

REVIEW ARTICLE

Artificial Intelligence and Deep Learning: Current Impact and Perspectives in Life Sciences and Medicine

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ABSTRACT

AI is heading to renovate medicine and somewhere even substitute real-medicine workers. Every year we witness the advent of new and more advanced explanations, under disruptive technologies. This, in turn, offers a whole slew of advantages, one of the most vital of them is reducing the time required to reach a diagnosis that permits medical workers to better prioritize patient instance. In the current time we can involve AI and Deep Learning approaches in drug development, medical imaging and genome research. In medical science, one of the most important terminology is "medical intuition", a doctor using his or her build in neural networks for narrowing down the solution space for making a diagnosis. This medical institution is an automated phenomenon that could be well performed by a machine also. To add on there are some diagnosis which can be better formulated by machines. For instance, L unit is a deep learning-based 3D visualization software that increases the probability of detecting airways cancer disease by 85%. On the other hand, Aira, which is still at its developing stage, helps blind and visually impaired people to realize the world. Python and R programming languages are important and most popular for machine learning applications. But in recent years, Julia is attaining its place and has become the new de-facto for machine learning. Julia bargains best-in-class support for modern ML-frameworks like MXNet and TensorFlow, making it laidback to acclimatize to existing workflows. Another important contribution is the Augmented Reality Microscope with Real-Time Incorporation of Artificial Intelligence for metastatic breast cancer and identifying prostate cancer. Prediction of protein tertiary structure is another dimension where AI is playing a crucial role using Neural Networks for fast and accurate structure prediction. ProteinNet neural network is gifted to forecast the structure of a protein in milliseconds. The present chapter focuses on the various applications of AI and deep learning in lethal disease detection and diagnosis, biomedical research and imaging techniques, in-silico protein structure prediction and medicine, analyzing large amount of data and make decisions much quicker than humans. All good things come with some drawbacks, the last section of the document encounters some of the major shortcomings of AI and its interpretation based on some real-life cases.

Keywords: Artificial Intelligence, Deep Learning, Medicine, Life Science, In-silico medicine

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INTRODUCTION

The Revolution of AI in Scientific Research

Data Economy is one of the reasons behind the emergence of Artificial Intelligence. It refers to the amount of data grown in the last few years and how much more it can grow in the coming years. The volume of data has grown exponentially from 2009 to 2021 with the help of social websites. The explosion of data has given rise to new economy and there is a constant battle for ownership of data between companies to derive benefits from it. Now that we know that the data has grown at a tremendous pace and will remain to grow, we need to understand the need of artificial intelligence. The increase in data volume has given rise to big data which helps manage huge amount of data. Data science help to analyze that data, so the science associated with data is going to award a new paradigm where one can teach machines to learn from data and derive a variety of useful insights giving rise to artificial intelligence. Artificial Intelligence

refers to intelligence displayed by machines that stimulates human and animal intelligence. It involves intelligence agents, the autonomous entities that receives their environment and take their actions that maximize their chance of success at a given goal. AI enables computers to mimic human intelligence using logics. It is a program that can sense, reason and act. AI is redefining industries by providing greater personalization to users and automating processes. One example of artificial intelligence in practice is self-driving cars. Self-driving cars are computer-controlled cars that drives themselves [1]. In these cars human drivers are never required to take control to safely operate the vehicle. These cares are also known as autonomous or driver less cars. From Siri of iphone to Amazon echo to Concierge robot from IBM Watson to the identification and screening of cancer, Artificial intelligence has captured all the fields. It is crucial to differentiate between artificial intelligence and machine learning. When computers learn without being explicitly programmed is machine learning whereas the science of making machines to do things is known as artificial intelligence.

Relationship between AI, ML and Data Science

Even though the Machine Learning, artificial intelligence and data science are the umbrella terms from the same domain and are connected to each other, they have a specific meaning and applications. Artificial Intelligence systems mimic or replicate human intelligence, Machine Learning provides the systems the ability to automatically learn and improve from the experiences without being explicitly programmed. Data Science is an umbrella term that encompasses data analytics, data mining, machine learning, artificial intelligence and several other related disciplines. First step is data gathering and data transformation. This step basically comes under data science. Data transformation is the process of converting data from one format or structure into another format of structure. Data transformation has two important activities: data management and data integration. After gathering data, one wants to make predictions and derive insights in order to get predictions out of the data set one uses machine learning techniques such as supervised learning and unsupervised learning. On an overview level, supervised and unsupervised learning are the machine learning techniques used to extract predictions from a given data set. In life science at every stage of the value process we are generating a lot data, a lot of decisions needs to be made by experts. Artificial intelligence data science equips them to make right decision at the right time [2].

