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Artificial Intelligence – Emerging Trends in Management of Pandemics

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Abstract Digital Health strategically leverages digital technologies, empowering patients to manage their illness, reduce health risk, and promote health and wellness. This era of digital innovation within our health care system provides new alternatives for managing chronic conditions, diagnosing diseases earlier, and promoting prevention. The extensive scope of digital health encompasses technologies such as mobile health (m Health) apps; artificial intelligence (AI) enabled medical devices, and smart connected devices. Artificial intelligence (AI) is a branch of computer science that deals with the problem solving by the aid of symbolic programming. One of the pivotal applications of AI in development of the expert system AI is not new concept, yet it has been accepted in many areas such as education, business, medical and manufacturing. Health care delivery requires the support of new technologies like AI, Internet of things (IoT), big data and machine learning to fight and look ahead against the new pandemic diseases. The role of AI as a decisive technology to analyze, prepare us for prevention and fight with COVID-19 pandemic. This descriptive article gives a broad overview of AI in medicine, pharmacy dealing with terms and concepts as well as the current and future applications.

Keywords AI, Medicine, Pharmacy, Research, COVID-19

1. Introduction

Artificial intelligence (AI) is defined as a field of science and engineering exercised with the computational understanding of what is commonly called intelligent behavior and with the creation of artifacts that exhibit such behavior [1]. Such Programs which enable computers to function in the ways, that make people seem intelligent are called artificial intelligent systems. The year 1948 Alan Turing introduced many of the central concepts of AI in a report entitled "Intelligence Machinery" [2]. In 2016, the biggest volume of investments in artificial intelligence research was in healthcare systems compared with other business sectors [3]. Today, we shall see most of the hospitals and highest grossing pharmaceutical companies which are using AI or machine learning for drug discovery, novel medication, predictions, data analysis etc [4]. AI finds its application in every health care systems and it has been forecasted that the profit from AI market will be increasing by as much as ten-fold between years 2020 and 2027. The corona virus (SARS-Co-V-2) infection outbreak started in December 2019 (COVID-19) in Wuhan, China; the consequences worldwide pandemic with its fast outbreak has yielded an extraordinary challenge to the world in the 21st century [5]. The problem has unique and even unknown features that human being has never been faced with. Therefore, reducing frequent lab testing and the potential clinical and financial implications are an important issue in ICU and CCU which an AI can predict the laboratory tests with high accuracy and in forecasting

the probable information. During the current era, a challenge in healthcare systems all over the world is to produce sophisticated and infection free management of diseases in COVID-19 pandemic [6].

