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Using artificial intelligence techniques to diagnose diseases and design new drugs

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Abstract

In recent times, AI technologies have made huge waves in the healthcare industry, sparking a heated debate over whether AI doctors could ultimately replace human doctors. Machines will not replace human doctors in the near future, but AI can help physicians make better medical judgments or even substitute human judgment in certain sectors such as healthcare. The recent successful applications of AI in healthcare have been enabled by the growing usage of healthcare data and the fast growth of big data analytic approaches. Effective AI strategies, driven by relevant clinical questions, can uncover clinically relevant knowledge contained in vast quantities of data, assisting clinical decision-making. In light of this, this research was carried out to shed light on studies and research that discussed the use of artificial intelligence in the fields of healthcare and disease diagnostics. in addition to providing the appropriate background to the research community in order to advance this area, and to assist in the integration of a variety of AI technologies around patient needs in a variety of healthcare settings, especially for chronic care patients with the most complex comorbidities and care requirements. The results of the research confirm that AI encompasses a variety of areas of the system, including thinking, information representation, searching for solutions, and machine learning (ML), to name a few. ML is a form of machine learning that uses algorithms to recognize patterns in a set of data that has been further classified. Deep learning (DL) is a subfield of machine learning that uses Artificial Neural Networks (ANNs). In addition, Artificial intelligence can help in developing drug formulation, aid in decision-making, diagnosing diseases, and evaluating the best treatment for a patient, such as customized drugs, dealing with the medical information produced and using it for potential drug production and AI is also expected to play an important role in the production of pharmaceutical products.

Keywords: healthcare, artificial intelligence, techniques, diagnose, diseases, drugs

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Introduction

Artificial intelligence (AI) and related innovations are becoming more common in business and culture, and they are starting to show up in healthcare. Several facets of patient care, in addition to management procedures within provider, payer, and pharmaceutical institutions, may be changed by these innovations (Davenport & Kalakota, 2019).

AI, robotics, and big data have changed the landscape and opened up unparalleled opportunities and possibilities in healthcare. Medical care is the only research discipline that provides as much optimism in the determination of life and death, as well as the fastest-paced innovation opportunity with the highest profit margin opportunities (Puaschunder, 2020).

Because of the growing sophistication and amount of data in healthcare, AI would be used more frequently. Consumers and providers of care, as well as life sciences firms, are now using AI in various forms (Schaffter et al., 2020). Diagnoses and care decisions, patient involvement and adherence, and administrative tasks are among the most common forms of applications. While AI can perform several healthcare tasks as well as or better than humans in several cases, implementation problems will delay large-scale automation of medical practitioner employment for a long time. Ethical questions regarding the use of AI in healthcare are also answered (Davenport & Kalakota, 2019).

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A growing body of evidence suggests that AI can perform as well as or better than humans at different healthcare tasks like disease diagnosis. Algorithms are now outperforming radiologists in terms of detecting malignant tumors and advising investigators on how to construct cohorts for expensive clinical trials. Nevertheless, we believe it will be several years before AI will fully replace humans in large medical process domains for a variety of reasons. In this article, the researcher discusses the role of AI techniques to diagnose diseases and design new drugs.

Problem

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AI has been widely used in a variety of sector of medicine to aid in the production of therapeutics. Rapid recognition, disease diagnosis, and referral administration have all benefited from the advancement of various AI techniques. Nevertheless, health care practitioners, medical service providers, and healthcare policy decision-makers have expressed reservations about the importance of advanced AI in diagnosis of diseases (Shen et al., 2019).

Soon after artificial intelligence and analytics (AIA) were introduced, healthcare was seen as one of the most exciting application fields. Using powerful algorithms from different branches of digital technologies, AI combined with analytics technologies is rapidly transforming medical procedure and healthcare in an incredible way. Every year, a large number of works are published in various institutions and development centers around the world, but there are questions regarding their effectiveness. AIA is increasingly being used in healthcare, and the findings are positive (Azzi, Gagnon, Ramirez, & Richards, 2020). In light of this, this research was carried out to shed light on studies and research that discussed the use of artificial intelligence in the fields of healthcare and disease diagnostics.

