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Review article

Implementation of Artificial Intelligence&Machine Learning for Sustainable Medical Devices

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Abstract

Artificial intelligence (AI) has been developing rapidly in recent years in terms of software algorithms, hardware implementation, and applications in a vast number of areas. In this review, we summarize the latest developments of applications of AI in biomedicine, including disease diagnostics, living assistance, biomedical information processing, and biomedical research. The aim of this review is to keep track of new scientific accomplishments, to understand the availability of technologies, to appreciate the tremendous potential of AI in biomedicine, and to provide researchers in related fields with inspiration. It can be asserted that, just like AI itself, the

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application of AI in biomedicine is still in its early stage. New progress and breakthroughs will continue to push the frontier and widen the scope of AI application, and fast developments are envisioned in the near future. Two case studies are provided to illustrate the prediction of epileptic seizure occurrences and the filling of a dysfunctional urinary bladder.

Keywords: Artificial intelligence, biomedicine, e-Doctor,

INTRODUCTION

Definition of Artificial Intelligence & Machin Learning

Human beings are intelligent creatures. As opposed to intelligence of humans, Artificial Intelligence (AI) is defined as intelligence of machines. AI can also be defined as any agent or device that can perceive and understand its surroundings and accordingly take appropriate actions to achieve its objectives. There are such situations wherein machines can stimulate human minds in learning, applying knowledge and analysis and thus can help in problem solving. This kind of intelligence is also referred to as Machine Learning [1. 2].

In fact, reviews have been published on the role of AI in biomedical engineering. More recently, new progress has been made in AI and its applications in biomedicine.This paper reviews recent breakthroughs in the application of AI in biomedicine, covering the main areas in biomedical engineering and healthcare. The goal for healthcare is to become more personal, predictive, preventative, and participatory, and AI can make major contributions in these directions. From an overview of the progress made,we estimate that AI will continue its momentum to develop and mature as a powerful tool for biomedicine.

Ambient Clinical Intelligence (ACI):

Development of ACI will be a critical application of AI in medicine which will help to create a sensitive, adaptive and responsive digital environment surrounding the physician and the patient. It will be capable of analyzing the interview and automatically fill the patient's electronic health records[1]

Applications of AI in Medical Devices

1. RUDO is a kind of intelligent system which can help blind people to live together with sighted people They can use of [i]
2. A ''smart assistant'' based on AI for pregnant women can help them with dietary and other necessary advice during crucial stages of maternity. It provides suggestions through its own

intelligence combined with ‘‘cloud-based communication media between all people concerned[2].

3. Alive CorKardia [2], The Atrial fibrillation affected approx. 33.7 millions individuals all overthe globe, It interconnected with facilitate some other cardiovascular disorder like stroke. Theidentification through the **CHADS-VAS cscore for stroke (3.5*).***

