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An Artificial Intelligence in Formulation of Pharmaceutical Products

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ABSTRACT: Artificial intelligence (AI) is bit by bit ever-changing practice. Through recent advances in digitized knowledge acquisition, machine learning, and computational technology, we tend to define recent breakthroughs in AI technologies and their medical specialty applications, determine the challenges for any progress in medical AI systems, summarize the economic, legal and social implications of AI intending. In the field of health care system AI is very easy, faster and having several innovations in the field of the healthcare system. Several types of AI have been involved in the general health care system till now to promote the healthcare system for safety and care of the patient. It involves diagnosis, treatment recommendations, patient engagement and adherence, and administrative activities. It help in the analysis of the complex medical data. The primary aim of the AI in the healthcare system is to analyze the connection between the prevention and diagnosis or treatment techniques and patient outcomes. AI also involves in the industry, technology, art, biomedicine, and other healthcare-related industries to improve healthcare at all rates. In this paper, we explore how to improve this system based on a realistic assessment of emerging AI technology and expected innovations. AI also very helpful in the field of pharmaceuticals like drug development personalized medicine, patient monitoring and care. We review several recent studies of AI applications related to healthcare that provide a view of a future where healthcare delivery is a more unified, human experience.

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INTRODUCTION:
Artificial intelligence (AI) describes computer systems that can 'think' and act like humans. They can sense their surroundings, absorb information, learn from past experiences and take decisions and act. For decades, humans have been developing machines that capture information and respond to it adaptively. The year 1956 considered the year when AI was born, while in the year 1955 that Dartmouth College conducts the widely known conference. However, the previous year, which is 1955, saw its first AI system called Logic Theorist, and

the people who developed it were Allen Newell, Herbert A. Simon [1]. However, AI has transformational power for two reasons the explosive growth in the amount of data, generated by billions of connected computers paired with tremendous improvement in computational power and transfer rates. Artificial intelligence (AI) is bit by bit ever-changing practice [2]. With recent progress in digitized knowledge acquisition, machine learning and computing infrastructure, AI applications square measure increasing into areas that were antecedently thought to be solely the province of human specialists. During this critique, we tend to define recent breakthroughs in AI technologies and their medical specialty applications, determine the challenges for any progress in medical AI systems, and summarize the economic, legal and social implications of AI intending. The important series of applications involve diagnosis; treatment recommendations, patient engagement and adherence, and administrative activities. Computers are most comfortable with analyzing structured data such as numbers when creating models and making predictions. However, a key challenge in healthcare is that as much as 80% of data is unstructured – including doctor's handwritten notes, prescriptions, the language contained in electronic medical records and clinical studies, as well as audiovisual content such as CT scans3. Natural language processing and image recognition are therefore key tools to process and analyze unstructured data that is stored in different places and formats, and to combine it with structured data [3]. The 1980s and 1990s brought microcomputer proliferation and new levels of network connectivity. During this time, researchers and engineers realized that healthcare AI systems have to be built to handle the shortage of perfect data and draw on physician knowledge [4]. The main purpose of AI is to understand the principles and functions of computers as an aid in human life to make it easy and also helpful in the healthcare system to increase the transparency of the healthcare and medical system.

IMPORTANCE OF AI IN HEALTHCARE SYSTEM:

The main aim of AI and computers in the healthcare system is basically to solve the complex problems related to medical and healthcare systems like data generated through the diagnosis of complex diseases like cardiovascular problems, Alzheimer's disease, diabetes, and different types of cancer. It is shown that AI is very helpful in the detection of the various serious diseases in the early stages which decrease the severity of the condition and also helpful in the treatment of the disease [5]. On any given day, the healthcare industry produces a tremendous amount of data. Healthcare professionals appreciated a method to be able to manage this data, centralize it and access it instantly. With developments in AI, all of these data points can be entered into algorithms for machine and deep learning for some fascinating predictive analysis for healthcare [6]. AI is also widely used in the research areas currently. A large number of compounds that could have the potential to combat a large number of specific diseases are available with tools at their disposal for their identification as such. Drug development and production is not an easy task, and it may cost a pharmaceutical company as much as $2.6 billion along with a time frame of as long as 12–14 years for completion In pharmaceutical companies AI reduces the time need for the process of drug development and, in turn, it reduces the cost related to the drug development, enhances the returns on investment and may even cause a reduced cost for the end-user also [7,8]. Robots are now becoming more trustworthy for doctors with the advent of big data and AI, and a large number of institutions are now employing robots along with human supervision to carry out activities that were previously carried out by humans [9]. Major disease areas that use AI tools include cancer, neurology, and cardiology [10].

