcare system for repetitive operations like prior authorization, patient record updates, and billing [21]. The application of AI-powered tools, such as AI, can get beyond these restrictions, improving the pharmacy system's effectiveness, accuracy, and personalization in the process [22–25].

EARLY RESEARCH:

According to outdated history texts (the phrase itself was coined by John McCarthy in 1955), the most prominent applications of AI in the field of restorative medicine took place in the 1970s. Early researchers, like Alan Turing, originally raised the question of whether it was possible to program computers to operate somewhat like the human cerebrum (i.e., to think). [26]

AI GOALS:

Expert system development:

It entails developing intelligent, automated systems that can advise users on the best course of action.

Human intelligence in computers:

It will aid in the development of cognitive patterns similar to human cognition in computers, enabling them to act human-like and take the necessary actions to deal with difficult situations.

Multi-domain applications:

AI will help with the implementation of many other fields, including psychology, medicine, ethics, the natural sciences, healthcare, and more [27].

DISCOVERY DRUG BY ARTIFICIAL INTELLIGENCE:

The process of finding and creating new medications is known as drug discovery and development. Artificial intelligence has been included in this procedure in recent years. AI can

be used to develop new medications, discover possible therapeutic targets, and forecast the results of pharmacological trials [28, 29].

In drug development, testing a chemical on sick cell samples could take a while. More research is required to identify compounds that are physiologically active and deserving of further study. Researchers from Novartis can identify which untested substances are likely to merit further investigation using images from machine learning algorithms [30–33]. The costs related to manually examining each chemical are decreased when novel and effective drugs are identified more quickly utilizing computers than with conventional human analysis and laboratory trials. The top biopharmaceutical companies are presently working on an AI project that includes: Using a mobile platform, health outcomes can be improved - Real-time data collection enables doctors to suggest patients and consequently improve patient outcomes [34–37]. Pharmaceutical corporations are working with software companies to use the most cutting-edge technologies in the time-consuming and expensive process of drug research.

MEDICINE AND CARE:

In the healthcare industry, which suffers from a talent shortage, artificial intelligence (AI) has a lot of potential. Four applications have been identified as the most promising as of this writing: To properly detect diseases, a doctor must undergo years of training. Even once training is complete, diagnosing a patient can take some time and effort [38–40]. In this area, demand for professionals often outpaces supply because of a persistent labor shortage. The science of autonomous disease diagnosis has made considerable strides in recent years, and deep learning algorithms in particular. Diagnostics could become more affordable and accessible thanks to artificial intelligence (AI) [41–43].

APPLICATIONS OF AI:

AI in diagnosis and targeted genomic treatments:

In hospital-based healthcare systems, AI is used in many ways [44, 45] to organize dose forms for particular patients and choose appropriate or available administration routes or treatment guidelines.

Maintaining medical records:

The upkeep of patients' medical data is a challenging endeavor. The use of the AI system simplifies data collecting, storage, normalization, and tracing. The Google Deep Mind health

project [46] helps to quickly extract medical records. As a result, this project is beneficial for providing quicker and better healthcare.

Treatment plan designing:

With the use of AI technology, effective treatment programs can be designed. When a patient develops a severe condition and choosing an appropriate treatment plan becomes challenging, an AI system is required to maintain control of the situation. The treatment plan provided by this technology takes into account all of the prior data and reports, clinical expertise, etc. The software as a service IBM Watson for Oncology is a cognitive computing decision support system that assesses patient data against thousands of prior cases and knowledge gained from collaborating with Memorial Sloan Kettering Cancer Center doctors for thousands of hours. It then offers treatment options to assist oncology clinicians in making knowledgeable decisions. More than 300 medical periodicals and 200 textbooks, totaling about 15 million pages of text, and maintained by Memorial Sloan Kettering, are used to support these therapy alternatives [47].

