Artificial Intelligence in Healthcare

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Abstract

Quality care that is accessible within the shortest time frame is a tenet of the healthcare sector. However, it is not often possible for medical practitioners to provide accurate diagnosis and treatment within a reasonable period of time. Therefore, errors are bound to happen and sometimes they may be very detrimental to the patient's health condition. In many areas the slow treatment process is also as a result of a low number of qualified medical practitioners compared to the large number of patients who seek medical care in the hospital institutions. Scientists and other stakeholders have spent many decades exploring the importance of AI in the healthcare sector. Some of the most successful research areas that have so far been implemented include how AI can be used for diagnosis, drug discovery, and prescriptions. It is an undeniable fact that the impact of AI has already been felt in various discipline within the medical field. That does not however, overwrite the fact that there are many challenges that slow down the integration of artificial intelligence to routine healthcare processes. This paper will analyze the existing literature review relating to artificial intelligence for healthcare and also expound on some of the findings that have been made so far. Thereafter, a befitting conclusion will be made briefing how the existing challenges can be solved to make artificial intelligence integration in healthcare a bit simpler.

Introduction

Artificial Intelligence (AI) is a budding technology that has been applied in different sectors. The Healthcare sector has not been left behind in tapping into the power of AI to ensure better provision of services for patients. Every day massive amounts of medical data are stored in the form of health records. This data can be used in combination with Machine Learning (ML) algorithms and statistical inferencing techniques to find patterns that have proven useful to medical practitioners for making improved decisions and predictions about various ailments.

AI has not only been applied in healthcare to help medical practitioners only, it is also being used by technology companies manufacturing smart health devices such as smart watches to help their users monitor basic health stats such as blood CO_2 levels through the skin, and even recommendation of workout plans based on past activities or the user's daily activity level.

Problem statement

There are many people who cannot access healthcare services due to limited healthcare medical staff. It also takes long time for a doctor to map symptoms to a particular disease. Many countries lack the economic muscle to employ adequate health practitioners. In most areas, the geographical location of healthcare institutions is not strategic for many patients. AI systems can process large volumes of data in a short time and show meaningful patters as well as making diagnostics. These AI systems are created from knowledge bases. The knowledge bases comprise of data collected from a wide range of people living in different geographical locations and with varying morphological and anatomical configuration.

Research objectives

I) Investigate the application of AI in making medical diagnostics.

II) Study the use of AI in drug discovery.

III) Explore how AI has been used in making health predictions.

IV) Explore what ethics in AI affects AI adoption in healthcare.

Research questions

I) How is AI being used in diagnostics?

II) How is AI being used in drug discovery?

III) How AI can be used in making medical predictions?

IV) How does ethics in AI affect AI adoption in healthcare?

Literature Review

Numerous studies and technical reviews have been conducted widely to show the vital role played by AI in enhancing healthcare. According to (Dinakaran & Anitha, 2018) artificial intelligence mimics human cognitive functions to enhance pattern transfer and ease of access to healthcare records. Machine learning methods are used to train software that is integrated into routine clinical functions, and also has been widely used in many stages of the drug development process to identify novel targets, increase understanding of disease mechanisms, and develop new biomarkers among others. Researchers and technology enthusiasts affirm that AI might take over the work of physicians and medical consultants in making decisions. However, a more rational scenario would be AI supplementing the work of doctors to come up with concise diagnosis for various ailments. Artificial intelligence systems also can monitor symptoms within a given period based on clinical information collected from experts.

Some topics that we'll be coving next include; uses of AI in diagnostics and medical prediction, AI in for drug development and discovery and finally ethics in AI.