Table 1. Pharmaceutical companies using AI system.

Name of Pharmaceutical companies	Markers
Pfizer	Owkin, CHAI
GSK	ATOM, AAIH
Ipsen	Owkin
Janssen	Benevolent AI, AAIH
Lundbeck	IBM, Numerate
Ono pharmaceuticals	TwoXAR
SK Biopharmaceuticals	Standigm
Santen	TwoXAR
Servier	Iktos, MELLODDY
Novartis	NIBR

Types of AI:

Machine learning:

Machine learning is a mathematical methodology in which algorithms can be connected to data and 'know 'from data through training models. Machine learning is one of the most common forms of AI; in a 2018 Deloitte survey of 1,100 US managers whose organizations were

already pursuing AI, 63 % of companies surveyed were employing machine learning in their businesses [11]. The most complex part of machine learning is *deep learning* introduced in recent years it can easily read the data generated from the diagnosis and can give result without the help of human experts [12]. The deep learning process can easily quantify the phenotypic characteristics of living tissues. Thus systems are improving the diagnostic system and clinical care. Deep learning having an advantage of required less time and reduced manual steps [13].

Natural Language Processing:

Since the 1950s, AI developers have been aiming to make sense of the human language. This area, NLP, involves applications such as speech recognition, text processing, language-related translation, and other objectives. There are two basic approaches to this: NLP statistics and NLP semblance. Statistical NLP is based on machine learning (particularly deep learning neural networks) and has contributed to a recent increase in recognition accuracy. It requires a large 'corpus' or body of language from which to learn in the healthcare system NLP applications are creation, understanding, and classification of clinical documentation and published research. It can easily understand the patient's clinical notes, radiological reports and transcriber patient interactions and observe conversational AI.

AI in Pharmaceuticals:

From last some years process of the development of the new drug is in decline phase of the drug development process the reason is because only increase risk of failure of the drug in the clinical trials exceed up to 90 % after drug therapies is examined in model organisms, and the cost of developing a new drug exceeds up to $2.6 billion. The aid of AI in the pharmaceutical industries helps to prevent these losses in the process of drug development and also improve pharmaceutical research and development [14].

In now a day's most of the pharmaceutical companies is start to connect with the artificial intelligence to promote the development of the latest and better diagnostic system, to determine the sites of drug action and in the development of the new drugs and new dosage form to increase the safety, efficacy, and stability of drug and drug-related dosage form [15]. The company's ability to design drug molecules comes from its work on generative adversarial networks (GANs). This is a form of deep learning developed by Google's AI team,

Google Brain, in 2014. The technique was used in the development of photo-realistic photographs from text descriptions. This type of AI can imagine or create new data, modeled on real data, rather than just analyzing data. We were the first group in the world to demonstrate we can use GANs to generate molecules, says Zhavoronkov, who presented Insilco's method in 2016 [16]. The strategy [GAN] is an adversarial activity between two profound neural networks, he states. One deep neural network evaluates the output of the other iteratively and in that adversarial game, the two networks learn how to generate more perfect objects, or in this case, perfect molecules [17].

Table 2. Biomarkers used for detection of diseases: Some USFDA biomarkers examples are given below.

Markers	Disease
CEA	Peritoneal cancer dissemination
CEA	Malignant pleural effusion
Bladder tumor antigen	Urothelial cell carcinoma
Her-2/neu	Stage 4 breast cancer
Alpha fetoprotein	Hepatocellular carcinoma
Thyro-globulin	Thyroid cancer metastasis
PSA	Prostate cancer
CA 125	Non-small cell lung cancer
CA 19.9	Pancreatic cancer
CA 15.3	Breast cancer
Leptin, prolactin, osteopontin and IGF- 2	Ovarian cancer
B-type natriuretic	Congestive heart failure
Troponin 1	Myocardial infraction

AI in new Drug and Dosage form Design:

The combination of computational de novo design with AI may allow a' digital chemist to learn from known useful compounds and to create chemically appropriate and synthesizable structures with a planned biological activity [18]. AI was stymied by the huge number of possibilities involved and the potential for multiple targets [19]. Advanced machine learning requires large well-annotated datasets that need to be compiled or generated, explained Gisbert Schneider, group leader for the study. Also, the chemical structure of a drug alone rarely accounts for the observed pharmacological effect simply. Most medications have numerous biological targets and functions, and their relative importance depends heavily on the patient's particular genetic profile and many other factors [20]. ANN models showed better fitting and predicting abilities in the

development of solid dosage forms in investigations of the effects of several factors (such as formulation, compression parameters) on tablet properties (such as dissolution). ANNs provided a useful tool for developing microemulsion based drug delivery systems which minimized experimental effort. To model the phase activity of quaternary microemulsion-forming structures consisting of oil, water, and two surfactants, ANNs were used. ANN was also used to simulate aerosol behavior, to employ this type of methodology in the evaluation and design of pulmonary drug-delivery systems [21,22].
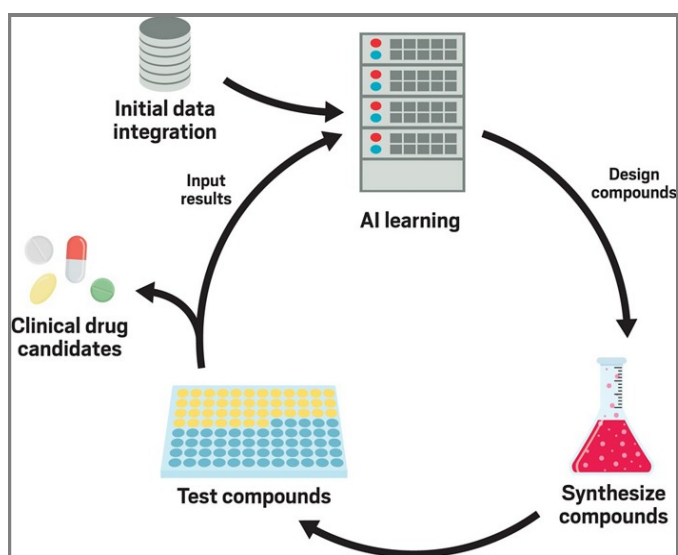

Fig l. Process of Drug development by using AI.

AI in Diagnosis and Treatment of Patient:

Artificial intelligence found to be very much helpful in the diagnosis and treatment of the various life-threatening disease and condition like different regions of cancer, cardiovascular problems, diabetes, neurological disorders also which generally help to prevent the patient from the death and other painful condition, increase safety of patient and reduce the severity of the disease and condition which helps a doctor in the curing and easy analysis of the disease by the help of computers, software related to the AI like ANNs. In 2018 there was a record of 18 million cases of cancer worldwide, of which 9.5 million were in men and 8.5 million were in women. Lung and breast cancer were the most common cancers in the world, each contributing 12.3 % of the total number of new cases reported in 2018 [23]. Late cancer detection is of paramount importance and assists inpatient treatment. There are increasing numbers of cancer patients worldwide, and new diagnostic techniques related to such types of patients and cancer prediction in its

different forms are needed. This can lead to a fall in mortality rates [24,25]. Early diagnosis can theoretically be accomplished by enhancing the clinical, genomic, EP or EMR examination techniques, the power of the AI method [26]. In 85 % of the cases, stroke is mainly caused by the thrombus in the blood vessel known as cerebral infarction because of lack of early symptoms judgment lead to the death of the patient only a few patients get the treatment because of early diagnosis. Villar, *et al*. discovered a device that involves the early diagnosis and prediction of stroke and thus provides the right therapy and helps in the treatment of disease [27].