Genetic Algorithm in Artificial Intelligence

John Holland gave the idea of genetic algorithm and its various application in artificial intelligence. The idea of genetic algorithm is nothing but the abstraction of real biological evolution including the study of genes, the study of chromosomes, how a new progeny is being created by the parents and the best of the parents is being passed to their progeny. The present generation will mate again to give rise to another new progeny which will be equipped with the more advanced genes. This way the genes are travelling from one generation to another and genetic algorithm is the basic crux behind it. Genetic algorithm is an optimization technique used to solve non-linear or non-differentiable optimization problems. It uses concepts from evolutionary biology to search for a global minimum to an optimization problem. The name genetic algorithm came form the name of the evolutionary biology techniques. Genetic algorithm works by starting with an initial generation of candidate solutions that are tested against the objective function, which then generates subsequent generations from the first generation through selection, cross over and mutation. Genetic algorithms can be used to generate solutions for the problems for which we have no way to calculate solution. These are a basically a part of evolutionary algorithms and they use natural selection to approximate solutions for a given problem [3].

How Genetic Algorithm Works

A genetic algorithm uses a population of possible solutions. The set of all current solutions at a given point during the algorithm is called as generation. The starting generation is just a random possible combination of the solutions. Next is the process of natural selection to stimulate the survival of the fittest. For this a fitness function (fitness ()) is used to determine how good a given solution is. After this the parents for the next generation of solutions are selected. Generally speaking, the solution with a higher fitness score is more likely selected for reproduction with the one with a very low score. We choose two parents and cut their genomes at random stops and switch their ends. This is called as single pint cross over function and it generates two new solutions for the next generation. This process is repeated till we have no more specimens in the current generation. Natural Selection not only works better in nature but even when simulated in computer it generates better solutions from generation to generation. But there is one important thing to make a note of, because the selection and the cross over function is governed by the randomness there is no way to guarantee that we don't destroy our best solutions that's where a process called elitism comes. Elitism simply means that we select the top solutions and just select n top solutions and just copy them into the next generation [4]. We will just keep the top two. The next step in evolution is mutation. Mutation helps to discover new solutions that weren't otherwise possible with the gene pool we

started. During the mutation phase we change a random bit of the genome with a certain probability and we get a new generation of solutions. This algorithm loops as long as no satisfying solution is found or for a maximum number of generations. There are various ways of implementing genetic algorithm but they all possess the same ingredients –

- A genetic representation of a solution
- A function to generate a new solution
- A fitness function to evaluate a new solution
- A select function to select the solution to generate the next generation
- A cross over function
- A mutation functions

AI – A Primer for Clinicians

As discussed earlier, Artificial Intelligence (AI) basically defines an elaborate list of techniques which let machines/computers perform different set of tasks which are usually done by reasoning and problem-solving skills of human brains. AI is very beneficial to the healthcare industry and helps in the following ways to list a few:

- Drug Discovery and Development process which includes development of effective drugs in reduced cost and time.
- Increases healthcare accessibility by the use of AI driven mobile apps in order to get treatment advices especially by the people with limited means in the remote areas.
- Tools/Applications based on AI algorithms help in detecting diseases earlier than they develop. These tools can collect and analyze patient's medical history data and help doctors diagnose diseases accurately.
- Improves the efficiency of the management of healthcare facilities such as hospitals, clinics.
- Most importantly, AI algorithms can make the healthcare processes fast and cost effective.
- Use of robots to assist doctors in surgery.

AI can benefit the clinicians in particular as well. Doctors/Clinicians can use the AI based applications/tools to record the health-related data, interaction with the patient regarding the issues they are facing and enter it into the database as Electronic Health records. Further, these tools analyze the data entered and assist the doctors for making accurate diagnosis [5]. Also, with the advancement of technology of AI, robotic surgeries are being performed in many countries which has benefitted the clinicians as well the hospital facilities in terms of revenue and expenditure. Major areas where AI is helping are as follows:

1. Drug Discovery and Development
2. Patient data management (Electronic Health Records)
3. Robotic Surgery

Drug discovery and Development

The traditional approach of drug discovery and its development is time consuming and an expensive process. With the use of AI algorithms, accurate leads and targets can be matched and a cost-effective drug can be developed in a significantly shorter time. The process includes designing of drug, screening, polypharmacology, chemical synthesis and repurposing. Prediction of protein target and its screening, interaction of drug molecule and target and thereby determining the activity of drug constitutes the drug designing process. Initially, drug like compounds are explored which have the potential to become a drug and then the drug is discovered by studying cell pathways or identifying target molecules. Next step is predicting the mechanisms of the compounds involved (Polypharmacology) which consists of designing specific molecules of drugs and also drug for multiple target molecules. Post the design, a population of individuals are identified who will be involved in the clinical trial process. Lastly, drug repurposing process takes place which consists of identification of targets and predicting the possible novel uses of the drug molecules. Further, drug is sent to authorized body for approval [6].

Patient Data Management through Electronic Health Records

Electronic Health Records (EHR's) are one of significant example where the AI approach is followed. Integration of EHR's and multiple other data collection tools with the health care systems has made it simpler for healthcare facilities and doctors to look at the patient's medical history in a concise form instead of scrolling through papers records for making a decision for effective treatment. Also, a lot of hospitals are using AI algorithms and utilizing real time data of patients such as discharge time, OPD time, admission time, revisit etc. to predict the footfall of patients in the coming days. This helps the hospitals to prepare themselves to be able to manage the facilities available efficiently. It also helps in reduction of

hospital visits by notifying hospital staff when patient needs assistance which assist in management of staff duties in the hospital.

