Volume 6 • Issue 1 • 2024

Research Article

Archives of Nutrition and Public Health

The Impact of Artificial Intelligence on Modern Medicine: Advancements, Applications, and Future Prospects

Timothy Allen[1]*, Jonathan Arnon[2], Nepton Sheikhkhoni[3], Indushekar Guddli Manjunatha[2], Ariella Allen[4], Andres Felipe Gonzalez[5], Divya Sree Peddagali[6]

[1]*MD, PhD, Nexus Alliance Biopharma*

[2]*Pharm D, Nexus Alliance Biopharma*

[3]*MD, MS, Nexus Alliance Biopharma*

[4]*R&D associate, Nexus Alliance Biopharma*

[5]*MD, MS, Nexus Alliance Biopharma*

[6]*Senior at Acton-Boxborough Regional High School, Acton, MA*

***Corresponding Author:** Timothy Allen, MD, PhD, Nexus Alliance Biopharma.

Received: June 28, 2024; **Published:** July 03, 2024

Abstract

Artificial intelligence (AI) is rapidly transforming healthcare, offering promising solutions to reduce costs and improve patient outcomes. This paper explores the diverse applications of AI in medicine, from diagnosis to drug discovery and clinical decision support. AI has demonstrated comparable accuracy to medical specialists in identifying conditions such as skin cancer and diabetic retinopathy. In clinical settings, AI-powered tools are assisting with tasks like note-taking and electronic health record management, potentially alleviating physician burnout. In drug discovery and development, AI accelerates the process through virtual screening, toxicity prediction, and lead optimization. AI also enhances clinical trial execution by streamlining patient recruitment, data capture, and adherence monitoring. For diseases like diabetes, AI-driven technologies are revolutionizing patient care through continuous glucose monitoring and automated insulin delivery systems. Furthermore, AI-based clinical decision support tools are aiding in complex diagnoses such as sepsis and optimizing treatment selection. While AI shows immense potential to transform healthcare delivery, challenges related to data privacy, model interpretability, and regulatory oversight must be addressed. As AI continues to evolve, its integration into medical practice promises to enhance efficiency, accuracy, and ultimately, patient care.

Key words: *Generative Artificial Intelligence (Gen-AI); AI value net; Gen-AI challenges; AI cost efficacy; AI Data management; AI ROI cost analytics*

Artificial intelligence attracts tremendous interest due to its potential to decrease costs and improve outcomes [1]. Artificial intelligence has demonstrated the ability to identify skin cancer with an accuracy comparable to board-certified dermatologists [2]. Additionally, an artificial intelligence program has identified diabetic retinopathy with a high rate of accuracy [3]. These are merely small examples of the capabilities offered by artificial intelligence.

Artificial intelligence programs have recently been developed to take notes for doctors during patient encounters. After obtaining

Citation: Timothy Allen, Jonathan Arnon, Nepton Sheikhkhoni, Indushekar Guddli Manjunatha, Ariella Allen, Andres Felipe Gonzalez, Divya Sree Peddagali. (2024). The Impact of Artificial Intelligence on Modern Medicine: Advancements, Applications, and Future Prospects. *Archives of Nutrition and Public Health* 6(1). DOI: 10.5281/zenodo.12721171

permission from the patient, an artificial intelligence system records the conversation between the patient and the healthcare provider [4]. The artificial intelligence program then summarizes the discussion and creates a summary for the patient [4]. This capability allows healthcare providers to free up much of their time, which can be better spent on treating more patients or staying abreast of new medical information. Electronic health records have been a source of substantial frustration and burnout for physicians in recent years [5]. Artificial intelligence holds the promise of seamlessly integrating medical information from various sources.

Artificial intelligence can potentially expedite the drug discovery process and lower costs [6]. Artificial intelligence can find associations in large data sets and possibly repurpose existing drugs for diseases without adequate therapeutic options [7]. Deep learning, a subset of machine learning that employs neural networks to make predictions from data [8], is one of the core strengths of artificial intelligence. Its ability lies in identifying complex and nonlinear data patterns by progressively extracting higher-level features from simpler, lower-level representations [9]. Deep learning also has the capability to mine unstructured data for information, saving healthcare providers a substantial amount of time [5]. Supervised learning involves training models using labeled datasets, where each data point is associated with a specific desired output [10]. This approach is widely used in drug discovery and development (DDD) and is essential in assessing the efficacy and safety of potential new drugs [6]. A typical application is virtual screening, which employs a dataset of compounds with known biological activities against a particular disease target to train the model. The algorithm learns the relationship between the chemical properties of these compounds and their biological activities, enabling it to predict how effective new compounds might be against the target. For instance, a model trained with a dataset of known kinase inhibitors could be used to evaluate the efficacy of new compounds as kinase inhibitors, thereby speeding up the process of identifying promising drug candidates [6].

