AI in healthcare domain

[1]Dhruvitkumar Talati

Abstract

Artificial Intelligence (AI) has emerged as a transformative force in the healthcare domain, revolutionizing various aspects of medical research, diagnostics, treatment, and patient care. This paper provides an overview of recent developments and applications of AI in healthcare, highlighting its potential to enhance efficiency, accuracy, and accessibility in medical practices. The integration of machine learning algorithms, natural language processing, and computer vision techniques has enabled AI systems to analyze vast amounts of medical data, support clinical decision-making, and personalize treatment plans. Additionally, AI-powered technologies play a crucial role in predictive analytics, early disease detection, and the optimization of healthcare workflows. Despite the promising advancements, challenges related to data privacy, ethical considerations, and regulatory frameworks need to be addressed to fully harness the benefits of AI in healthcare.

Introduction

The medical industry has recently seen a transition from a hospital-centric to a patient-centric perspective, allowing the patient to have control over health operations. Emerging breakthroughs in big data, cloud and edge networks, Internet of Things (IoT), and artificial intelligence (AI) help to realize and enable this change. To put it briefly, digital health is outfitted with intelligent sensors that generate business information and real-time prediction models (Bhattacharya, et al., 2021). Healthcare 4.0 refers to this sensor-driven, patient-centric analytical perspective that enables patients to receive linked, intelligent treatment (Gupta, et al., 2020). Although the healthcare sector has synchronized its activities with this goal, the sector is about to enter a new phase of paradigm change (Gupta, et al.,

2020). The change, known as Healthcare 5.0, would include augmented and virtual reality, smart control, and interpretable healthcare analytics (Mbunge, et al., 2021). As a result, reason-based analytics, dynamic, individualized, and all-encompassing healthcare would spur creative solutions for business in the medical field (Saraswat, et al., 2022).

AI for Drug Discovery

Pharmaceutical businesses have been able to expedite their drug research process with the use of AI technology in healthcare. However, it automates the process of identifying targets. Furthermore, AI in medicine facilitates the repurposing of drugs through the analysis of off-target molecules (Díaz et al., 2019). Consequently, AI discovery of drugs expedites and decreases repetitious effort in the artificial intelligence and healthcare sectors.

There are several treatments that top biopharmaceutical companies have found. Pfizer is using IBM Watson, a system that is based on machine learning, to assist in the discovery of immuno-oncology medicines (Agrawal, 2018). While Roche affiliate Genentech is depending on a system using artificial intelligence from GNS Healthcare in the Massachusetts city of Cambridge to help with its hunt for cancer medicines, Sanofi has decided to use Exscientia's artificial intelligence technology to look for pharmaceuticals for metabolic diseases. Similar partnerships or internal initiatives exist at almost all of the big biopharmaceutical companies. If those who support these approaches are right, artificial intelligence (AI) and the use of machine learning will usher in an exciting new period of more efficient, affordable, and rapid drug development. While some experts are dubious, the majority think that such instruments will become increasingly important in the future. This shift presents opportunities as well as challenges for scientists, especially when the methods are combined with automation (Chan, et al., 2019).

Artificial Intelligence in clinical trials

In a clinical study, individuals get newly made medications to evaluate their efficacy. It has cost a lot of money and time to complete this. But the success rate is really low. Clinical trial digitization has therefore shown to be advantageous for AI as well as the healthcare industry. Moreover, healthcare and artificial intelligence help to eliminate laborious data monitoring processes. Furthermore, AI-assisted clinical trials manage massive data sets and yield incredibly precise results (Chan, et al., 2019).

Smart clinical trials

The most reliable method for confirming the effectiveness and safety of novel medications is still through conventional "linear and sequential" clinical studies. Developed primarily for the evaluation of mass market medications, the long-standing, well-tried protocol consisting of discrete and well-defined stages of RCTs (randomized controlled trials) has not undergone significant modifications in recent decades. Artificial intelligence provides the ability to improve efficiency and the development of clinical outcomes, as well as reduce the length of clinical trial cycles. This research by Angus (2020) and Lee (2021) is the latest in a series on the effects of AI on the biopharma industry value chain.

Real-world data (RWD) is the term used to describe the vast amounts of theoretical and empirical information that biopharma enterprises can now access from a variety of sources. Nevertheless, they have often lacked the knowledge and resources required to make effective use of this data. Researchers can locate relevant patients and key investigators, gain a better understanding of diseases, and create novel clinical study designs by utilizing prediction AI models and sophisticated analytics to uncover RWD (Woo, 2019).

AI algorithms may be used in conjunction with a productive digital infrastructure to clean, aggregate, code, preserve, and retain clinical trial data. Additionally, enhanced EDC or electronic data capture could facilitate seamless system integration and lessen the effects of mistakes made by people in data collecting (Mayorga-Ruiz et al., 2019).