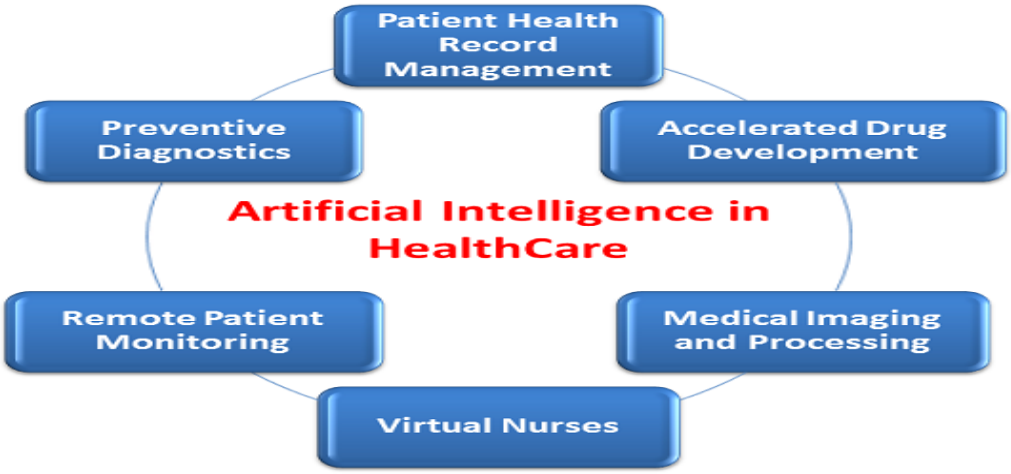

Figure 1: AI in Health Care Systems

Artificial intelligence (AI) was first described in 1950; however, several limitations in early models prevented widespread acceptance and application to medicine**.** The earliest work in medical artificial intelligence (AI) dates to the early 1970s, when the field of AI was about 15 years old (the phrase " artificial intelligence" had coined at a famous Dartmouth College conference in 1956 [7]. Early AI in medicine researchers had discovered the applicability of AI methods to life sciences, most visibly in the Dental experiments of the late 1960s and early 1970s, which brought together computer scientist named Edward Feigenbaum [8]. Now AI systems are capable of analyzing complex algorithms and self learning we enter a new age in medicine where AI can be applied to clinical practice through risk assessment models, improving diagnostic accuracy and workflow efficiency [9].

Artificial intelligence in medicine classified into two subtypes: Virtual and physical.

Virtual: The virtual part ranges from applications such as electronic health record to neural network based guidance in treatment decisions.

Physical: The physical part deals with robots assisting in performing surgeries, intelligent prostheses for handicapped people and elderly one. The basis of evidence based medicine is to establish clinical correlations and insights via developing associations and patterns from the existing database of information. Computers learn the art of diagnosing a patient via two based technique- flowcharts and database approach [10].

Artificial intelligence simplifies the lives of patients, doctors and hospital administrators by performing tasks that are typically done by humans, but in less time and at a fraction of the cost. Path AI is developing machine learning technology to assist pathologist in making more accurate diagnoses. Incomplete medical histories and large case loads can lead to deadly human errors[11]. AI can predict and diagnose disease at a faster rate than most medical professionals. The first application of a computer in a pharmacy presumably dates back to 1980s and since then, computers have been utilized in everything from data collection, retail pharmacy management, clinical research, industrial management, pharmacy education and research [12].

2. Applications of Artificial Intelligence

2.1. Medicine

The development of medical artificial intelligence has been related to the development of AI programs intended to help the clinician in the formulation of diagnosis, the making of therapeutic decisions and the prediction of outcome. This includes artificial neural network (ANN), fuzzy expert systems, and evolutionary computation and hybrid intelligent systems. They are designed to support healthcare professionals in their every day duties, assisting with clinical tasks that rely in the manipulation of data and knowledge [13]. A new AI innovation centre established in

shanghai to capitalize on the latest digital technology in research and development, manufacturing, operations and commercialization in order to accelerate the delivery of medicines to patients in china and globally [14].

2.1a. Artificial Neural Network

ANN is computational analytical tool which are influenced by the biological nervous system. They consist of networks of highly interconnected computer processors called "neurons" that are capable of performing parallel computations for data processing and knowledge representation. This system have been mainly used in the clinical diagnosis, image analysis in radiology and histopathology, data interpretation in intensive care setting and wave form analysis and histological specimens [15]. PAPNET, a computerized automated screening system based on neural networks, has been developed to assist the cytologist in cervical screening and is one of the few ANN models which were promoted commercially [16].

2.1b. Fuzzy Experts Systems

Fuzzy logic is a data handling methodology that allows ambiguity and hence is particularly suited to medical applications. Fuzzy experts systems have the structure of a series of "if – then" rules for modeling. The application of fuzzy logic has been explored in the diagnosis of acute leukemia, breast and pancreatic cancer. Fuzzy logic has also been used to characterize ultrasound images of breast, CT scan images of liver lesions PET (Positron Emission Tomography) scan images, MEG (Magneto Encephalography) scan images and MRI images of brain tumors [17].