Research aim and objectives

This review article examines the past ten years of AI technologies in healthcare, spanning a variety of methods and medical specialties, as well as the emerging issues and concerns surrounding this transformative technology. The aim of this paper is to:

- To investigate the use of artificial intelligence techniques for disease diagnosis and the design of new drugs.
- To provide the appropriate background to the research community in order to advance this area.
- To assist in the integration of a variety of AI technologies around patient needs in a variety of healthcare settings, especially for chronic care patients with the most complex comorbidities and care requirements.

Methodology

The study approach is one of the basic parts of scientific research that affects the level of achieving the study objectives. To achieve the objectives of the current study, the researcher used the descriptive approach, which is considered one of the most popular research methods and the most used in scientific research.

Types of AI of relevance to healthcare

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Artificial intelligence is a set of technologies rather than a single one. The majority of these innovations have direct application in the healthcare sector, but the processes and tasks they support are diverse. The following sections identify and explain several specific AI technologies that are critical to healthcare.

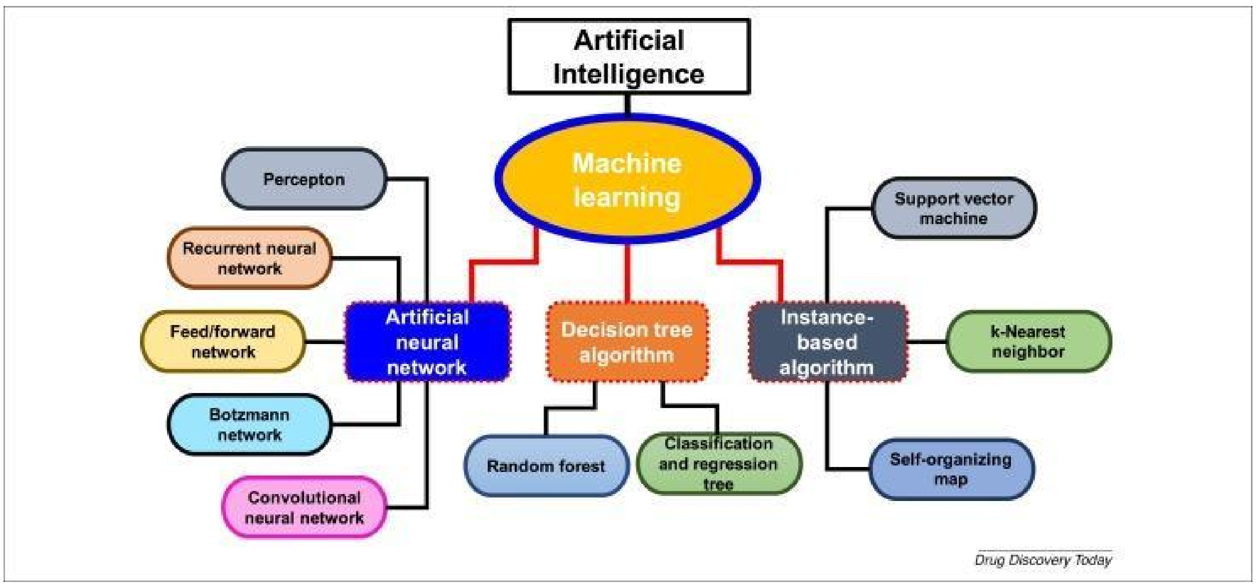

Figure 1: Method domains of artificial intelligence (AI).

Machine learning – neural networks and deep learning

Machine learning is a computational method for fitting models to data and 'learning' from data through classification algorithms. Machine learning is one of the most popular types of AI; according to a 2018 Deloitte survey of 1,100 US executives whose organizations were already implementing AI, 63% of those surveyed used machine learning in their

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operations. It is a broad strategy that is at the heart of a lot of AI methods, and there are a lot of different variations of it (Davenport & Kalakota, 2019).

Precision medicine – predicting the treatment procedures are most likely to work on a patient based on different patient characteristics and the treatment background – is the most popular application of conventional machine learning in healthcare (Lee et al., 2018). The vast majority of machine learning and precision medicine implementations necessitate supervised learning, which requires a training dataset with a defined outcome measure (for example, disease onset).