AI in Medical Imaging:

AI is proved very effective and helpful in the medical imaging diagnostic system. Two methods that are generally used in medical imaging related to AI. The very first method is known as Handcrafted engineered features" which generally give a result by the help of mathematical equations and so it can easily solve by the help of computer programs. While the second method of medical imaging diagnostic system with the help of AI is known as Deep Learning introduced in the recent years it can easily read the data generated from the diagnosis and can give result without the help of human experts [28]. The deep learning process can easily quantify the phenotypic characteristics of living tissues. Thus systems are improving the diagnostic system and clinical care. Deep learning having an advantage of required less time and reduced manual steps [29]. An US biosensor company named Cycadia health use develops a personalized wearable device which helps in the detection of breast cancer and thus helps in the early-stage diagnosis of breast cancer and slow down the progression of cancer by controlling on it. In this technique Cycardia breast patches fitted with a sensor that tracks changes in temperature changes due to the receptor of estrogen that is PER1and PER2 in the breast and protein expression in breast cancer [30]. ANN used to examine cancer and noncancerous imaging. A useful tool for assisting in breast cancer diagnosis and second opinion used to process and organize data obtained from fine-needle aspiration of breast mass smears [31].

AI in Management of Diabetes:

Diabetes is a metabolic disorder due to an increased level of glucose in the blood due to the destruction of insulin beta cells or due to the get resistance to insulin. If not cured it may, can lead to serious conditions like neuropathy, nephropathy, retinopathy, and cardiomyopathy. But the treatment and prevention of

diabetes are very hard because various factors are involved in the controlling of glucose levels in the body. Thus, by making diagnosis and monitoring of diabetes and its complication more robust by the use of AI lead to increase in the safety of the patient. For early detection and monitoring purpose from a group of the scientists Hebrew University of Jerusalem and Hadassah Medical Center evolve a washable intelligent sensor known as "Sense GO™" which can easily track pressure change in patient's foot it contains several pressure sensors to detect the pressure changes in foot and prevent from the risk of foot ulcer [32,33].

Fig 2. X-ray of the hand of a 16.27-year-old male, with automatic calculation of bone age by Bone Xpert, taken because of delayed puberty.

CONCLUSION:

From the above the study found that Artificial intelligence is important to promote the health care system, and also helping in pharmaceutical industry, conduction of pharmacy with the help of the robotic system, also in diagnosis and treatment of the patient. In pharmaceutical industry AI generally help in the development of the drug by the use of AI, it prevent the loss of the pharmaceutical industry like in drug discovery about 90 % of drugs get failed in the clinical trials, and the cost is about the 2 billion rupees in the development which causes loss to pharmaceutical industry. The aid of AI in pharmaceutical industries helps to prevent this loss in the process of drug development and also improve the pharmaceutical

research & development. In the case of the conduction of pharmacy by artificial intelligence to provide the overall healthcare system. Artificial intelligence helps to provide the analytical data on drug interactions, drug therapy monitoring, and also in drug formulary selection.

In diagnosis system and disease treatment, AI is most important because it is very useful in the detection of life-threatening disease and condition in early-stage and thus reduces the severity and progression of the diseases and disorders like different types of cancer (breast cancer, lung cancer, ovarian cancer, prostate cancer, etc.), cardiovascular problems, neurological disorders, diabetes, etc. A different type of biomarkers is used in the diagnosis of the disease (CAE, CA and PSA) in an early stage. A US company develops a personalized wearable device for the men and women who have temperature-sensitive sensors, and help in early diagnosis of breast cancer. In the case of diabetes, it is a very tough task to control and monitor the blood glucose level in blood a device named "Sense GO™" developed to control and monitor the blood glucose level and prevent the serious complications of diabetes.

Different types of AI system like Deep learning and Handcraft engineered features are used to make easy and radio diagnosis with the highly précised results and also help to differ in between cancerous and noncancerous cells by consuming very less time and also reduce the manual steps.

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REFERENCES:

1. Flasinski M. Introduction to Artificial Intelligence. 1st ed. Switzerland: Springer International Publishing; 2016.
2. Long E, Lin H, Liu Z, *et al*. An artificial intelligence platform for the multihospital collaborative management of congenital cataracts. Nat Biomed Eng, 2017; 1: 1-8.
3. Huot C. Big unstructured data's contribution to health care. France: Health Care Data Institute; 2015.
4. Deepak N. AI in the Healthcare World. California: Humans for AI; 2017.

5. Mishra SG, Takke AK, Auti ST, *et al*. Role of Artificial Intelligence in Health Care. Biochem Ind, 2017; 11(5): 120-130.

6. Avery P. The Role of AI in Healthcare Technology. Becoming Human: AI Magazine; 2018.

7. Kadurin A, Aliper A, Kazennov A, *et al*. The cornucopia of meaningful leads: applying deep adversarial autoencoders for new molecule development in oncology. *Oncotarget,* 2017; 8: 10883-10890.