2.1c. Evolutionary Computation

The most widely used form of evolutionary computation for medical applications are "Genetic logarithms" proposed by John Holland (1975); they are classes of random search and optimization algorithms based on natural biological evolution. They are applied to the several types of tasks like diagnosis and prognosis, medical imaging and signal processing, and planning and scheduling [18].

2.1d. Hybrid Intelligent System

AI technologies allow a hybrid system to accommodate common sense, extract knowledge from raw data, human like reasoning mechanisms, deal with uncertainty and imprecision, and learn to adapt to a rapidly changing and unknown environment [19]. The application of the hybrid intelligent systems has been explored in many diverse clinical scenarios such as breast cancer diagnosis, assessment of myocardial viability, and control of the depth of anesthesia.

The potential of AI in medicine has been expressed by number of researchers and Hoong (1998) summarized as follows [20]

- Provides a laboratory for the examination, organization, representation, and cataloguing of medical knowledge.
- Produces new tools to support medical decision-making, training and research.
- Integrates activities in medical, computer, cognitive and other health allied sciences.
- Offers a content rich in discipline for future scientific medical super specialty.

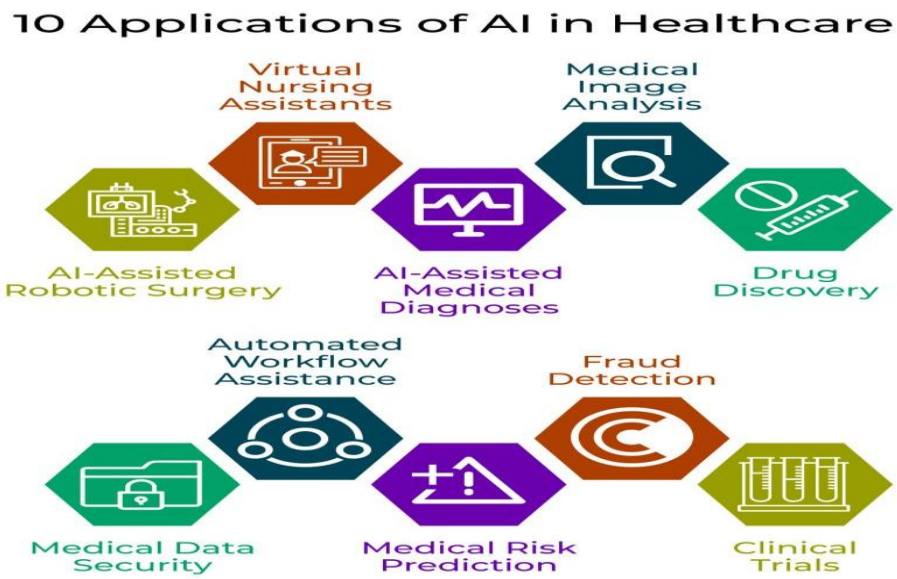

Figure 2: Applications of AI in Medicine

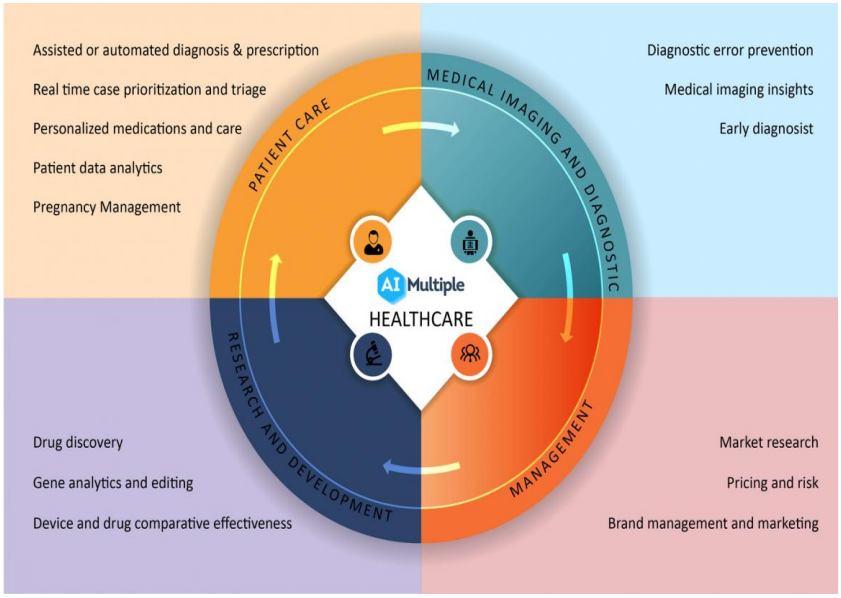

Figure 3: AI in multiple applications

Many intelligent systems have been developed for the purpose of enhancing healthcare and provide of enhancing health- care and provide better health care facilities, reduce costs etc. intelligent medical system such as MYCIN, CASNET, and PIP. MYCIN was developed in the early 1970s to diagnose certain antimicrobial infection and recommends drug treatment [21]. CASNET (Casual Association Networks) was developed in early 1960s for the diagnosis and recommendation of treatment for glaucoma. PIP (Present Illness Program) was developed in 1970S to stimulate the behavior of an expert nephrologist in taking the history of the present illness of patient with underlying renal disease. ICHT (Intelligent Referral System for Primary Child Health Care) developed to reduce child mortality especially in rural areas.