Natural language processing

Since the 1950s, AI researchers have been attempting to understand human language. NLP encompasses technologies including speech recognition, text processing, translation, and other language-related objectives. It can be approached in two ways: statistical and semantic NLP. Methodological NLP is focused on ML (in general, deep learning neural networks) and has contributed to recent improvements in recognition accuracy. It necessitates a vast linguistic corpus from which to learn.

The development, interpretation, and identification of medical information and previous studies are the most common uses of NLP in healthcare. NLP systems can review

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unstructured patient clinical notes, prepare reports (for example, on radiology examinations), transcribe patient experiences, and perform conversational AI.

Data Mining

Data mining, which incorporates ML and data science, is the process of extracting information and features from data utilizing automated or semiautomatic techniques. Indeed, data mining is the process of identifying and discovering related trends, correlations, and information in order to make predictions based on pre-determined parameters. Data mining is becoming increasingly common and important in the healthcare industry. The use of data mining in healthcare has a lot of potentials. These can be divided into four categories: clinical administration, diagnosis and treatment efficacy assessment, management information systems, and fraud and abuse identification (Niakšu, 2015).

In order to aid healthcare professionals in making decisions, DM approaches usually perform biomedical data classification, clustering, grouping, and visualization tasks. According to Esfandiari et al. (2014), the most recent and comprehensive systematic literature review, there are four major application areas for DM in healthcare:

1. Increasing performance and eliminating the human element: deals with tasks requiring precision in the diagnosis of such diseases.

2. Time and cost savings: useful when traditional diagnostic approaches take a long time or are prohibitively costly.

3. Healthcare decision support process: employs multi-process automation, such as prediction models and expert systems, to assist less qualified or professional medical personnel.

4. Knowledge extraction is a technique for extracting new information or hypotheses.

AI in the lifecycle of pharmaceutical products

Given that AI can help reasonable drug design, assist in decision making, assess the best treatment for a patient, such as customized drugs, and handle the medical information produced and use it for potential drug production, AI can be expected to play a role in the production of drug products (Blasiak, Khong, & Kee, 2020). Eularis' E-VAI system is an analytical and decision-making AI system that provides machine learning techniques and an intuitive user interface to build analytical roadmaps based on rivals, key stakeholders, and existing market share to forecast primary factors in medical billing (Baronzio, Parmar, & Baronzio, 2015). As a result, marketing executives were able to direct resources for optimum market share benefit, reverse weak sales, and predict where to spend. Figure below summarizes the various AI technologies in drug discovery and development.

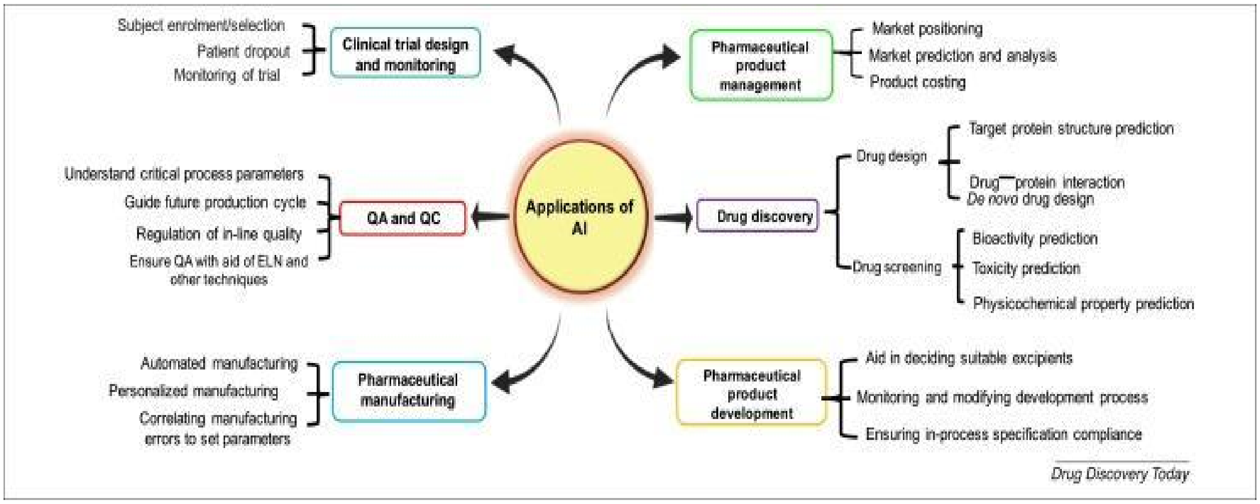

Figure 2: Artificial intelligence (AI) technologies in the healthcare industry, ranging from drug development to drug product management. Cited from (Paul et al., 2020)