Collaboration on clinical trials and sharing of models

Scientists from several fields are working together in an amazing effort to help the response to COVID-19. Accessible data, framework, and code exchange strategies, application localization, and cross-border cooperation are all necessary for using AI tools to have a global impact (Luengo-Oroz et al., 2020).

Applications of AI require information. There are now dozens of global, national, and local COVID-19-focused data-sharing initiatives at each of the three application categories. A few of the materials available are genetic sequences, genomic studies, protein structures, clinical information about patients, images used in medicine, data on incidents, epidemiological data, mobility data, remarks made on social media, news articles, and scientific literature.

The issue of hyper-fragmentation in data-sharing activities arises from the possibility of innovations being restricted

to particular initiatives and communities. By providing scalable methods for statistics, framework, and code sharing, new applications might be created and spread more quickly. At this level, linking and fostering cooperation between diverse communities and geographies will be aided by international, accessible, extensive, analogous, and credible data-sharing initiatives (Luengo-Oroz et al., 2020).

Open research can accelerate the dissemination of knowledge and the development of national health systems' capability through multi-stakeholder AI partnerships that span international borders. For instance, the EIOS, or the Epidemic Intelligence from Open Sources program makes use of open source data to facilitate the early identification, confirmation, and evaluation of risks and hazards to public health (Sucharitha & Chary, 2021). Organizations around the world, governments, and research institutes make up the global community of centers of excellence for health care intelligence. They work together to evaluate and exchange information about outbreak events in real time, adhering to the idea that cooperation is preferable to rivalry in early detection. Epidemiologists believe that global norms and database interoperability could help promote coordinated response and decision-making at the international, national, and local levels. As the pandemic spreads, it will be necessary to include public health interventions, environmental factors, health system capacity for resource mobilization, and the socioeconomic effects of COVID-19 in order to comprehend the epidemiologic traits and risk aspects of different demographic groups (Sucharitha & Chary, 2021).

Few initiatives exist today that trade developed artificial intelligence models for any of the above uses, aside from data sharing. Among the challenges are those posed by particular computational, design, and infrastructure requirements; a lack of documentation; problems with verification and interpretability; and legal considerations pertaining to intellectual property and secrecy. Exchange of approved and pre-trained AI models could facilitate faster situational adaptation. Algorithms that could be widely useful include those that are used to diagnose illnesses from visuals, forecast patient outcomes, filter false information based on patterns that spread through social media, and condense knowledge graphs from a huge number of scholarly papers (Luengo-Oroz et al., 2020).

Medical Attention

Artificial intelligence has an impact on patient outcomes in the medical field. Medical AI companies develop a system that supports the patient on all fronts. Clinical intelligence also provides insights to patients to assist them improve

their quality of life by analyzing their medical data. A few noteworthy clinical intelligence technologies that enhance patient care are as follows:

Maternal Care

One possible method to detect high-risk mothers and lower maternal mortality as well as postpartum complications is the following: Using artificial intelligence and electronic health data to predict whether expectant moms are much more likely to experience complications during delivery (AI). Making more patients eligible for regular and high-acuity (i.e., more complex and frequent) care during their pregnancy by utilizing digital technologies. High-risk maternal women who give birth at low-acuity clinics run a greater risk of experiencing severe maternal morbidity as compared to giving birth in higher-acuity facilities with stronger resources and professional experience.

Robotics in Healthcare

Certain medical robots help patients in conjunction with medical professionals. For example, exoskeleton robots can help paralyzed individuals walk once more and regain their independence (Shi et al., 2019). An additional instance of technology in use is a smart prosthesis. With the option to wrap them with bionic skin while connecting them to the individual's muscles, such bionic limbs connect sensors that make them more accurate and reactive compared to natural body parts. Robots can assist in surgery and recuperation.

For example, Cyberdyne's HAL, or Hybrid Assistive Limb exoskeleton uses sensors applied to the skin to effectively detect electrical impulses in the patient's body and respond with movement at the joint. This technology aids in patients' rehabilitation from conditions that cause lower limb disorders, such as strokes and spinal cord injuries.

Data-Driven Medicine via Genetics and AI

Nowadays' healthcare consumer is more active in their own medical care than ever before, thanks to advancements like genome sequencing and the creation of personalized health statuses using information from fitness and activity monitors. A person's health or medical condition is being more accurately predicted by compiling and connecting all of this massive data. In addition to increasing the accuracy and speed of genetic illness detection, data-driven medicine may pave the way for customized medical interventions (Hummel & Braun, 2020).

2.3.4 Stethoscope driven by AI

One significant benefit is that readings may be obtained even in noisy situations, which is not possible with standard stethoscopes and enables more precise diagnosis. The digital instrument does not require any training to use; therefore anyone can obtain the medical records and telemeter them to the doctor (Prabu, 2021). Additionally, this reduces their risk of catching COVID-19 and facilitates the delivery of better healthcare to patients who are chronically ill and in remote locations.