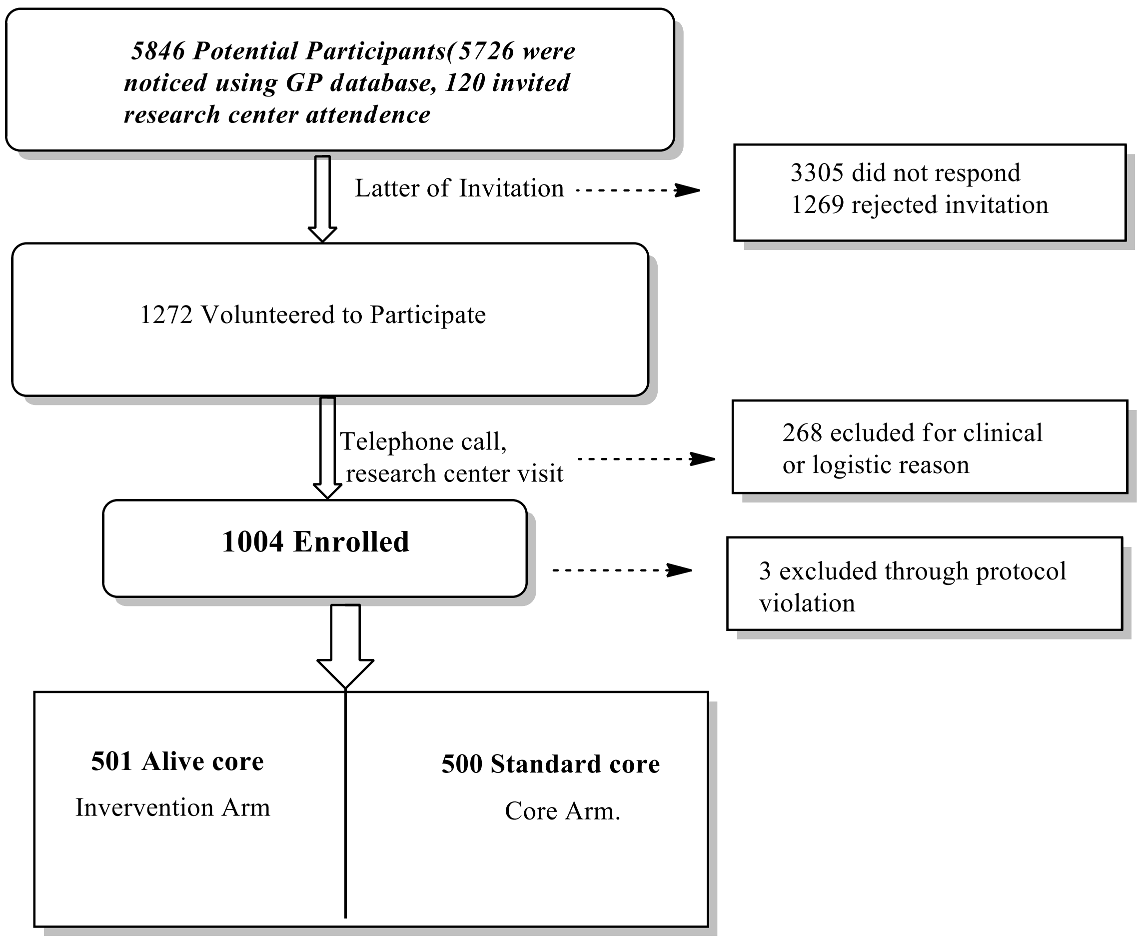

Figure: 1 Overview of voluntary clinical trial.

4. Intelligent seizure detection devices are promising technologies that have the potential to improve seizure management through permanent ambulatory monitoring. Empatica received FDA approval in 2018 for their wearable Embrace, which associated with electro-dermal

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captors can detect generalized epilepsy seizures and report to a mobile application that is able to alert close relatives and trusted physician with complementary information about patient localization. A report focused on patient experience, revealed that, in contrast to heart monitoring wearable, patients suffering from epilepsy had no barriers in the adoption of seizure detection devices, and reported high interest in wearable usage [4].

Information processing and algorithm implementation

The main applications of AI in biomedicine can be divided into four categories. The first three categories described in this section are intended to efficiently treat big data and provide quick access to data in order to solve issues related to healthcare. These applications deal with living assistance for elderly and disabled people, natural language processing techniques, and fundamental research activities.

Artificial intelligence to disabled individuals:

The developing assistance for the disabled peoples as well aged one, the Artificial intelligence may perceived great involvement in terms of better life style [9]. This all facilities are done through by assisting smart robotic. Some of machine processors are highly command to recognized the facial expression that recall it Human machine interface. HMIs are more favorable for the disabled individuals like paralyzed peoples, this works due to automated sensors and robotic system which implements into motor vehicles as well as wheelchairs. without any additional support[10].The current status of robotics it involve collection of data about the ambient condition and behavior of mankind, that further identified by cloud computing (data security). To perform the particular function first make decision regarding direction individual action. Its best requires Artificial intelligence support which mechanically attached to mobile cloud service to regulate and smooth function of devices. PADs(Personal digital assistance used for to maintain the memories capabilities so as to perform everyday living functions[11]. Therefore ES-MS used for memories rehabilitation for those who might not aware to technologies.