2.1e. Electronic Health Record

AI in EHRs (Electronic Health Records) is primarily applied for the improvement of data discovery, extraction, and personalized recommendations for treatments. AI powered systems absolutely integrate and offer solutions with a variety of functionalities [22]. Machine learning and Natural Language Processing (NLP) can help in recording the

medical experiences of the both out and in- patients, organizing the large HER data banks for finding important documents, gauging patient satisfaction, etc [23].

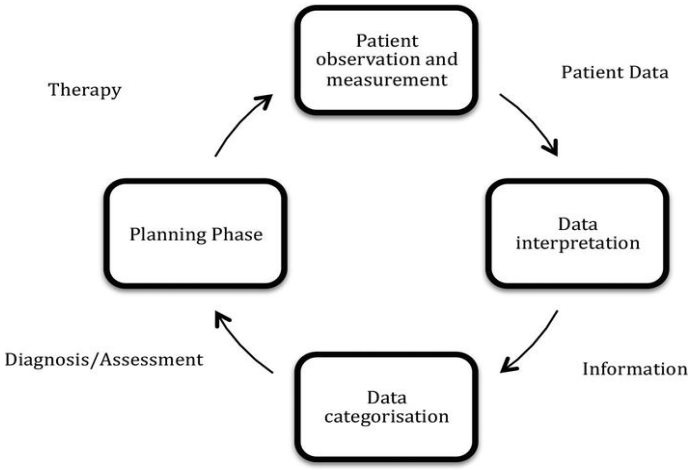

Figure 4: AI in patient data management

2.2 Pharmacy

Several types of information technology will likely to reduce the frequency of medication errors, however, insufficient data exist for many technologies and most available data come from adult settings [24]. Computerized physician order entry with decision support substantially reduces the frequency of serious inpatient medication errors in adults. Other specific inpatient information technologies may be beneficial even though less evidence in available now. These include computerized medication administration records, robots, and automated pharmacy systems, bar coding, smart intravenous devices and computerized discharge prescription [25].

Artificial intelligence and machine learning may have a enormous multifaceted impact on pharmacy operational efficiencies, patient- centered care, and outcomes. In today's world, AI complements human interaction with patients [26]. Recently pharmacists can be empowered by AI to shift from prescription filling roles to patient engagement and management of diseases. AI is optimizing pharmacy operations for inventory control and supply chain management to enhance pharmacy productivity, and increase patient stratifications and outcomes [27].