Computers can now identify patterns and anomalies in disease from vast amounts of clinical data thanks to artificial intelligence (AI) as well as machine learning. The same concept applies here since blood flowing through normal arteries differs from blood flowing adjacent to a blood clot in blood vessels.

Conclusion

As artificial intelligence (AI) permeates contemporary business and daily life, it is gradually being used to the healthcare industry. Healthcare practitioners could benefit from artificial intelligence in several areas, including patient care and administrative duties. While most AI and healthcare advances are beneficial to the healthcare sector, the approaches they support may differ significantly. It will be a while before artificial intelligence (AI) in healthcare supplant people for a variety of medical vocations, despite some articles on the subject claiming that AI can perform alongside or superior to humans at certain tasks, such as detecting illness.

Even with these notable advancements, AI application in healthcare is still very much in its infancy. Ongoing research keeps giving the technology new capabilities, which will lead to greater breakthroughs in the upcoming years across a range of industries. The essential healthcare industry, which is currently experiencing one of the fastest digital transitions, can benefit greatly from AI and machine intelligence, and resources have the potential to significantly raise patient quality of life (Shaheen, 2021).

References
Agrawal, P. (2018). Artificial intelligence in drug discovery and development. *J Pharmacovigil*, 6(2).

Angus, D. C. (2020). Randomized clinical trials of artificial intelligence. *Jama*, 323(11), 1043–1045.

Bhattacharya, S. Tanwar, U. Bodkhe, S. Tyagi and N. Kumar. (2021). BinDaaS: Blockchain-based deep-learning as-a-Service in healthcare 4.0 applications, *IEEE Trans. Netw. Sci. Eng.*, vol. 8, no. 2, pp. 1242-1255.

Chan, H. C. S., Shan, H., Dahoun, T., Vogel, H., & Yuan, S. (2019). Advancing drug discovery via artificial intelligence. *Trends in Pharmacological Sciences*, 40(8), 592–604.

Díaz, Ó., Dalton, J. A. R., & Giraldo, J. (2019). Artificial intelligence: a novel approach for drug discovery. *Trends in Pharmacological Sciences*, 40(8), 550–551.

Lee, E. (2021). How do we build trust in machine learning models? SSRN 3822437

Gupta, A. Shukla, P. Mehta, P. Bhattacharya, S. Tanwar, S. Tyagi, et al. (2020). VAHAK: A blockchain-based outdoor delivery scheme using UAV for healthcare 4.0 services, *Proc. IEEE Conf. Comput. Commun. Workshops (INFOCOM WKSHPS)*, pp. 255-260.

Gupta, A. Shukla and S. Tanwar. (2020). AaYusH: A smart contract-based telesurgery system for healthcare 4.0, *Proc. IEEE Int. Conf. Commun. Workshops (ICC Workshops)*, pp. 1-6.

Luengo-Oroz, M., Pham, K. H., Bullock, J., Kirkpatrick, R., Luccioni, A., Rubel, S., Wachholz, C.,

Chakchouk, M., Biggs, P., & Nguyen, T. (2020). Artificial intelligence cooperation to support the global response to COVID-19. *Nature Machine Intelligence*, 2(6), 295–297

Hummel, P., & Braun, M. (2020). Just data? Solidarity and justice in data-driven medicine. *Life Sciences, Society and Policy,* 16(1), 1–18

Mayorga-Ruiz, I., Jiménez-Pastor, A., Fos-Guarinos, B., López-González, R., García-Castro, F., & Alberich-Bayarri, Á. (2019). The Role of AI in Clinical Trials. In Artificial Intelligence in Medical Imaging (pp. 231–243). *Springer*.

Mbunge, B. Muchemwa, S. Jiyane and J. Batani. (2021). Sensors and healthcare 5.0: Transformative shift in virtual care through emerging digital health technologies, *Global Health J.*, vol. 5, no. 4, pp. 169-177.

Prabu, A. (2021). SmartScope: An AI-Powered Digital Auscultation Device To Detect Cardiopulmonary Diseases.

Saraswat, D., Bhattacharya, P., Verma, A., Prasad, V. K., Tanwar, S., Sharma, G., ... & Sharma, R. (2022). Explainable AI for healthcare 5.0: opportunities and challenges. *IEEE Access*.

Shaheen, M. Y. (2021). Applications of Artificial Intelligence (AI) in healthcare: A review. *ScienceOpen Preprints.*

Shi, D., Zhang, W., Zhang, W., & Ding, X. (2019). A review on lower limb rehabilitation exoskeleton robots. *Chinese Journal of Mechanical Engineering*, 32(1), 1–11

Sucharitha, G., & Chary, D. V. (2021). Predicting the effect of Covid-19 by using artificial intelligence: A case study. *Materials Today: Proceedings*.

Woo, M. (2019). An AI boost for clinical trials. *Nature*, 573(7775), S100–S100.