Artificial intelligence in biomedical research

Rapid development of drug research to cure the diseases Artificial intelligence may play a key importance to invention and develop the suitable condition in biomedical research. In this dynamic are several impactful discoveries have been made. AI has seems like e-Doctor which carefully identify diagnosis and prognosis, management that enables his un-explored abilities in field of Biomedical research[12].Artificial machinery enable to findout& indexing all literature related biomedical research or innovations [13, 14].

Artificial intelligence executing find out latest literature different biomedical science like tumor suppressing gene, how protein- protein interact information extraction, the genetic linkage to human transferring the genome discovery to health care practice[15,17]. Enabling of AI is not only help in the survey of literature on particular interest; however it helps to rank the biomedical research paper beyond its readability. This allow to manage the scientific hypothesis, it is necessary in term of biomedical innovations with help ofan AI[18]. Now a days Artificial intelligence aided medical devices increases at high rate. This might useful for biomedical research[19,20].Biomedical engineering have been discussed in order to better understand the impact of this development [21].

Disease diagnostics and prediction

The most urgent need for AI in biomedicine is in the diagnostics of diseases. A number of interesting breakthroughs have been made in this area. AI allows health professionals to give earlier and more accurate diagnostics for many kinds of diseases [22]. Artificial intelligence interconnected through the different detecting machine(biosensors) which enable to identifies various abnormalities, In addition to identification POCT (point of care testing) system diagnosed cardiovascular problems at early stage[23]. AI can also helps to predict about different types of cancer such as colon cancer [24]. Apart from beneficial point of view limitation is also their, minimizing their drawback by following some stepwise procedure [25]. Thus, there is still much potential for AI in diagnostics and prognostics. Another important class of disease diagnostic is based on medical imaging (two-dimensional) and signal (onedimensional) processing. Such techniques have been employed in the diagnosis, management, and prediction

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of illnesses. For one-dimensional signal processing, AI has been applied to biomedical signal feature extraction [26], such as electroencephalography (EEG) [27], electromyography (EMG) [28], and electrocardiography (ECG) [29].

And electrocardiography (ECG) [30].An important application of EEG is epileptic seizure prediction. It is very important to predict seizures so as to minimize their impact on patients [31]. In recent years, AI has been recognized as one of the key elements of an accurate and reliable prediction system [32,33]. It is now possible to predict by means of deep learning [34], and the prediction platform can be deployed in a mobile system [35]. AI can also play an important role in diagnosis based on biomedical image processing[36]. AI has been utilized in image segmentation [37], multi-dimensional imaging [38], and thermal imaging [39] to improve image quality and analysis efficiency. AI can also be deployed in portable ultrasonic devices, so that untrained personal can use ultrasound as a powerful tool to diagnose many kinds of illnesses in undeveloped regions [40].In addition to the above applications, AI can assist standard decision support systems (DSSs) [41,42] to improve diagnostic accuracy and facilitate disease management in order to reduce the burden on personnel. For example, AI has been used in the integrated management of cancer, to support the diagnosis and management of tropical diseases [43] and cardiovascular diseases [44], and to support the decision-making process of diagnostics. These applications demonstrate that AI can be a powerful tool for early and accurate diagnostics, management, and even prediction of diseases and patient conditions.

WFO System for women Cancer Treatment:

However, a cognitive-support approach for oncology therapy selection has, to our knowledge, not been offered until the introduction of IBM's Watson for Oncology (WFO). It is a unique system, with an ability to acquire much of its knowledge by 'reading' the literature, protocols, and patient charts, and learning from test cases and experts from Memorial Sloan Kettering Cancer Center. We conducted a study assessing the level of agreement regarding cancer treatment between WFO and the multidisciplinary tumor board from a major comprehensive cancer center in India. The objective of the study was to determine the level of recommended treatment concordance (degree of agreement) in a large population of breast cancer cases. We report herein the results of this assessment and discuss the potential value of the technology as a learning system both for cases where concordance is found and where it is absent.Treatment non-

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concordance may mean that WFO has suggested a treatment regimen not considered by the treating oncologist rather than a regimen that the oncologist had considered but rejected. Since WFO provides evidence for its decision, the oncologist can examine the data and consider the basis for WFO's recommendation. Although we did not assess this situation in the current study, in routine use, an unexpected recommendation by WFO may spur the clinician to examine his or her own weighted evidence and to reconsider it based on the oncology treatment advisor's assessment. Treatment decisions might not change because of this transparency, but learning would be fostered[44].