Surgery through the use of Robots

Artificial Intelligence techniques are widely used for assisting clinicians in multiple critical surgeries. Robots utilize machine learning in order perform surgeries and other operation theatre related tasks. Using AI in the field of surgery reduces time and lessens the scope of medical errors with improved surgical results. One of the major areas of surgery where robots are being used is laparoscopic surgery where the robots work as laparoscopic instruments. The aim is to build self-sufficient robots who can work independently and the current robots which exist need to be transformed into superior ones so that they can identify problems and perform the appropriate tasks on their own. The major challenge in this area is the lack of acceptance by general population and even clinicians is giving patients in the hands of robots. Hence, it has a lot of ethical implications attached to it which are discussed further in the chapter.

AI IN DRUG DEVELOPMENT LIFE CYCLE AND HEALTH CARE

Artificial Intelligence (AI) has started establishing its significant presence across industries especially pharmaceutical industry, which has found numerous benefits to make things easier. The biopharmaceutical corporate companies such as AstraZeneca, Abbvie, GSK to name a few, are working towards using the AI technology to enhance the drug discovery process which usually takes a long time to develop, minimize the amount of money used for research and development and generate high quality drugs for effective treatment of diseases.

APPLICATIONS OF AI IN PHARMACEUTICAL INDUSTRY

Artificial Intelligence is not only restricted to the drug discovery and development when it comes to pharmaceutical industry. The various applications are depicted in Fig1.

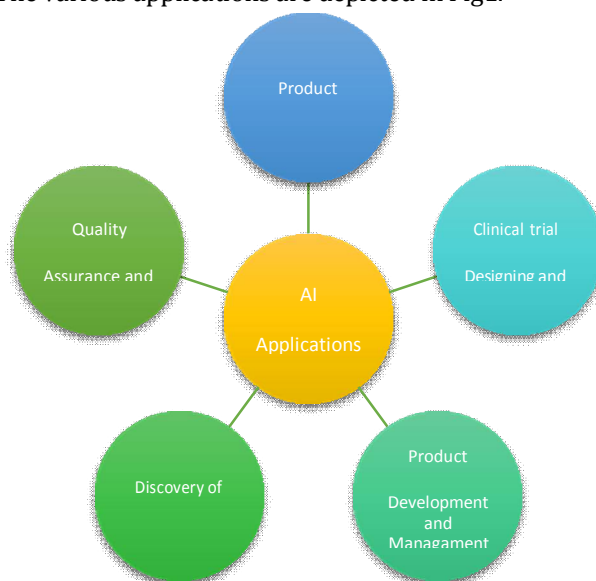


Fig 1: Applications of Artificial intelligence in Pharmaceutical Industry

Clinical Trial Design & Quality Assurance and Quality Control

Clinical trial designing includes choosing the subject/patient, its enrollment and complete monitoring of trial. AI approach is also widely used in the Quality assurance and Quality Control process during the trial as well as for product development. QA and QC includes identification and analysis of critical parameters of the complete process of trial and also inferring future production and making informed decision about production etc [7].

Product Development, Management and Manufacturing

Product development and management includes effective costing, prediction and analysis of market based on the trend data, modification of development process and ensuring process compliance. Product manufacturing includes manufacturing through automation, personalization and setting parameters through correlating manufacturing errors.

Drug Discovery

AI is widely being used in Drug discovery and development process. It includes designing of drug, screening, polypharmacology, chemical synthesis and repurposing. Broadly, drug design consists of - Prediction of protein target and its screening, Interaction of drug and target protein and Determine activity of the drug. Drug Screening consists of: Prediction of biological activity, Prediction of toxicity, Prediction of physio-chemical properties and Identifying and classifying targets. Polypharmacology deals mainly with Designing of specific molecules of drug and Designing drug molecules for multiple targets. The Chemical Synthesis mainly involves Estimation of how much the reaction will yield, designing artificial pathways and Inferring useful information through mechanism of reactions.

Repurposing of drug

- Identifying targets
- Prediction of novel usage

With the use of multiple open access databases such as PubChem, molecules can be selected and virtually screened for testing through various in-silico methods. These methods assist in achieving better analysis of profiles, eliminating non-lead compounds and selecting drug molecules through minimal expense. Various AI based algorithms take into account the toxicity and physio-chemical properties, in order to choose the lead compound. Studies suggest that Artificial Intelligence can be effectively be used as an aid in the rational drug design process, deciding the best treatment for patients, handling the clinical data and further use it for the process of drug development.