AI-based techniques have advanced into flexible techniques that can be used across the board in drug production, like drug target recognition and validation, drug design, drug repurposing, aggregating and analyzing biomedicine data, and improving the decision-making system to recruit patients for clinical experiments (Mamoshina, Vieira, Putin, & Zhavoronkov, 2016).

Other applications of AI in drug production involve predicting feasible technological solutions for drug-like molecules (Merk, Friedrich, Grisoni, & Schneider, 2018), pharmacological properties, protein features, and effectiveness (Menden et al., 2013), drug combination, and drug-target interaction (Nascimento, Prudêncio, & Costa, 2016),

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and regenerative medicine (Menden et al., 2013; Schneider, 2018). The development of novel biomarkers and therapeutic goals, customized medicine based on omics markers, and the discovery of drug-disease interactions have all made it possible to identify novel approaches and targets utilizing omics research (Matthews, Hanison, & Nirmalan, 2016). DL has shown exceptional progress in identifying promising drug targets and correctly predicting their structures as well as potential toxicity threats (Hughes et al., 2011).

The vast chemical room, which contains over 10^{60} molecules, encourages the creation of numerous drug molecules (Mak & Pichika, 2019). The lack of advanced technology, on the other hand, restricts drug production, rendering it a time-consuming and costly challenge that can be solved by using AI (Vyas et al., 2018). AI can identify hit and lead compounds, as well as validate the drug goal and optimize the drug formulation design more quickly. Figure below depicts various AI technologies in drug discovery. The results and methods of the different elements of the drug production process are discussed. There are also examples of AI implementations at various stages of drug development.

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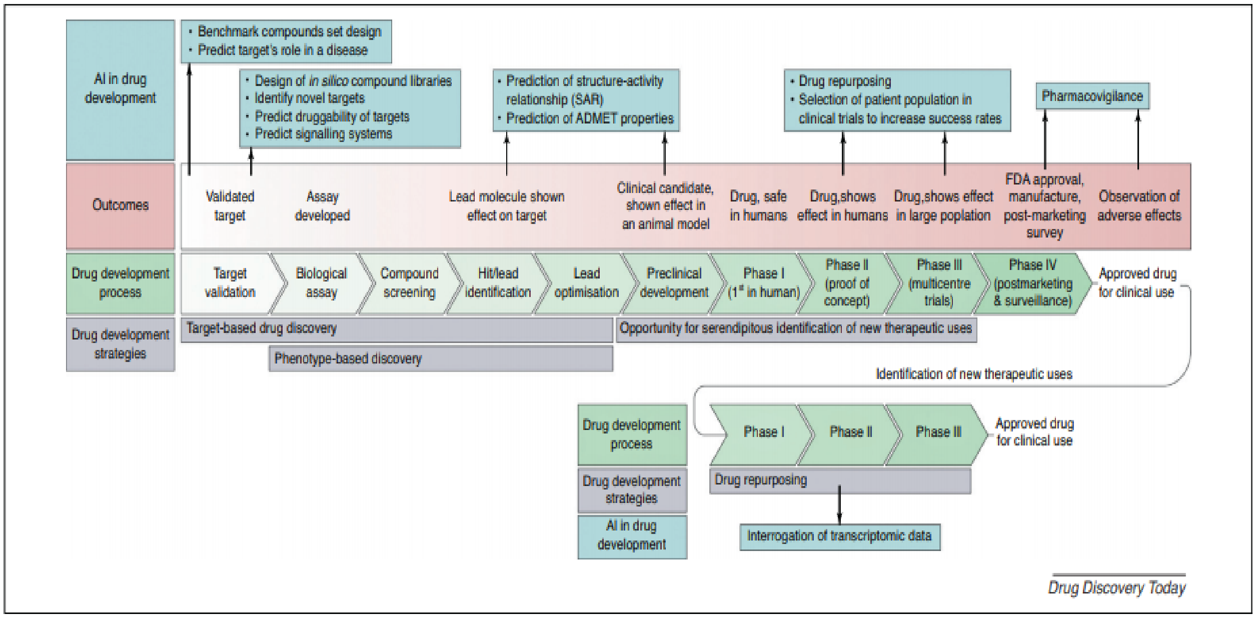