Table: 1 Different AI based Medical devices with their Application.

S.No	AI Powered Devices/Apps/Assistance	Applications	References
1	**RUDO**	Help Blind people live with sighted people	Hudec, M., &Smutny, Z. (2017).
2	**Smart Assistant for Pregnant Women**	Provides suggestions on crucial stages of maternity through its own intelligence combined with cloud based communications media between all people concerned	S. N. Tumpa at. al. 2017
3	**Kardia**	Smartphone-based ECG monitoring and detection of atrial fibrillation.	Acampora G. at al. 2013
4	**Intelligent Seizure Detection Devices**	Detection for epileptic consequences	Smith D. et. al. 2016
5	**Computational modeling Assistance (CMA)**	CMA allows it to integrate all this knowledge and these models, and it transforms the hypothesis of the researchers into concrete simulation models.In addition, some intuitive machines could guide scientific research in fields such as biomedical imaging, oral surgery, and plastic surgery	Kanevsky J. et al 2016

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6	**IBM Watson**	It suggests that an AI-based advisory system may have broad value in offering breast cancer treatment advice, particularly for environments where expert resources are not readily available.	Somashekhar et al. 2018.
7	**OncoDoc**	OncoDoc allows physicians to control the contextualinstantiation of patient characteristics to build the best formal equivalent of an actual patient.	Seroussi B et. al. 2003
9	ORGANIC	A molecular generation tool that helps to create molecules with desired properties	https://github.com/aspuru-guzik-group/ORGANIC refe24
10	DeltaVina	A scoring function for rescoring drug–ligand bindingAffinity	www.nyu.edu/projects/yzhang/DeltaVina

Onco Doc

It has been developed as a guideline-based decision support system to provide best treatment recommendations. Applied to breast cancer, it relies on a knowledge base structured as a decision tree where nodes describe the patient state and leaves propose. the best corresponding

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therapeutic options. Designed as a browsing tool, it allows the physician to control the contextual instantiation of patient parameters, thus offering flexibility in the interpretation of general knowledge to a specific clinical situation. As any CT depository, OncoDoc may provide the list of all CTs in a CT-centered view independently of any patient context (Fig. 2). For documentation purposes, they may be simply displayed in an alphabetically ordered list of protocol names with color convention on buttons indicating when CTs are open, closed or to come. A detailed view, i.e. the synopsis of the trial with the objectives of the study, eligibility criteria, administration scheme, follow-up modalities, as well as statistical data about the trial, could be obtained by clicking on any of the names.