PROCESS OF AI BASED DRUG DISCOVERY

Pictorial Representation of the drug discovery and development procedure using AI approach is as follows in Fig2:

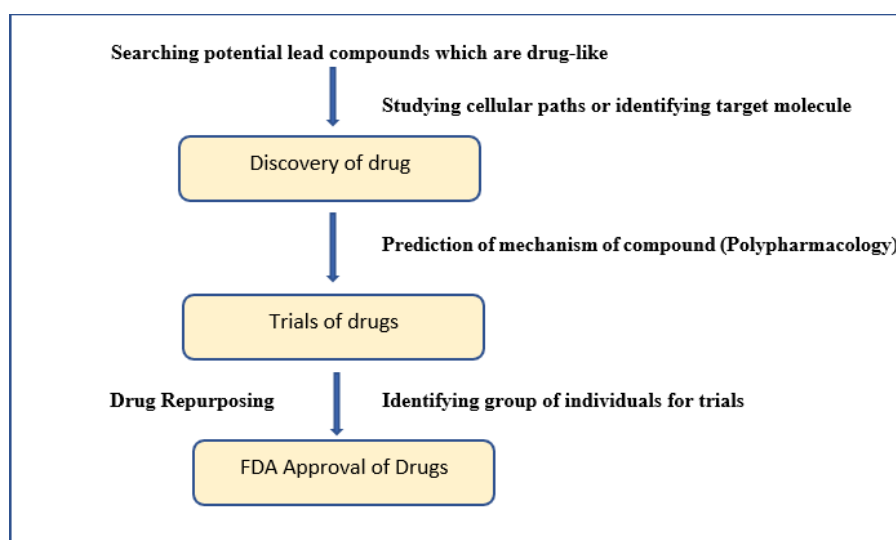


Fig 2: Drug Design using Artificial Intelligence Approach

ADVANTAGES OF USING AI FOR DRUG DISCOVERY AND DEVELOPMENT

Few advantages of using AI approach over traditional drug development process are as follows:

1. Absence of biasness for a specific subject since AI does not depend on already defined protein targets.
2. AI uses latest computational techniques to write algorithms which is cost effective and less time-consuming process.
3. Higher predictability of inferring significant interaction of molecules i.e. drug and target, causes reduction in probability of having false positives, there more accuracy. '.
4. Drug Screening is now not limited to wet labs due to involvement of AI and computational techniques which has reduced the time of screening. Also, effective targets are identified with reduced man hours and cost-effective experimental setup.

Even with all the advances of Artificial Intelligence and related technologies, AI still cannot substitute the presence of science experts. It still needs a human to validate predictions made for a drug [8].

Also, AI is new and still being researched hence there are multiple ethical implications to it which need to be addressed for it to be used more efficiently in different fields. The ethical issues have been discussed in the section of challenges for Artificial techniques.

CHALLENGES IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN HEALTHCARE

Artificial Intelligence (AI) & Machine Learning (ML) approach is helping the healthcare industry to improve the process and accuracy of the treatment given to the patients at a reduced cost. This generation which believes in innovation has built numerous tools which use the AI approach to solve many problems of the healthcare business and these AI based tools have the ability to transform the remaining aspects as well. The growing use of the AI and ML is expected to reduce medical errors, but this increased use has raised many concerns and challenges which need to be addressed before it takes over majority of the health-related tasks. Few challenges which the healthcare industry need to overcome are:

- a) Data Confidentiality
- b) Justification of the decision made by the algorithm
- c) Analysis of Root and Cause/ Understanding Causality
- d) Capital Investment
- e) Requirement of synergy between AI and Health Experts
- f) Ethical or Socio-Culture Issues

The above challenges are discussed in detail below:

Data Confidentiality

The AI and ML powered applications rely on clinical data of patients to get trained and perform tasks which will assist the administration, patients or the clinicians. A lot of healthcare facilities such as hospitals, clinics and research centers have strict data privacy rules and getting real time data from them to be able to train the ML algorithms is a tedious task for the AI experts. Also, normalization and structuring of datasets to be used, need good expertise and is a time-consuming process. Apart from the privacy issue, the complete data is never available due to multiple factors, hence the missing data should also be taken into consideration for writing algorithms.

Justification of the decision made by the Algorithm

Decision support transparency is very important to medical science, hence a clinician is expected to justify the treatment protocol advised by the ML algorithm. Hence, tools need to be developed which are intuitive and predictions made by it are very transparent.

Analysis of Root and Cause

To understand causality of any outcome by an algorithm is of utmost importance and to achieve this, a lot of expertise is required i.e. predictive modelling. It requires a healthcare expert who can concentrate on a particular problem to perform the root cause analysis to be able to give insights to the AI expert for him to develop a predictive model for the problem solution.

Capital and Time Investment

Developing models based on AI approach require investing ample time and money to be accurate since it is a new area which is still being researched. There are limited resources which can be leveraged upon. Also, many healthcare organizations do not have the capital to invest in this field.

Requirement of synergy between AI and Health experts

There are limited AI analytics experts who also have healthcare knowledge and expertise and similarly healthcare professionals also lack AI analytics expertise. Hence, in order to develop accurate prediction models, both experts need to be brought together, which is a very challenging task [9].

Ethical/Socio-Cultural Issues

The Ethical issues pose the biggest challenge for Artificial Intelligence approach to be implemented in our day to day activities. The clinicians have been making disease diagnosis and treatment protocol based on their studies, experience and problem-solving skills. Though AI aims in assisting doctors and not replacing them but making the clinicians accept that computers/machines will be making decisions is a hard task to do. Not only doctors, other healthcare workers also assume that this will be a threat to their jobs. Also, making the patients accept this change is seen as a hurdle to cross. Apart from the people directly getting affected by the AI implementation, experts also are concerned about the use of AI for malicious activities which can cause serious damage. Hence, a lot needs to be done in order to make AI tools more secure. However advanced AI technology is, machine still can make errors and it will be challenging to establish answerability of the error made. There is also a scope of algorithm biasness which will affect the decision making of the clinicians. These issues necessitate the need of regulatory bodies and healthcare facilities get together and make rules and laws to handle such issues when they arise.