Diagnostics and Medical Prediction

The AI model is trained on all possible scenarios and uses algorithmic classification and reasoning to determine occurrence of a specific disease. Currently AI has been successful in processing images to predict the prevalence of lung disorders. Recent health studies journals show that deep learning systems have achieved a high level of accuracy in detecting breast cancer. The diagnosis obtained from such systems is indistinguishable from that of an average radiologist. With the potential to continually learn from new data AI models can outperform a

doctor's diagnosis capability. AI-based software trained using neural networks have the ability to detect cancer even before symptoms start appearing. This is an improvement compared to radiologists who depend on evident symptoms to make concise diagnosis (Mansour et al., 2021)). A less understood topic is the role played by NLP methods in enhancing healthcare outcomes. Most of the data found in healthcare records is in an unstructured format that cannot be directly used by the models. This data has to be transformed into a form that is easy to understand and process. Patients do not often give their explanation in a coherent format. In most cases doctors record patient history as a series of sketch notes. NLP converts text to structured data that can be processed by ML models. The models are then trained using this data in either supervised or unsupervised techniques. Supervised learning involves feeding a series of inputs to the model that are mostly patient symptoms. The model is then trained on the expected outcomes which are mostly diagnosis of whether the patient is suffering from a particular disease or not. Unsupervised learning techniques on the other hand, can be used for clustering data to help identify symptoms or records that are more the same than expected, which can later be used for better analysis of disease prevalence. Diabetes is a common lifestyle disease that is affecting millions of people around the world. It is severe when the body cannot produce insulin or make use of available blood glucose. Many times, people are not aware that they suffer from diabetes until its too late and the insulin levels are no longer manageable. The metrics used to diagnose Diabetes include glucose level, age, BMI, Hdl and ldl. Artificial Intelligence is being studied in the radiology field to detect and diagnose patient's diseases through Computerized Tomography (CT) and Magnetic Resonance (MR) Imaging (Davenport & Kalakota, 2019). A study at Stanford lead to the creation of an algorithm that could detect pneumonia in patients with a better average F1 metric (a statistical metric based on accuracy and recall) better than radiologists

involved in the trial. Through oncology imaging, AI has been able to detect abnormalities and monitoring changes over time. AI is being used in medical screening. In 2018, a published paper in the journal Annals of Oncology stated that skin cancer could be detected more accurately by an artificial intelligence model (which used deep learning convolutional neural networks) than by dermatologists. On average, the human dermatologists accurately detected 86.6% of skin cancers from the images, compared to 95% for the deep learning model. In January 2020 researchers demonstrated an Artificial Intelligence system, based on a Google DeepMind Algorithm, which is capable of outdoing human experts in breast cancer diagnosis (Carter et al., 2020). In psychiatry, Artificial Intelligence applications are still in a phase of proof-of-concept. Areas, where the evidence is widening quickly include chatbots, conversational agents that imitate humans in their behavior, and which have been studied for anxiety and depression. Challenges include the fact that many applications in the field are in constant development and proposed by private corporations such as the screening for suicidal ideation by Facebook in 2017. Such applications which don't fall under the healthcare field raise various professional, ethical and regulatory questions.

According to a study by Jiang, et al. (2017) he demonstrates that there are various AI techniques that have been tested by medical practitioners to treat different diseases and also support diagnosis. The techniques applied in AI for healthcare include support vector machines, neural networks, and decision trees. The techniques are used for designing models and they are made of a “training goal” and also the “classifications agree with the outcomes as much as possible…”. Through the reliance on Medical Learning Classifiers (MLC’s), Artificial Intelligence has been able to substantially aid doctors in patient diagnosis through the manipulation of mass Electronic Health Records EHR’s). Medical conditions have grown more complex and mutate every day.

There is now a widespread use of electronic medical records building that has made it easy to keep cleaner records in healthcare institutions. However, the probability of case duplication is still high. It is possible to find someone suffering from a rare illness that was somehow prevalent in the past. However, the physicians may face a challenge of obtaining previous data on how the symptoms manifested in other patients. Artificial intelligence techniques can map similar cases and show an interrelation on the chief symptoms. Physicians can therefore ask the most appropriate questions and make an accurate diagnosis and consequently the appropriate treatment plan for a patient without physically going through physical records.

AI in Drug Development and Discovery

Drug discovery and development is the process of introducing a new drug into clinical practice, and it involves all stages from fundamental research to large-scale clinical trials to promote the drug's public offering, as well as post-market and pharmaceutical repurposing research (Chen, Liu, Hogan, Shenkman, & Bian, 2020). It is evident that the field of AI has moved widely into solving real-world problems and many steps of the drug development process make use of this technology, such as understanding disease mechanisms.