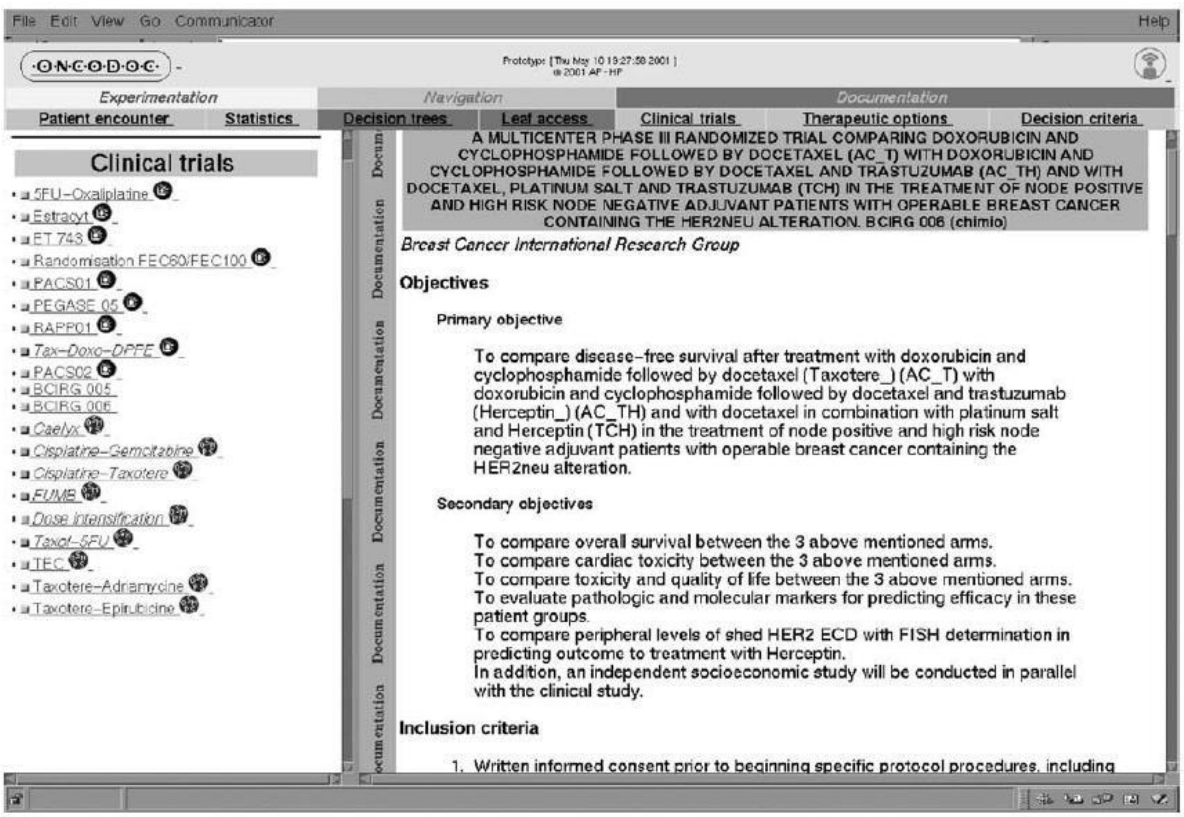

Figure: 2 Experimental design with the help of software.

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However, the recall at the point of care of relevant patient-specific CTs requires a patient-centered view of active CTs that a classical CT-centered view does not provide. On the contrary, when using OncoDoc, a physician navigates through the knowledge base and thus builds a patient-specific context while selecting the best patient-centered path. Then, the physician is given corresponding therapeutic options that may be either evidence-based guideline recommendations or candidate CTs [45].

Deep Chem

Despite its advantages, AI faces some significant data challenges, such as the scale, growth, diversity, and uncertainty of the data. The data sets available for drug development in pharmaceutical companies can involve millions of compounds, and traditional ML tools might not be able to deal with these types of data. Quantitative structure-activity relationship (QSAR)-based computational model can quickly predict large numbers of compounds or simple physicochemical parameters, such as log P or log D. However, these models are some way from the predictions of complex biological properties, such as the efficacy and adverse effects of compounds. In addition, QSAR-based models also face problems such as small training sets, experimental data error in training sets, and lack of experimental validations [46].

Organic molecule development

Various parameters, such as predictive models, the similarity of molecules, the molecule generation process, and the application of in silico approaches can be used to predict the desired chemical structure of a compound [46]. Pereira et al. presented a new system, DeepVS, for the docking of 40 receptors and 2950 ligands, which showed exceptional performance when 95 000 decoys were tested against these receptors [47]. Another approach applied a multiobjective

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automated replacement algorithm to optimize the potency profile of a cyclin-dependent kinase-2 inhibitor by assessing its shape similarity, biochemical activity, and physicochemical properties [48].

Delta Vina

Protein–ligand docking is a computational approach that attempts to predict the binding mode between a protein receptor and a small molecule ligand as well as their binding affinity. It plays an increasingly important role in structure based drug design as well as in functional studies of proteins. The most critical component of docking is the scoring function, which is needed to determine binding site and binding mode of a ligand on a protein, to screen virtual small molecule libraries to identify potential leads for further inhibitor development, and to explicitly estimate the binding affinity between a protein and a ligand given their complexStructure[49,50].