Opportunities for AI in healthcare

Even with multiple challenges, there are numerous opportunities in the healthcare industry where Artificial Intelligence and Machine Learning can be put to use and make human lives easier. Few opportunities to mention are as follows:

In Patient Department monitoring

Monitoring the vital activity of the patients especially in the Intensive Care Units (ICU) is an essential task because the recovery of the patients depends on effective and continuous monitoring. In order to do so, AI based sensors can be used to monitor the activity of the patients and inform the staff in case of an emergency so that patients can be tended to immediately.

Automation of tasks during treatment

Certain well-defined clinical tasks can be automated using AI/ML algorithms which are usually performed by clinicians or the paramedic staff, which can make them a bit free to perform other essential tasks such as giving them more time with the patients.

Improved Electronic Health Records (EHR's)

The Electronic Health Records are the essence of any patient and clinician interaction. The traditional writing of prescriptions and maintaining health records manually is a cumbersome process. The Speech recognition technology which uses the AI and deep learning approach comes into good use. Such tools create a profile of the patients as soon as they hear the doctor-patient interaction, which the doctors can refer to for making diagnosis and treatment protocol later. This leads to reduced error in the entire process. Also, health records and medical history can be maintained through automated systems because of which there is no need to revisit the numerous paper records to see the previous health related information of the patient.

Effective Management of Hospital facilities

AI based tools can be utilized to predict the footfall of patients in the hospital based on the realtime data of patients such as the visit timings, admission, discharge etc. Based on the prediction, the staff augmentation can be done effectively which will eventually reduce the cost and time.

Clinical Trials of Drugs

Clinical trials of drugs can be monitored effectively with the use of AI based tools. These tools select the right population for the trial and monitors the entire process effectively end to end.

There are multiple opportunities in the healthcare industry apart from the ones mentioned above where Artificial Intelligence and Machine Learning can be put to use in order to make the existing healthcare processes accurate and less time consuming. Extensive studies are being done to explore more areas of AI technology so that it can be applied for serving more important purposes in healthcare [10].

FUTURE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN HEALTHCARE

Artificial Intelligence (AI) and Machine Learning (ML) is becoming very popular in the healthcare industry and is being used in patient care and other administrative processes. Several research studies propose that AI can outgrow human efficiencies when healthcare procedures come into picture. AI and ML algorithms are helping healthcare professionals in detecting multiple diseases. Broadly, a few areas of medicine where AI is being used are in Fig3.

AI has the ability to enable the healthcare practitioners to make a better diagnosis and then aid them in deciding the most effective treatment for the patient. The approach of AI is based upon using the existing data to train the algorithms for achieving the desired outcome [11].

APPLICATIONS OF ML AND AI

Treatment through personalized medicine which is commonly termed as Precision Medicine, is one of the most common uses of Machine learning. Precision medicine is the prediction of a set of procedures which might prove effective in treatment of a patient's ailment. It is done through the method of Supervised Learning which requires a training dataset which has a known outcome.

Another application of ML and AI which is being researched, is to predict accurately the number of patients expected to visit the hospital few days in advance by using the real time data of patients such as arrival time, discharge time, waiting time etc. The algorithms can use this data to find patterns and predict the outcome which will improve the revenue of the healthcare facilities and also help in managing the hospital facility for the patients efficiently.

Few researches are being done which uses software as a therapy to manage the challenges related to age and its corresponding illnesses in cognitive and physical performances. It uses the data of the subject in spot and thereby creates a personalized profile to identify that how different subjects behave under different intensities [12].