AI is also playing a crucial role in Adverse Drug Reactions (ADRs), which are occurrences that occur when a drug has an unanticipated or unwanted effect (Mohsena, Lokesh, & Mizuguch, 2020). According to them, AI has been used extensively to determine the potential effects a drug during development might have on people depending on their unique biological data. They developed Open TG–GATEs, a large–scale toxicogenomics database that collects gene expression profiles of in vivo as well as in vitro samples that have been treated with various drugs, which can be used to train more AI models.

Lastly (Benhenda, 2017) developed the ChemGAN challenge to test whether AI's applications in Reinforcement Learning and Generative Neural Networks can be used to produce natural chemical diversity for drug discovery. The paper concluded with both techniques failing at it, showing that AI's application in Drug Discovery is still at it's prime.

Ethics in AI

From workflow, optimization to a medical procedure in disciplines such as diagnostics and imaging and the use of apps to assess and predict an individual's symptoms, we confident that Artificial Intelligence is the future for healthcare. Economic prognosticators have projected a rapid increase of AI in the health care market in upcoming years, conferring to a study; the demand has increased more than ten percent in the last seven years (Rigby, 2019). With this immerse growth comes challenges; thus, these challenges must be advised, most importantly, how ethical AI is in medicine and how it can be implemented ethically.

AI ethics is an area of study interested in designing morally working artificial agents, computers, and robots that act ethically (Rigby, 2019). This topic, ethics in AI, has been an essential topic for discussion for a while. However, the necessary steps for clarity and well ethically implemented AI systems have not been drafted. It is common knowledge to computer science stakeholders that we can improve AI practitioners' ethical decision-making process by simply availing enough guidelines and knowledge from the necessary ethical databases.

Generally, present AI systems mainly those developed by technical institutions or companies, take a principled approach. It is not sufficient to establish principles alone without being into the

test first. The majority of developers find it challenging to come up with ways of implementing the same.

AI will assist a big deal in health applications, but the question is how it will implement principles of cognizant consent in assisting healthcare. The values of well-versed consent should be applied in the clinical AI discipline; this topic should precisely be studied. For example, in the event of a complex treatment to want to extend of complexity is a doctor is permitted not to share the details of the treatment with the patient.

Another significant challenge for AI in healthcare is safety. IBM Watson for oncology, for example, uses AI algorithms to examine data from patients' medical records and assist doctors in discovering cancer management options for their patients. However, it has recently been criticized for making wrong cancer treatment recommendations. The issue appears to be with Watson for Oncology's training; instead of using actual patient data, the model was created using unsearched data. To comprehend the full potential of AI, stakeholders should keep in mind; the validity and reliability of data sets and their clearness.

AI also endures the threat of prejudices and thus a lack of equality. Developers, therefore, should take into consideration while developing the potential risk of bias in every step. They should consider what data set they should use for programing and which machine learning procedures they should use to train the algorithms.

Lastly, there should be data privacy. Procedures should be laid to protect patient privacy rights. If the end-users of the program, that is, the doctors and the patients, do not trust it. Them, it usually will have a hard time adjusting to the AI program. Thus, it is crucial to promote an open suggestion dialog for users to promote trust.

Methodology

This section contains details related to what criteria we used to consider studies for review, search methods used for identification of studies and finally selection of studies.

The topic on AI in Healthcare is multi-disciplinary, spanning fields such as Computer Science, Medicine and even Psychology, and because we all have more knowledge in Computing than the other fields, this entire study is based on review only and we only considered studies which were less than 5 years old, since they tend be more up to date with current trends.

As for search methods applied for identification of studied, the main factor was whether the title of the study closely matched our objectives keywords, which were; Medical Predictions, Diagnostics, Drug Discovery and Ethics. Tools used included Google Scholar, Academic, Research Gate, and finally arXiv.org by Cornell University which is an open-source electronics preprint website for posting studies or research papers from both Academia and Industry.

Selection of studies not only followed the criteria for considering a study and also whether it had matching keywords to our objectives, but also the ease of understanding the paper's introduction section, and the credibility of data and results obtained from each study. Credibility here meant that the data collection methods reached a large number of the target population, and the participants were keen of giving out accurate information that was in line with the outlined variables in the studies.