In past 5 years with the arrival of big data and AI, robots are now becoming more trustworthy for doctors, and large numbers of institutions are now employing robots along with human supervision to carry out activities that were previously done by humans in order to prevent direct human contact during pandemic like COVID-19[28]. Novartis and Microsoft announce collaboration to transform medicine with artificial intelligence. Novartis continues evolving into a focused medicines company powered by advanced therapy platforms and data science, alliances like this will help us to deliver on our purpose to re imagine medicine to improve and extend patient`s lives. Microsoft leading expertise in AI could transform the way discover and develop medicines for the world [29].

AI become the boon for pharmaceutical company and reduces the time that is needed for drug development. The applications of AI are not only seen in the diagnosis, monitoring, prediction of the disease, but also in the development of new drug molecules [30]. The use of machine learning, in preliminary stages in drug discovery, starts from the initial screening of drugs to the predicted rate of success. The major benefit of AI is that it is much more superior to humans in analyzing data and it can analyze large number of data that would normally not fit into any of the conventional computers [31].

2.2a AI in Dispensing

Dispensing of drugs is the systematic way to preparation and dispensing medicines to a particular person on the basis of prescription. The patient uses the prescription which comprises the exact explanation of the wishes of the person who has prescribed and the systematic preparation and the labeling [32]. AI technology can help pharmacists

improve the speed and efficiency of manually intensive tasks- verifying medication, counting pills and maintaining adequate staff and inventory while ensuring patient safety and adherence [33].

Regardless, where and when the dispensing is done, any miscalculation in the process of dispensing can certainly affect the patient care. For the betterment of the rationale uses, certain programs include concentrating on prescribing habits, overlooking, dispensing and medicines used by the patients [34]. AI can churn the details of pharmacy sales activities, sociodemographic information, location etc. From this sales potential of the pharmacies can be determined and based on scales potential of the pharmacies, efforts can be customized based on categories of interest (e.g. price sensitivity or responsiveness to promotional activities, etc) [35].

2.2b AI in Patient Handling

Artificial intelligence can be used to forecasting patient flow and avoid unnecessary trips to the emergency department [36]. Rapid interpretation of clinical data would enable to segregate patients and predict outcomes in the emergency department operations. A pilot study in Finland evaluated the impact of an Intelligent Patient Flow Management System (IFPM) in streamlining patient flow to hospital [37].

2.2c AI in Outpatient Handling

One of the promising areas in outpatient practice is the introduction of chat bots. AI will quickly collect and analyze general symptoms of the condition, and then schedule an appointment with the right MD, for instance, Babylon Health and Health Tap Inc, has already developed such technology and is now actively introducing in practice [38].

AI can analyze patient`s data collected from the doctor's records, Lb tests results, and diagnostics results and compare them with medical protocols, clinical tests, and recommendations, thus determining which additional tests are required and which treatment is best for the patient. This way, AI will allow tailoring medical solutions, including in outpatient healthcare [39].

2.2d AI in Drug Purchase

The application of AI to drug discovery has the potential to revolutionize the current time scale and scope of drug discovery [40].

- AI does not rely on predetermined targets for drug discovery. Therefore , subjective basis and existing knowledge is not a factor in this drug development process
- AI utilizes the latest advances in biology and computing to develop state of the art-algorithm for drug discovery [41].
- AI has a higher predictive power to define meaningful interactions in a drug screen. With rapid increase in processing power and reduction in processing cost, AI has the potential to level the playing field in drug development [42].

The prime objective of Artificial intelligence (AI) in drug discovery market report is to help the user understand the market in terms of definition, segmentation, market potential, influential trends and the challenges that the market facing with 15 major regions and 50 major countries [43]. According to this report Global Artificial Intelligence (AI) in drug discovery market will rise from covid-19 crisis at moderate growth rate during 2020 to 2027 [44]. Artificial Intelligence (AI) in drug discovery and impact of COVID 19 over the forecast period 2020 to 2027 [45].