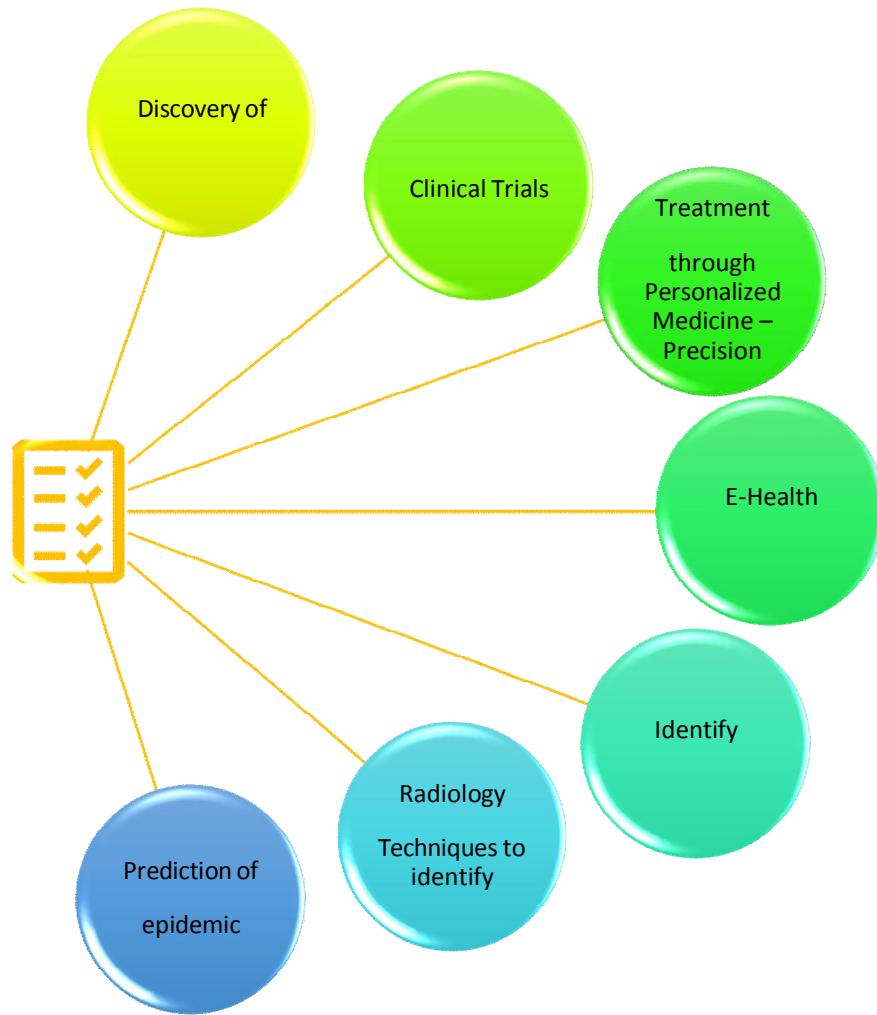


Fig 3: Applications of Artificial Intelligence

AI also has the capability to handle the administrative work at healthcare facilities. Administrative work includes:

- a) Revenue Management
- b) Documentation of the clinical records of trials
- c) Management of medical history of patients
- d) Billing Management/Processing of Medical Claims. Chatbots are also being used for interaction with patients, telehealth etc.

DIFFERENT TYPES OF ARTIFICIAL INTELLIGENCE USED IN HEALTHCARE

The following Fig4 details the various types of artificial intelligence in life science and healthcare.

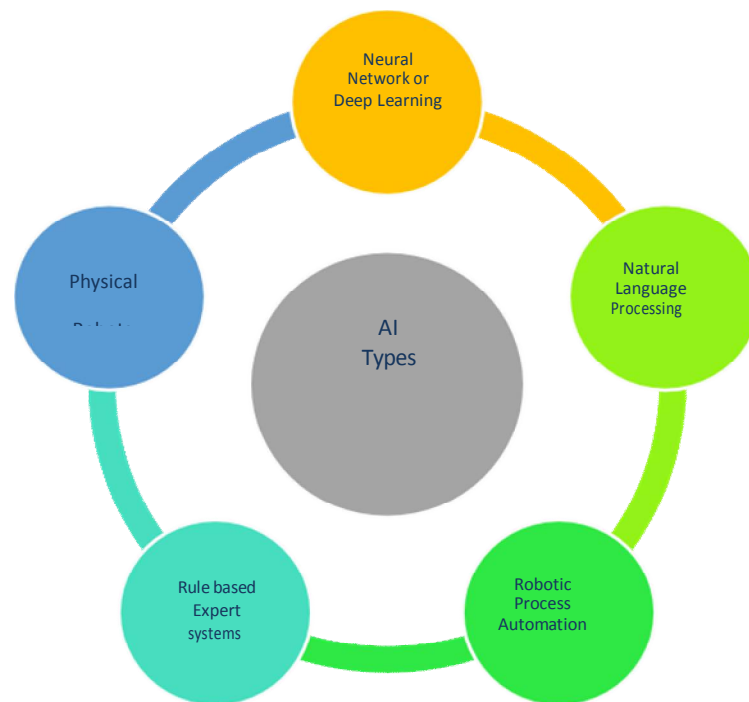


Fig 4: Types of Artificial Intelligence

Neural Networks or Deep Learning

Another important part of AI and ML is Neural Networks, also called as Deep Learning, which is quite complex in nature. This technique works in determining whether a patient will contract a particular disease in his lifetime or not. It works with inputs and outputs to predict outcomes and utilizes the concept of how the neurons in the brain identify and process a signal. A very common application of deep learning is in the field of radiology for identifying lesions which can be cancerous. Radiology and deep learning are commonly found in cancer-related image analysis of body organs. This relation between the two helps in diagnosis of diseases with more accuracy.

Natural Language Processing (NLP)

NLP is applied in human language-related tasks such as speech recognition, translation, analyzing text. In healthcare, clinical documentation analysis is the most used application of NLP which includes data generation, understanding and classification. NLP softwares have the ability to understand and infer conclusions from the raw clinical notes about patients, its reporting, transcription of patient interactions and further initiate AI conversation.

Rule Based Expert Systems

Rule-based Expert Systems are used for making clinical decisions. A set of rules are set about a domain by human experts and subject matter experts for the systems to use and perform a task. Though, this is now being replaced by other AI methods due to its inefficiency to handle large number of rules.