Assisting in repetitive tasks:

AI technology also helps with some tedious activities, such as analyzing X-ray images, radiography, ECHO, ECG, etc. to find and diagnose diseases or abnormalities. An IBM algorithm called Medical Sieve [48] is a "cognitive assistant" with strong analytical and deductive skills. To enhance the patient's condition using deep learning and medical data, a medical start-up is required. For each bodily part, there is a specialized computer program that is used in particular disease situations. For practically all imaging analyses, including X-ray, CT scan, ECHO, ECG, etc., deep learning can be used.

Health support and medication assistance:

The usage of AI technology in recent years has been acknowledged as effective for pharmaceutical assistance as well as health support services. The start-up-designed virtual nurse Molly [49] is greeted with a friendly voice and a smiling visage. Its purpose is to support patients with chronic diseases during medical appointments and to assist individuals in directing their care. A program called Ai Cure [50] that works with a smartphone webcam monitors patients and helps them take control of their diseases. individuals who take part in clinical trials and individuals with serious drug issues can both benefit from this app.

Employees can spend more time directly caring for patients because dispensing errors are decreased [51]. Holdings of stocks have decreased [52]. Products circulated in the warehouse with a greater variety [53]. A decrease in the amount of stock that is discarded because it has expired [54]. Waiting times and contamination risks are decreased and it boosts effectiveness.

Accuracy of medicine:

The influence of AI on genetic evolution and genomics is positive. An AI system called Deep Genomics [55] helps identify patterns in genetic data and medical records that relate particular mutations to specific diseases. This technique provides clinicians with information on what happens inside a cell when genetic variation modifies DNA. The inventor of the human genome project, Craig Venter [56], created an algorithm that uses DNA to provide details on a patient's physical traits. To pinpoint the precise site of cancer and vascular disorders in their early stages, "Human Longevity" AI technology is helpful.

It is also used in personalized medicine to create medical treatments that are unique to each patient. In the pharmaceutical sector, personalized medicine can be applied to the development of medications that are uniquely suited to each patient, the identification of patients who are likely to respond to a certain medication, and the prediction of a medication's side effects [57–59]. Using artificial intelligence systems to forecast future events is known as predictive modeling. Predictive modeling can be used in the pharmaceutical business to foretell a patient's propensity for contracting a specific illness, the effectiveness of a medication, or its negative effects [60].

Drug Reaction:

Pharmaceutical research & development takes more than ten years and costs billions of rupees. The supercomputer-based AI program "Atomwise" helps locate treatments in a database of molecular structures. It launched a virtual search campaign for a secure and productive treatment for the Ebola virus using already available medications. Two medications that spread the Ebola virus were found thanks to technology. In contrast to manual analysis, which could take months or even years, this analysis was finished in a single day. Big data was created by a Boston-based biopharma company for patient management. Data is held back to determine the causes of some patients' disease survival. To distinguish between meteorological conditions that are conducive to health and those that are conducive to disease, researchers employed

biological data from patients and AI technology. It supports the development of applications for problem-solving, healthcare, and drug discovery [61].

AI HELPS PEOPLE IN THE HEALTH CARE SYSTEM:

One of the top 10 emerging technologies in 2016 was the "open AI ecosystem". Gathering and comparing data from social awareness algorithms is helpful. In the healthcare system, a large amount of data is logged, including patient medical histories and treatment information going back to childhood. Ecosystems can analyze this vast amount of data and make recommendations on the patient's behaviors and way of life [62].

Healthcare system analysis:

Data retrieval in the healthcare system is made simple if all the data is digitized. 97% of the bills in the Netherlands are kept in digital format, and they include information about the treatments received as well as the names of the hospitals and doctors who provided them. Because of this, they are simple to retrieve. Utilizing cloud computing from IBM Watson, a local business, Zorgprisma Publiek analyzes the bills. It senses every accident right away and reacts appropriately. This makes a difference and keeps patients out of the hospital [63]. Clinical care, medical imaging, echocardiography, screening for neurological problems, surgery, image-based diagnosis, radiography, dermatology, skin image analysis, pathology, medicine, and drug development are some of the potential clinical applications of artificial intelligence [64].