*Figure 3: AI technologies in drug discovery. Cited from (**Mak & Pichika,2019)***

The most common ML implementation was the patient diagnosis, and this method was used to diagnose all autoimmune diseases. A goal of many researches was to distinguish instances from healthy controls. Diagnostic classification techniques utilized patients with other autoimmune disorders as monitors to distinguish between diseases with overlapping or related symptoms or phenotypes (Stafford et al., 2020), For instance, Ohanian et al. (2016) studied the identification of various autoimmune disorders and stratified coeliac disease and inflammatory bowel disease (Ohanian et al., 2016; Berks et al., 2014; Arasaradnam et al., 2014; Iwasawa et al., 2018; Forbes et al., 2018). Previous reviews recommended ML for early diagnosis of the later-onset degenerative diseases MS

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and RA (Heard et al., 2014; Stafford et al., 2020; Yoo et al., 2018). Other diagnostic applications involved separating those with coeliac disease from those at risk (Hujoel et al., 2018) and identifying those with problems in T1D (Maulucci et al., 2017; Cordelli et al., 2018). Random forests and support vector machines were the most commonly used.

Conclusion

In recent times, AI technologies have made huge waves in the healthcare industry, sparking a heated debate over whether AI doctors could ultimately replace human doctors. Human doctors will not be replaced by machines in the near future, but AI can help physicians make a better medical judgments or even substitute human judgment in certain sectors such as healthcare. The recent successful applications of AI in healthcare have been enabled by the growing usage of healthcare data and the fast growth of big data analytic approaches. Effective AI strategies, driven by relevant clinical questions, can uncover clinically relevant knowledge contained in vast quantities of data, assisting clinical decision-making. In light of this, this research was carried out to shed light on studies and research that discussed the use of artificial intelligence in the fields of healthcare and disease diagnostics. in addition to providing the appropriate background to the research community in order to advance this area, and to assist in the integration of a variety of AI technologies around patient needs in a variety of healthcare settings, especially for chronic care patients with the most complex comorbidities and care requirements.

AI encompasses a variety of system domains, including reasoning, information representation, solution search, and ML, to name a few. ML is a form of machine learning that employs algorithms to recognize patterns in a collection of data that has been further categorized. DL is a subfield of machine learning that uses ANNs. There are a set of interconnected sophisticated computing components that include ‘perceptons,' which are similar to human biological neurons and simulate the propagation of electrical impulses in the brain. ANNs are made up of a series of nodes, each of which receives a distinct input and then converts it to output, either singly or in groups, utilizing algorithms to solve issues. Multilayer perceptron (MLP) networks, recurrent neural networks (RNNs), and convolutional neural networks (CNNs) are all examples of ANNs that use either supervised or unsupervised teaching strategies.

AI can help reasonable drug design, assist in decision making, assess the best treatment for a patient, such as customized drugs, and handle the medical information produced and use it for potential drug production, AI can be expected to play a role in the production of drug products.

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Recognition system, optimization aids, process detection, and controls are all implementations of the MLP network, which are normally, trained using supervised teaching strategies that operate in only one direction and can be used as universal pattern classification models. RNNs, including Boltzmann constants and Hopfield systems, are closed-loop systems that have the memorization and process data. CNNs are a type of dynamic system characterized by local connections and used in image and video processing, biological system modeling, complicated brain function processing, information processing, and sophisticated processing software. Kohonen systems, RBF systems, LVQ systems, counter-propagation systems, and ADALINE systems are among the more complicated structures.

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