2.3 Tools of AI

2.3a. Diagnostic Tool of AI

Chronic diseases like diabetes and heart disease being so common among population worldwide. Researchers have emphasized (AI) could play a big role in diagnosis of a condition without a physician, and prompt higher risk of patient earlier in their diseases course to seek care before catastrophic complications [46]. The first autonomous AI diagnostic device approved by the Food and Drug Administration (FDA), IDX-DR, is able to detect diabetic retinopathy by capturing an image of the eye and having its AI software analyze the image for signs of diseases without a physician [47]. Similarity, AI technologies for heart diseases and other illnesses could potentially be used

to identify at risk patients earlier and bring them into subspecialty cave scanner preventing more serious diseases such as Echo Go and Echo Go pro that automate cardiac ultrasound measurements for heart functions and make it possible for physicians to even predict occurrence of coronary artery disease (CAD).

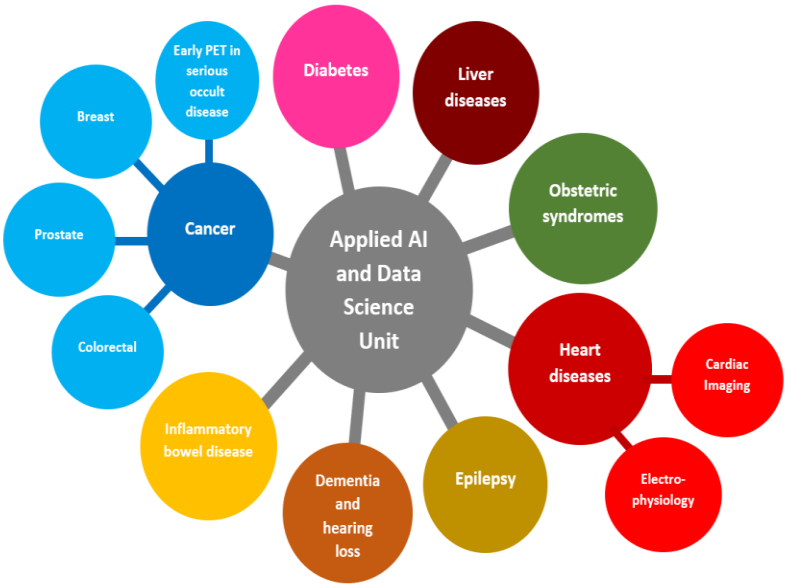

Figure 5: AI in data science unit

A large number of AI tools have been created to meet the current need of the pharmaceutical industry [48]. Some of the AI tools that have gained huge popularity in pharmaceutical sector have been described below

2.3b Robot Pharmacy

The prime objective of improving the safety of patients, UCSF Medical Centre uses robotic technology for the preparation and tracking medications [49]. The abilities of robotic technology include preparation of oral as well as inject able medicines which include chemotherapy drugs that are toxic. Within the automated system of the pharmacy, the computers first receive medication orders electronically from the physicians and pharmacists of UCSF. After this, individual doses of pills are picked, packed, and dispensed by the robotics [50].