AI IN PHARMACY PRACTICE IN HOSPITAL AND COMMUNITY PHARMACIES:

Emails can be customized with machine learning models more quickly and accurately than a human could. Chatbots can be used to boost service delivery effectiveness. Customer complaints and inquiries can be automatically resolved by chatbots, while the most challenging inquiries are forwarded to human workers. The chatbots can be developed to simulate interactions between pharmacists and patients [65]. Walgreens teamed up with telehealth company Medline to establish a channel for patients to communicate with medical staff via video chat. Imagine as a retail pharmacist being able to foresee what your patients will require shortly, stocking those items, and using tailored software to send e-mails to patients to remind

them of their medication needs. It is possible to forecast a patient's future drug purchases by using AI-powered data analytics [66].

Although there are currently available inventory management programs and tools used in retail pharmacies, such as Mckessons, Liberty, Winpharm, PrimeRx, and WinRx, not all of them make use of AI or machine learning. For instance, the German online and catalog retailer Otto Group used software created by Blue Yonder, an AI business. With 90% accuracy, this software can forecast what Otto will sell in the next 30 days. This resulted in a one-week delay in the delivery of purchased goods [67]. The University of California San Francisco (UCSF) Medical Center uses robotic technology for the preparation and tracking of pharmaceuticals to increase patient safety. They claim that the technology has accurately prepared 3,50,000 doses of medication. The manufacture of hazardous chemotherapy drugs for oral and injectable use is one of the capabilities of robotic technology. The pharmacists and nurses at UCSF now have the freedom to put their skills to use by concentrating on providing direct patient care and collaborating with the doctors. The computers in the pharmacy's automated system first receive electronic prescriptions for medications from UCSF doctors and pharmacists. The robotics then choose the package and administer specific amounts of medication. [68]

CHALLENGES THAT PHARMA COMPANY'S FACE WHEN ATTEMPTING TO ADOPT AI INCLUDES:

Given the unfamiliarity of the technology and its infancy and esoteric nature, many pharmaceutical businesses still view AI as a "black box." The majority of the IT programs and systems in use today were not developed or built with artificial intelligence in mind, which results in inadequate IT infrastructure. Even worse, pharmaceutical businesses must spend a significant chunk of money to upgrade their IT infrastructure. Pharmaceutical businesses must go above and beyond to gather and organize the data in an analytically-friendly manner because a major amount of it is in free text format. Despite these drawbacks, it is undeniable that AI is already transforming the biotech and pharmaceutical sectors [69, 70]. The study is limited in that it only examines the advantages of AI in pharmacy without considering potential drawbacks and lacks real-world application and validation. Further investigation is required to study potential difficulties and detrimental effects of AI in pharmacy, as well as to validate findings in real-world settings [71].

FUTURE PROSPECTS:

It is projected that AI will have more challenging development which challenges in the future. Many AI methods can be applied to a variety of therapeutic problems. AI has significantly increased the threshold for medical services, radically changed how traditional medicine is conducted, and offered several assurances for human health. It is anticipated that medical AI will continue to advance. The area of medicine is going into a new, undiscovered region, and primary care physicians need to be aware of these breakthroughs in AI. There is compelling evidence that medical AI can aid physicians in effectively delivering healthcare in the twenty-first century.

CONCLUSION:

In conclusion, the prospective use of AI in pharmacy could revolutionize the field and bring about a host of advantages for both patients and pharmacists. AI technology can enhance the precision and safety of medicine administration, speed up the drug development process, and aid in improving patient outcomes in a variety of areas, including medication management, drug discovery, and the management of chronic diseases. Incorporating AI technology can lower healthcare expenses by enhancing efficiency and minimizing mistakes. It is crucial to remember that implementing AI in pharmacy also has some drawbacks and difficulties that must be resolved. Recent advancements in AI have scientists enthralled, especially when it comes to how it is being used for medical and pharmaceutical research and services. The future of healthcare will be shaped by smart hospitals and healthcare facilities that are equipped with AI, ML, and Big Data.

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