Physical Robots

Physical Robots were primarily used in factories for performing tasks related to assembling of a machine. Now, they are also being used in the healthcare industry to assist clinicians in performing surgeries in gynecology, prostate etc. In future, with more research, these physical robots will be of more help in performing critical healthcare tasks.

Robotic Process Automation (RPA)

RPA involves a set of computer programs which have been put together to perform a task especially administrative work. In healthcare, RPA technique is majorly being used in hospitals for billing, updating patient details etc.

In future, all the technologies mentioned above can be integrated into various composite solutions which will be used for solving problems more effectively. Various corporate startups have been started in India and overseas which focus on AI and ML and are working towards enhancement of these technologies to get benefitted from in future. Few startups are

- SigTuple
- Aindra
- Niramai Health Analytix
- Ten3T
- Touchkin
- Healthmir

Artificial Intelligence through Machine learning has a significant role to play today and in future and can be used to develop robust risk models. The healthcare industry is facing a lot of burden due to the increase in population and lack of doctors who are well trained. With the use of AI and ML technology, the productivity of the existing setups can be enhanced and it will help in handling more patients in less time along with reducing expense and increase in desirable treatment outcomes. Even with multiple opportunities for AI to grow, there are ethical implications attached which need to be addressed in order to proceed further.

REAL TIME EXAMPLES OF AI IMPLEMENTATION

Somewhere in March 2016, Johns Hopkins Hospital declared the inauguration of a hospital command center that practices predictive analytics to sustain a more competent operative flow. The hospital team up with GE Healthcare Partners to project the Judy Reitz Capacity Command Center which accepts “500 messages per minute” and fit in data from “14 different Johns Hopkins IT systems” at 22 high-resolution, touch-screen aided computer displays. In the year 2017 in Washington, D.C., UCLA researchers Dr. Edward Lee and Dr. Kevin Seals offered the research behind the strategy of their Virtual Interventional Radiologist (VIR) at the Society of Interventional Radiology’s annual conference. In essence a chatbot, the VIR “robotically communicates with mentioning clinicians and speedily provides evidence-based responses to regularly asked questions.” Presently in testing mode, this first VIR model is being used by a trivial team of UCLA health professionals which comprises “radiation oncologists, hospitalists and interventional radiologists”. The AI and deep learning driven application delivers the referring doctor with the capability to communicate data to the patient such as a summary of an interventional radiology action or following steps in a treatment plot, all in real-time. This virtual radiology consultant will be in the form of an iPhone application and could be used by non-radiology clinicians in the hospitals (general physicians, nurse practitioners etc.) to get the information rapidly regarding radiology powered by artificial intelligence. They might ask that can my patient of creatinine of 4.5 get a CT Scan of contrast and the artificial intelligence processes this query and gives the response carefully curated from the radiology literature and supported by cutting edge evidence based guidelines compiled by team based of academic radiologists. This type of support is very beneficial as the clinicians rapidly get the information, they needed really quick and also the interventional radiologist may get some time free in taking care of their patients and other treatment related work.

The largest impact of artificial intelligence is been in healthcare. According to the latest report of PwC, the artificial intelligence will contribute additionally fifteen point seven trillion to the world economy by 2030 and the greatest impact will be in the field of healthcare. The reason behind the sudden growth of artificial intelligence in healthcare industry is high availability of medical data (medical history in hospitals). Basically, with the availability of data the implementing of artificial intelligence becomes easier. The AI is based on technologies such as deep learning and machine learning which requires tons and tons of data, so the availability of data it became easier to use AI in healthcare industry. Another important reason that led to the development of AI in healthcare is the introduction of complex algorithms. Now what happens in machine learning is that machine learning is not capable of handling high dimensional data particularly the medical data or healthcare data is of very high dimension in character with thousands and thousands of attributes. In order to process and analyze the data of this dimension is hard to do with machine learning but as soon as deep learning and neural networks were introduced this became much easier because deep learning and neural networks basically focus on solving complex problems of high dimensional data. AI is actually benefiting healthcare organizations by implementing cognitive technology in order to unwind a huge amount of medical records and in order to perform any power diagnosis. For example, nuance, nuance is a production service provider that uses artificial intelligence and machine learning in order to present or predict the intent of a particular user. By implementing nuance in an organization’s system or in organization’s workflow one can develop a personalized user experience that allows a company to make a better decision and better actions that enhances the customers experience and overall it will just benefit the organization. So, nuance basically helps in storing, collecting and reformatting data in order to provide faster and more consistency access of all the data so that any further analysis or any diagnosis can be performed. Some key features about nuance –

1. Service acceleration
2. Call Deflection
3. Churn reduction
4. Automates tedious tasks
5. Increases the revenue generation

ARTIFICIAL INTELLIGENCE IN MEDICAL DIAGNOSIS

Medical imaging and diagnosis powered by AI should witness more than 40% growth to surpass 2.5 billion US dollars by 2024 as reported by global market insights. So, with the help of neural networks and deep learning models, artificial intelligence is actually revolutionizing the image diagnosis in medicine. One major application of AI in medical diagnosis is the MRI scans. AI has taken over the complex analysis of MRI scans and it has made it a much simpler process. MRI scans are the most difficult to analyze because of the amount of information that they contain. Normal MRI analysis will take about several hours. The solution here is clearly deep learning as large and complex data sets can be analyzed using neural networks. MIT developed a neural network called as Voxel Morph that was trained on a dataset of approximately 7000 MRI scans. So how a neural network function is it functions by inputting the data at one end of the neural network and this input will undergo transformation throughout the network until the final desired output is formed. So, the neural network works on the principal of weights and bias. The end result of this was that Voxel Morph succeeded in beating the conventional MRI analysis methods, the neural network took seconds to perform MRI analysis, the same analysis that will take hours from a conventional MRI method.