Surveys are a common method of collecting response from the target audience. Participants have the opportunity to fil out the surveys at their own convenient time. It is also likely that they will provide an unbiased opinion since they do not have the fear of being reprimanded for their opinion.

Findings

AI research has made rapid advancement in the field of medicine. However, the rate of acceptance into routine clinical functions is dependent on how easily legislation can be passed and data structured to fit into medical needs. Findings from the above-mentioned research suggest that the implementation of AI in Healthcare is still far much limited especially in developing areas. There is developing interest in AI but implementation remains to be a theoretical concept, which can be attributed to the following factors;

- Mistrust in AI
- Legislation challenges
- Large volumes of unstructured data
- Limited research in AI for Healthcare
- Success in making medical diagnosis and prescriptions.

Mistrust in AI

There is existing evidence that AI has immense benefits for healthcare. However, stakeholders believe that AI is not all that trustworthy and does not have the capacity to make diagnosis on critical ailments such as cardiac complications. Health related information is fragile and therefore should be handled by a medical professional who has the considerations for humanity and capacity to avert errors that may be witnessed. There is little confidence in existing AI tools and this creates doubt whether the world is ready to accept more change. The success of AI in healthcare can only be achieved if there is trust between the public and AI tools. The trust can be

fostered through programs that educate people on the foundations of AI and how they can use AI to achieve better treatment outcomes.

Legislation challenges

Many regions lag in creating legislations that protect the implementation of AI tools in healthcare. For instance, the laws governing protection of medical data are too strict. Therefore, willing practitioners cannot access this data for experimentation purposes due to the strict regulations. Despite the trials in diagnostics, imaging, and drug discovery the failure of governments to offer support for legislation and regulations has stalled the implementation of AI in healthcare (Schönberger, 2019). Several bills are already proposed in developed countries such as the United States but have not yet been approved to offer support to AI enthusiasts.

Large volumes of unstructured data

To be useful health related data has to be processed using data analytic tools and methodologies. The data must be well-structured and organized in a credible manner that makes it easy to analyze using machine learning algorithms. However, the current situation is that health records are not structured and sometimes not readily available. Over the years medical practitioners have collected enough information about illnesses by observing the trends in symptoms observed in patients. They have not put the findings into official records that can be accessed for the purposes of AI implementation. Moving into the future many hospitals seek to put patient records and all the available information pertaining various ailments into official records that can be retrieved for advanced studies.

Limited research in AI for healthcare.

Many people within the healthcare field talk about AI and the large benefits it could have for the future of medicine. However, these individuals rarely invest resources nor spend time to understand the foundations of Artificial intelligence in healthcare. Of the enthusiastic individuals most of them are computing professionals who have little background information in healthcare. To achieve success in using artificial intelligence for diagnosis and management of ailments there must be coordinated efforts among the involved stakeholders. Doctors and other healthcare practitioners must be in the forefront to provide knowledge about medical conditions and computer professionals provide the technology to be used in making predictions or integrating AI in routine clinical practices.

Success in Making Medical diagnosis and prescriptions.

In recent years misdiagnosis of illness due to incomplete or inaccurate medical records has accounted for almost 10% of the deaths in the United States. Results show that provided with relevant data AI can make medical diagnosis at a faster rate compared to humans. Success has already been made in making diagnosis for breast cancer, bone injury, and monitoring patients in intensive care using AI models powered by algorithms and deep learning techniques. Using applications such as the Buoy health checker patients are able to track their symptoms and even request for medical advice from the intelligent virtual assistant. Therefore, they can get the much-needed care without a visit to the doctor. The model further interprets the data to give output in the user's preferred language.

Conclusion

Rapid advances in technology definitely change social interactions, formal communications and professional life. One of the core technological changes that could impose significant effects on healthcare is the fronted spirit to implement AI. AI technology can be an integral element of many organizations' business models, and it is a significant strategic component in the economic and timely delivery plans for multiple sectors. Healthcare institutions form the major implementation area of artificial intelligence.

To appropriately implement AI systems in healthcare requires a comprehensive evaluation of the factors that may deter technology acceptance among relevant stakeholders.

Technology, ethics and regulatory concerns must be well addressed for people to embrace and work towards the implementation of AI in healthcare.

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