Computational modeling Assistance (CMA)

Some intelligent medical devices are becoming increasingly ‘‘conscious” [51,52], and this consciousness can be explored in biomedical research. An intelligent agent called the computational modeling assistant (CMA) can help biomedical researchers to construct ‘‘executable” simulation models from the conceptual models they have in mind. Fig. 3 [53] shows a general view of the process flow and interactions between a CMA and human researchers. The CMA is provided with various knowledge, methods, and databases. The researcher hypothesis is expressed in the form of biological models, which are supplied as input to the CMA. The intelligence of the CMA allows it to integrate all this knowledge and these models, and it transforms the hypothesis of the researchers into concrete simulation models. The researcher then reviews and selects the best models and the CMA generates simulation codes for the selected models. In this way, the CMA enables a significantly accelerated research process and enhanced productivity. In addition, some intuitive machines could guide scientific research in fields such as biomedical imaging, oral surgery, and plastic surgery [54,55].

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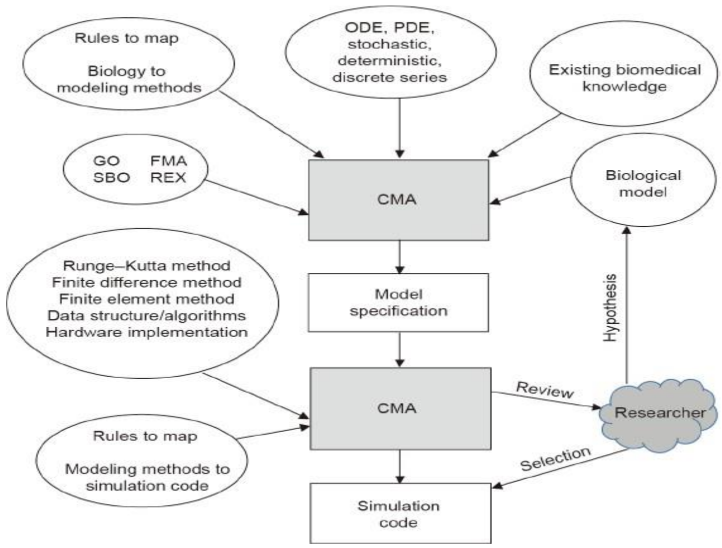

Figure: 3 *A general perspective of process flow and interactions between a CMA and human researchers in view of various ontologies and knowledge databases [55]. ODE: ordinary differential equation; PDE: partial differential equation; GO: gene oncology; FMA: foundational model of anatomy ontology; SBO: systems biology ontology; REX: physicochemical process ontology.*

Conclusion and Future Remarks on AI

The progression of simulated intelligence, alongside its exceptional apparatuses, consistently means to lessen difficulties looked by drug organizations, affecting the medication improvement process alongside by and large lifecycle of the item, which could make sense of the expansion in the quantity of new businesses in this area. The ongoing medical care area is confronting a few complex difficulties, like the inflated expense of medications and treatments, and society needs unambiguous huge changes around here. With the consideration of man-made intelligence in the assembling of drug items, customized prescriptions with the ideal portion, discharge boundaries, and other required viewpoints can be produced by individual patient need. Utilizing the most recent simulated intelligence based advances won't just accelerate the time required for the items to come to the market, yet will likewise work on the nature of items and the general wellbeing of the creation cycle, and give better use of accessible assets alongside being savvy, accordingly expanding the significance of robotization .

The most significant worry regarding the incorporation of these technologies is the job losses that would follow and the strict regulations needed for the implementation of AI. However, these systems are intended only to make work easier and not to completely replace humans. The new profound getting the hang of displaying studies have shown advantages contrasted with conventional AI approaches for this test. Nonetheless, standard standards and displaying work processes are as yet required for profound learning models to be appropriate. The uses of man-made intelligence have been broadly stretched out into all significant regions past customary medication discovery. Combined with data set curation, online interface improvement as information storehouse servers, and the improvement of PC equipment, computer based intelligence and ongoing profound learning studies have cleared the street to current medication disclosure. AI can also contribute to establishing the safety and efficacy of the product in clinical trials, as well as ensuring proper positioning and costing in the market through comprehensive market analysis and prediction.

AI-based approaches and specific challenges remain with regards to the implementation of this technology, it is likely that AI will become an invaluable tool in the pharmaceutical industry in the near future.

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