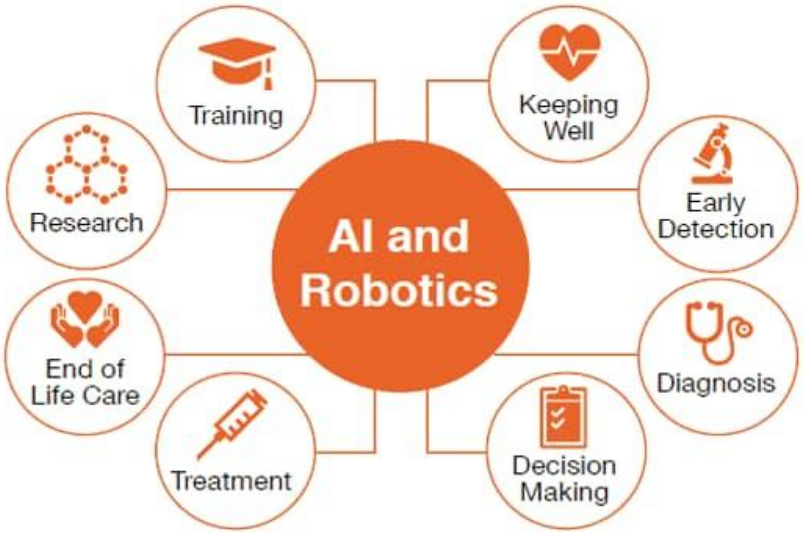

Figure 6: AI in robotic pharmacy

2.4 AI in Pharmacy and Medical Education

Students and teachers will be able to communicate instantly with one another as well as to connect with resources they need exactly when they need them. It is better way to offer more personalized learning opportunities for students than to have AI be able to analyze student responses, and find resources or create new understanding of the content. The future likely holds a lot of possibilities for AI and teachers can take the opportunity to be informed of the possibilities and being open to discussion with students [51].

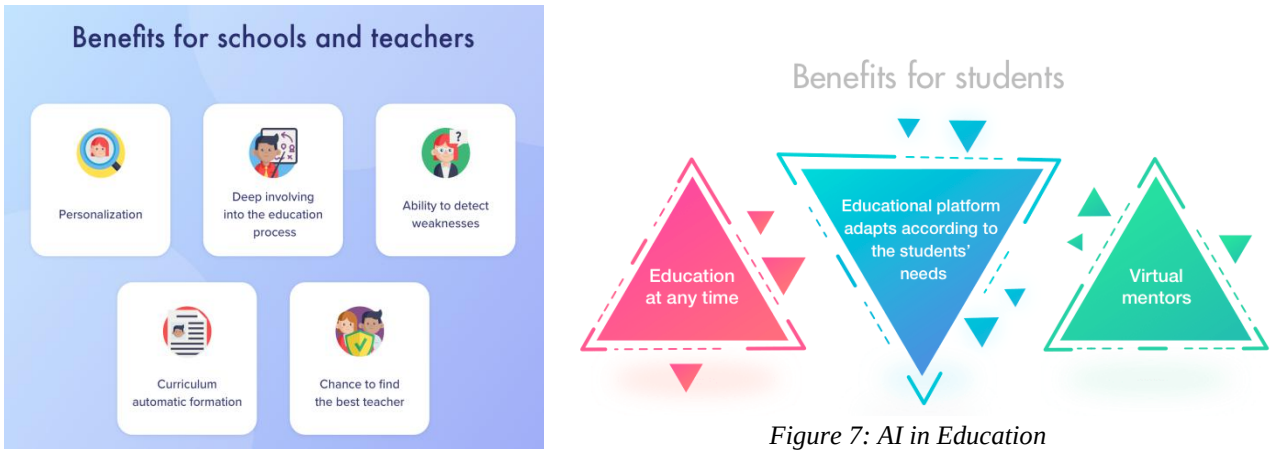

Figure 7: AI in Education

Computer software and applications have found uses in many areas of pharmacy from research to industry, retail and many more. The International Pharmaceutical Federation conducted a study between 2015-2017 to access the state of pharmacy practice worldwide. AI technology aimed at reducing the spread of Covid-19 through temperature checks and contact tracing is making waves in the health care industry [52].