Additionally, supervised learning is instrumental in predicting toxicity, a vital part of drug development [6]. By using datasets where compounds are labeled according to their toxicity levels, algorithms can be trained to forecast the potential side effects of new compounds. This capability helps researchers focus on compounds with safer profiles, minimizing the time and resources dedicated to developing drugs that could be potentially harmful [6]. For example, a supervised learning model trained with hepatotoxicity data can be used early in the drug development cycle to identify and eliminate compounds likely to cause liver damage.

The drug discovery and development process, with help from artificial intelligence, is an exciting field that may usher in many new effective medicines. Target identification is the first step in the process. When a particular receptor is activated, it causes blood vessels to constrict. This receptor could be the target in that specific case. Another scenario is when a protein triggers uncontrolled cell growth. Once the targets are known, artificial intelligence will search databases of known compounds that can either be an antagonist at the receptor or be a suicide inhibitor of the protein that causes unchecked cell growth. The compounds that are discovered are referred to as "leads" [9]. The leads are further refined to ensure the highest levels of safety and effectiveness.

Artificial intelligence can also lower costs and facilitate the execution of clinical trials. Artificial intelligence can scan electronic health records for clinical trial patients [10]. Different parameters can be used to select specific patients, such as age, contraindications, gender location, and more [10]. This can save an enormous amount of time for the trial employees and speed up the initiation of the clinical trial. Artificial intelligence chatbots can also facilitate data capture from trial participants [10]. Artificial intelligence can also help in the data-gathering aspect of the clinical trial through wearable devices [10]. Data can also be managed better and processed quicker using artificial intelligence [11].

Adherence tools managed through artificial intelligence can also help clinical trial participants adhere to their medicine. Tools like smart pillboxes or visual confirmation by artificial intelligence can help clinical trial investigators know whether or not clinical trial participants are adherent [10]. Artificial intelligence can also be used.

Currently, 29.7 million Americans live with diabetes [12]. In 2022, diagnosed diabetes cost the U.S. $412.9 billion, including $106.3 billion in indirect costs and $306.6 billion in direct costs [12]. Wearables and new glucose monitors can monitor and warn patients about hypoglycemia [13]. These new glucose monitors are worn by patients 24 hours a day and continuously monitor glucose levels. They transmit their readings to the patient's smartphone or a dedicated reader. Patients can easily observe trends and determine if certain medications or lifestyle interventions affect their glucose levels. Artificial intelligence can be utilized to optimize automated insulin delivery systems [14]. Many type1 diabetes patients use insulin pumps, and the artificial intelligence in these closed-loop delivery systems could act as a decision-maker or "brain" regarding insulin administration. The FDA has recently approved a device capable of detecting diabetic retinopathy [15]. Early detection of diabetic retinopathy is a cost-effective alternative to reduce ophthalmic complications and prevent blindness associated with the progression of diabetes [15].

Artificial intelligence augments clinical providers and offers clinical decision-support capabilities. Clinical decision support is highly beneficial for clinicians when confronted with complex diagnoses. Artificial intelligence is being employed to aid in the diagnosis of sepsis [16]. There are no definitive methods for diagnosing sepsis, and every hour of delayed therapy increases the patient's risk of morbidity or mortality. Artificial intelligence can effectively diagnose critically ill patients with sepsis in the early stages of the disease [16]. Clinical support artificial intelligence can also be utilized in drug selection for patients. A recent clinical decision support tool for drug selection was employed in a small trial for depression. The tool did not increase appointment length and may have improved drug selection [17]. Many new clinical support decision tools are being made for many different diseases. These models will likely improve outcomes and decrease costs.

Artificial intelligence applications in the medical field are vast and rapidly evolving. From expediting drug discovery and repurposing existing treatments to providing clinical decision support and optimizing disease management, AI is poised to revolutionize healthcare delivery. While still in its early stages, AI has already demonstrated remarkable prowess in image analysis, data processing, and pattern recognition that could dramatically improve diagnostic accuracy and treatment efficacy. As the technology advances, AI's potential to reduce costs, increase efficiencies, and ultimately save lives is immense. However, critical challenges around data privacy, model interpretability, and regulatory oversight must be carefully navigated. With proper governance and the ethical implementation of these powerful technologies, the era of AI-augmented medicine holds great promise for enhancing patient outcomes and transforming the practice of medicine as we know it.