ARTIFICIAL INTELLIGENCE IN DETECTING DISEASES AT EARLIER STAGES

AI has played a very important role in the early predictions of medical conditions such as heart attacks. There are many AI based wearable health trackers that are being developed to monitor the health of a person and display any warnings when the device collects something unusual or something unlikely. Examples of such wearables include FitBit, Apple watch and many others. Like we say precaution is always better than cure, this was the moto behind the latest release of the apple watch. Apple used artificial intelligence to build a watch that monitors an individual health. This watch will basically collect data like person's heart rate, sleep cycle, blood pressure, breathing rate, activity level and all, and keeps a record of all these data 24 X 7. Person has to just wear the watch and all of this data is automatically collected by the watch. After the collection of data, the next step in machine learning is processing, analyzing and making prediction from the data. So, this collected data is processed and analyzed using machine learning and deep learning algorithms so as to build a model that predicts the risks of heart attacks. With the help of data one can predict whether a person has the chance of getting a heart attack or not.

Apple watch actually saved a person's life, there was a person known as Scott Gillan and he suddenly had a small heart attack and his life was saved by this apple watch because it gave a repetitive warning to him regarding his high blood pressure and heart rate. He got a immediate message from his apple watch which states that his heart rate and blood pressure was increasing in a drastically manner and he should visit a doctor as early as possible. This example is self-explaining that artificial intelligence is not a threat to mankind, it is only a threat if you use it as a weapon, but if you use it as a solution it can save many lives as well as millions of dollars.

ARTIFICIAL INTELLIGENCE IN MEDICAL ASSISTANCE

As the engine for medical assistance has grown the development of artificial intelligence based virtual nurses has increased. According to a recent survey virtual nursing assistance correspondsto the maximum near turn value of 20 billion US dollars by 2027. A virtual nurses named Sensely is implementing natural language processing, speech recognition machine learning and wireless integration with medical devices such as blood pressure cuts in order to provide medical assistance to patients. Basically, a nurse which not physically present but virtually present with you. So Sensely provides selfcare, clinically advice to you about which medicine has to be taken at what time and also scheduling a appointment for you. So, Sensely works for selfcare and actually works as a personal nurse for you proving you with a lot of clinical advices. With such a revolution in healthcare it is clear that despite all the risks and so called all the threats, artificial intelligence is actually benefiting us in many ways. Artificial Intelligence will surely improve our situation in each and every domain, its that we just need to know how to use AI in the correct way.

ARTIFICIAL INTELLIGENCE IN DECISION MAKING

AI has played a very important role in decision making, not only in healthcare but also in lots of business by studying customer needs and evaluating any potential risks that a business might face. A powerful use case of artificial intelligence in decision making is the use of surgical robots that can minimize errors and any variations and will eventually help in increasing the efficiency of the surgeons. One such surgical

robot is Da Vinci. This device allows the profession surgeons to implement complex surgeries with better flexibility and control than conventional approaches. The key features of Da Vinci are –

1. Aiding the surgeons with an advanced set of instruments
2. It is used in translating the surgeon's hand movements at the console in the real time
3. It produces clear and magnified images of the surgical area

Da Vinci is not a robot that performs the surgery rather it provides a set of instruments that will help in performing the surgery. We still have not developed AI robots or AI based systems that are well capable of performing surgeries on their own. There are a couple of robots that could perform certain tasks on their own but still they require human interventions and assistance. Da Vinci is basically an instrument that helps in performing surgeries, it provides a set of instruments that could be used in performing complex surgeries. So not only these robots assist in decision making but also improves the overall performance by increasing the accuracy and the efficiency of the work that has been done.

CONCLUSION

Artificial Intelligence now more than ever impacts the design make test analyze cycle of molecular design by enabling big data ingestion and exploitation, actively learning and autonomous optimization and rapid decision making. There is a lot of room for exploration and innovation, every single week there is a new paper about a new type of architecture or models to predict a specific outcome. But there are a lot of challenges so we still need a lot of data as the molecules could be small but their functional groups can be diverse and so we need a lot of data so as to build a model that is generalizable enough. AI and digital transformation require cultural change the way it operates to digitalize the information, but it's a long process. The market of AI is desperate for talented AI experts and hopefully we will have many in the coming generation.

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CONFLICT OF INTEREST

There is no conflict of interest by the authors.

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The study does not involve any experiment on humans and animals.

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NA

DATA AVAILABILITY

NA

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