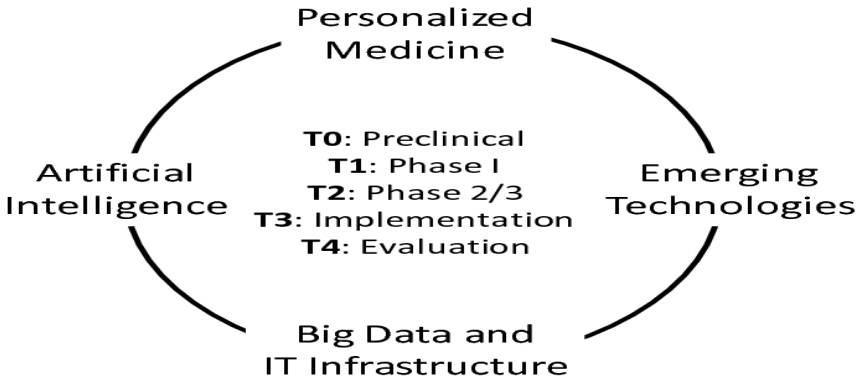

Figure 8: AI in clinical trials

2.4a AI in Pharmacy Research

AI can be applied to nearly every aspect of the pharmaceutical and health care industry, to enhance data processing. Adopting the technology will reveal the astonishing potential of the health care sector, with success rates flying higher than even before- especially in the research and development of crucial, life- changing drugs [53].

Artificial Intelligence use in pharmaceutical technology has increased over the years, and the use of technology can save time and money while providing better understanding of the relationships between different formulations and process parameters [54]. Pharmaceutical industry can accelerate innovation by using technological advancements. The recent technological advancement that comes to mind would be artificial intelligence, development of computer system able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision making, and translation between languages. The pharmaceutical industry is a sales-driven sector, with AI

becoming more useful in refining the style of marketing and strategies that business use. AI has the capability to optimize marketing strategies, benefit manufacturing process and drug trialing, so will be adopted for further uses in future [55].

2.5 AI Applications in COVID-19 Management

One of the critical points of this challenge is the management of COVID-19 patients needing acute and /or critical respiratory care. To discover AI based model to improve the critical care of the COVID-19 patients [56]. Developing AI models to predict whether a patient have a high risk of having a health crisis or not based on specific information from the patients is possible. Clinical symptoms and signs of COVID-19 could be flagged before clinicians discover them; this is an alarming property of AI. A newly developed Vaxign reverse vaccinology tool integrated with machine learning has proposed candidates [57]. In silico models of vaccine production (like vaccine investigation and online information network: VIOLIN; http:/WWW.violet.org) have been claimed useful which reply on AI, databases and in silico tools [58].

- Early detection, diagnosis, management and to provided fasted decision making in cost-effective manner.
- AI is an intelligent platform for automatic monitoring and prediction for disease, this would help in proper diagnosis, monitoring and treatment of affected individuals
- AI helps in analyzing the level of infection by this virus identifying the individuals and also monitors them. It also helpful in predicting the reappearance.
- AI is used for the development of the drugs and vaccines for the effective management of COVID-19.
- It helps in early diagnosis and providing treatment at an initial stage using digital approaches in reducing the work load of healthcare workers.
- AI can provide uploaded information of real time data analysis in prevention of disease.

Conclusion

There are different types of AI techniques that are applied to analyze structured and unstructured data from health care system. These techniques provide a more accurate and efficient diagnosis for a patient, and the faster and more targeted the diagnosis is, the sooner a patient can recover. AI has been applied in many areas in the medical field, including managing healthcare records and data, drug creation, treatments design etc. furthermore AI is allowing clinicians to make more efficient and accurate decisions which in turn better the care of patient as whole. AI will change medicine and medical innovation. Using AI is one way we can address health disparities [59]. However, for AI to react its potential in improving care and reducing disparities in heart disease, diabetes or other conditions, physicians, clinics, and patients must be supported. Medicare and the government will have to incentivinge. AI use for its widespread adoption and for the benefits & AI to reach their full potential in helping patients. AI can track the crisis of COVID-19 at different scales such as medical, molecular and epidemiological applications. AI can help in developing proper treatment regimens, prevention strategies, and drug and vaccine development. Our goal was to design and deploy a decision support tool using AI capabilities- mostly predictive analysis- to flag future clinical corona virus severity [60].

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