References

1. Mintz, Y., & Brodie, R. (2019). Introduction to artificial intelligence in medicine. Minimally Invasive Therapy & Allied Technologies, 28(2): 73–81.
2. Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2017). Dermatologist-level classification of skin cancer with deep neural networks. Nature, 542: 115–118.
3. Ting, D. S. W., Cheung, C. Y.-L., Lim, G., Tan, G. S. W., Quang, N. D., Gan, A., … Lee, S. Y. (2017). Development and validation of a deep learning system for diabetic retinopathy and related eye diseases using retinal images from multiethnic populations with diabetes. Jama, 318, 2211–2223.
4. How Sunoh works. sunoh.ai. (2024, April 12).
5. Friedberg, M. W., Chen, P. G., Van Busum, K. R., Aunon, F., Pham, C., Caloyeras, J., Mattke, S., Pitchforth, E., Quigley, D. D., Brook, R. H., Crosson, F. J., & Tutty, M. (2014). Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy. Rand Health Quarterly, 3(4): 1.
6. Mak, KK., Wong, YH., Pichika, M.R. (2023). Artificial Intelligence in Drug Discovery and Development. In: Hock, F.J., Pugsley, M.K. (eds) Drug Discovery and Evaluation: Safety and Pharmacokinetic Assays. Springer, Cham.
7. Amisha MP, Pathania M, Rathaur V (2019) Overview of artificial intelligence in medicine. J Family Med Prim Care 8: 2328–2331.
8. Mak K-K, Balijepalli MK, Pichika MR (2021) Success stories of AI in drug discovery - where do things stand? Expert Opin Drug Discovery 17(1): 79–92.
9. Alzubaidi L, Zhang J, Humaidi AJ, Al-Dujaili A, Duan Y, Al-Shamma O, Santamaría J, Fadhel MA, Al-Amidie M, Farhan L (2021) Review of deep learning: concepts, CNN architectures, challenges, applications, future directions. Journal of Big Data 8(1): 53.
10. Zeng X, Xiang H, Yu L, Wang J, Li K, Nussinov R, Cheng F (2022b) Accurate prediction of molecular properties and drug targets using a self-supervised image representation learning framework. Nature Machine Intelligence 4(11):1004–1016.
11. Mak, KK., Wong, YH., Pichika, M.R. (2023). Artificial Intelligence in Drug Discovery and Development. In: Hock, F.J., Pugsley, M.K. (eds) Drug Discovery and Evaluation: Safety and Pharmacokinetic Assays. Springer, Cham.

Citation: Timothy Allen, Jonathan Arnon, Nepton Sheikhkhoni, Indushekar Guddli Manjunatha, Ariella Allen, Andres Felipe Gonzalez, Divya Sree Peddagali. (2024). The Impact of Artificial Intelligence on Modern Medicine: Advancements, Applications, and Future Prospects. *Archives of Nutrition and Public Health* 6(1). DOI: 10.5281/zenodo.12721171

12. U.S. Department of Health and Human Services. (n.d.). Diabetes statistics - NIDDK. National Institute of Diabetes and Digestive and Kidney Diseases. https://www.niddk.nih.gov/health-information/health-statistics/diabetes-statistics#:~:text=Estimated%20prevalence%20of%20diabetes%20in,8.9%25%20of%20the%20population).
13. Parker, E. D., Lin, J., Mahoney, T., Ume, N., Yang, G., Gabbay, R. A., ElSayed, N. A., & Bannuru, R. R. (2024). Economic Costs of Diabetes in the U.S. in 2022. Diabetes care, 47(1): 26–43.
14. Guan, Z., Li, H., Liu, R., Cai, C., Liu, Y., Li, J., Wang, X., Huang, S., Wu, L., Liu, D., Yu, S., Wang, Z., Shu, J., Hou, X., Yang, X., Jia, W., & Sheng, B. (2023). Artificial Intelligence in diabetes management: Advancements, opportunities, and challenges. Cell Reports Medicine, 4(10): 101213.
15. Ellahham, S. (2020). Artificial Intelligence: The future for diabetes care. The American Journal of Medicine, 133(8): 895–900.
16. Wu, M., Du, X., Gu, R., & Wei, J. (2021). Artificial Intelligence for clinical decision support in sepsis. Frontiers in Medicine, 8.
17. Popescu, C., Golden, G., Benrimoh, D., Tanguay-Sela, M., Slowey, D., Lundrigan, E., Williams, J., Desormeau, B., Kardani, D., Perez, T., Rollins, C., Israel, S., Perlman, K., Armstrong, C., Baxter, J., Whitmore, K., Fradette, M.-J., Felcarek-Hope, K., Soufi, G., … Turecki, G. (2021). Evaluating the clinical feasibility of an artificial intelligence-powered, web-based clinical decision support system for the treatment of depression in adults: Longitudinal Feasibility Study. JMIR Formative Research, 5(10).

Citation: Timothy Allen, Jonathan Arnon, Nepton Sheikhkhoni, Indushekar Guddli Manjunatha, Ariella Allen, Andres Felipe Gonzalez, Divya Sree Peddagali. (2024). The Impact of Artificial Intelligence on Modern Medicine: Advancements, Applications, and Future Prospects. *Archives of Nutrition and Public Health* 6(1). DOI: 10.5281/zenodo.12721171