8. Silver D, Schrittwieser J, Simonyan K, *et al*. Mastering the game of Go without human knowledge. *Nature,* 2017; 550: 354-359.

9. Brazil R. Artificial Intelligence: will it change the way drugs are discovered? Pharm J, 2017; 299(7908).

10. Jiang F, Jiang Y, Zhi H*, et al*, Artificial intelligence in healthcare: past, present and future. Stroke Vasc Neurol, 2017; 2: 1-14.

11. Thomas D, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthcare J, 2019; 6(2): 94-98.

12. Shen D, Wu G, Suk H-I. Deep learning in medical image analysis. Annu Rev Biomed Eng, 2017; 19: 221-248.

13. Veeraraghavan H. MO-A-207B-01: Radiomics: Segmentation & feature extraction techniques. Med Phys, 2016; 43: 3694-3694.

14. Zhavoronkov A. Artificial Intelligence for Drug Discovery, Biomarker Development, and Generation of Novel Chemistry. Mol Pharm, 2018; 15(10): 4311-4313.

15. Kadurin A, Aliper A, Kazennov A. *et al*. The cornucopia of meaningful leads: applying deep adversarial autoencoders for new molecule development in oncology. *Oncotarget*, 2017; 8:10883-10890.

16. Merk D, Friedrich L, Grisoni F, Schneider G. *De novo* design of bioactive small molecules by artificial intelligence. Mol Inform, 2018; 37(1-2): 1-4.

17. Francesca L. Artificial intelligence in drug discovery: what is new, and what is next? Future Drug Discov, 2019; 1(2): 1-4.

18. Gen M, John CR, Sons W. Genetic algorithms and engineering design. Art Intell Med, 1997; 31; 183-196.

19. Sable P, Khanvilkar VV. Pharmaceutical Applications of Artificial Intelligence. Int Journal Pharm Res Health Sci, 2018; 6 (2): 2342-2345.

20. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global Cancer Statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin, 2018; 68(6): 394-424.

21. Ontario HQ. Cancer screening with digital mammography for women at average risk for breast cancer, magnetic resonance imaging (MRI) for women at high risk: An evidence-based analysis. Ont Health Technol Assess Ser, 2010; 10(3): 1-55.

22. Early Breast Cancer Trialists' Collaborative Group (EBCTCG). Effects of chemotherapy and hormonal therapy for early breast cancer on recurrence and 15-yr survival: An overview of the randomised trials. Lancet, 2005; 365(9472): 1687-1717.

23. Long E, Lin H, Liu Z, *et al*. An artificial intelligence platform for the multihospital collaborative management of congenital cataracts. Nat Bioned Eng, 2017; 1(1): 1-8.

24. Villar JR, Gonzalez S, Sedano J, *et al*. Improving human activity recognition and its application in early stroke diagnosis. Int J Neural Syst, 2015; 25: 1450036.

25. Castellino RA. Computer aided detection (CAD): an overview. Cancer Imag, 2005; 5: 17-19.

26. Shen D, Wu G, Suk H-I. Deep learning in medical image analysis. Annu Rev Biomed Eng, 2017; 19: 221-248.

27. Veeraraghavan H. MO-A-207B-01: Radiomics: Segmentation & feature extraction techniques. Med. Phys, 2016; 43: 3694-3694.

28. Saritas I. Prediction of breast cancer using artificial neural networks. J Med Syst, 2012; 36(5): 2901-2907.

29. Sizilio GR, Leite CR, Guerreiro AM, *et al*. Fuzzy method for pre-diagnosis of breast cancer from the fine needle aspirate analysis. Biomed Eng Online, 2012; 11(1): 83-89.

30. Hebrew University of Jerusalem. To help diabetics, intelligent socks are paired with smartphones. US: Science Today; 2016.

31. Ole SA. A Literature Review on Artificial Intelligence. Int J Inform Manag Sci, 2008; 19(4): 535-570.

32. Mahind R, Patel A. A Review Paper on General Concepts of Artificial Intelligence and Machine Learning. International Advanced Research Journal in Science, Engineering and Technology, 2017; 4(4): 79-82.

33. Ludger GF. Artificial Intelligence - Structures and strategies for complex problem solving. 5th ed. New York: Pearson; 2009.