AI IN HEALTHCARE

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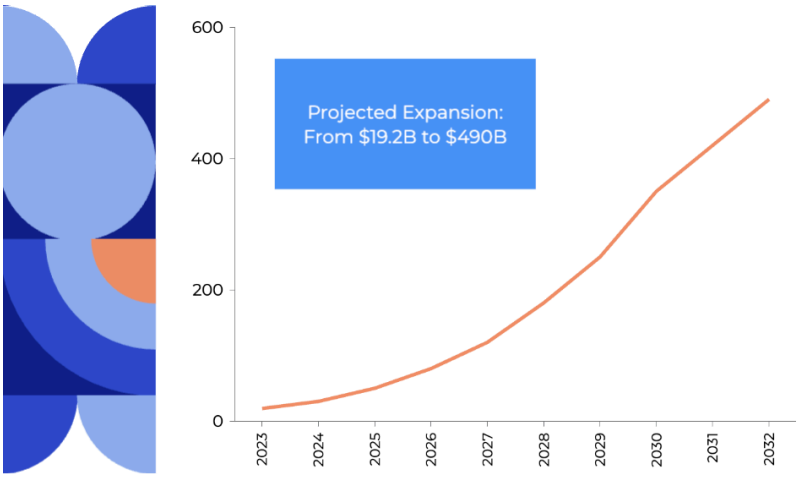


In the past few years artificial intelligence in the healthcare industry has evolved rapidly. With the global AI in healthcare market predicted to grow from $19.2 billion in 2023, to $490 billion by 2032, and the technologies cutting edge achievements, the future of AI in healthcare holds promise.[1] However, AI implementation in healthcare raises significant concerns about data privacy, ethics, bias, and social impact.[2] What was once a novelty is now a technology with potential for serious consequences and remarkable innovation, and we find ourselves at one of the most critical turning points in the history of the healthcare industry.

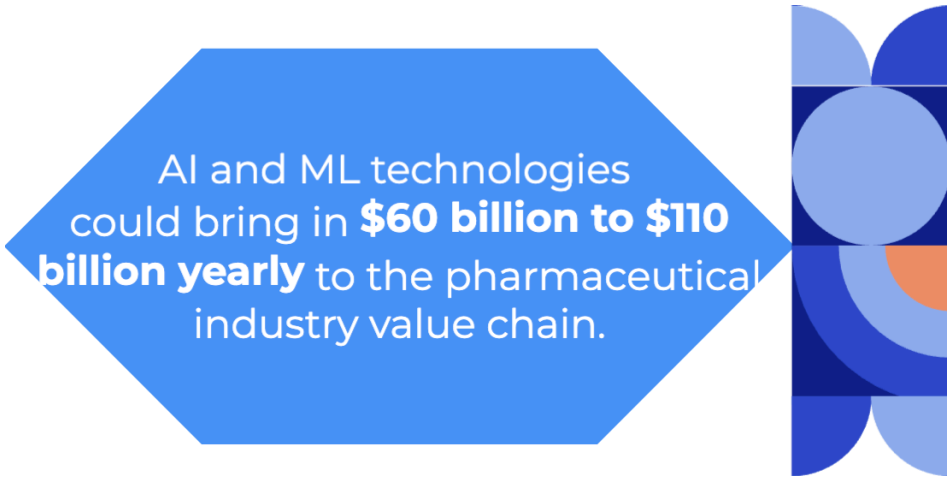
Artificial intelligence is a broad term, encompassing several specifications of technologies which are able to mimic human behavior and decision making. Machine learning (ML) is the most widely used AI technology in healthcare. This is the term for an AI that can learn and improve by itself, and excels at natural language processing, classification, speech and image recognition, and pattern recognition. A common ML algorithm type is the neural network, a system of artificial neurons meant to imitate the way biological systems process data. The neurons are split into layers, with an input layer receiving data, and an output layer issuing a final result. There are shallow and deep learning variants, artificial neural networks (ANN) and deep neural networks (DNN) respectively, with the deep learning version nesting hidden layers between the input and output layers, increasing sophistication. DNNs are typically used for processing large sets of multi-dimensional data, such as image, video, and audio data. However, ANNs still yield the best results when processing limited and low dimensional datasets.[3] Decision trees, similar to neural networks as they are both trained on supervised learning techniques, are another common algorithm type used in healthcare.[4]

Through these technologies AI has proven to be significantly beneficial in healthcare. In the field of medical diagnosis, rigorous testing and research have provided enough information to show definitive potential. One such study analyzed 102,059 patient results from an AI medical interview, using virtual care providers to verify the quality of the AIs diagnosis. In 84.2% of cases providers were in direct agreement with the diagnosis. For 35 types of diagnosis, AI and provider agreement rates were as high as

[1] "Top Artificial Intelligence Companies in Healthcare." The Medical Futurist, 12 Aug. 2024, https://medicalfuturist.com/top-artificial-intelligence-companies-in-healthcare/.
[2] Murdoch, Blake. "Privacy and Artificial Intelligence: Challenges for Protecting Health Information in a New Era." BMC Medical Ethics, vol. 22, no. 1, 15 Sept. 2021, https://doi.org/10.1186/s12910-021-00687-3.
[3] Janiesch, Christian, et al. "Machine Learning and Deep Learning." Electronic Markets, vol. 31, no. 3, 8 Apr. 2021, pp. 685–695, https://doi.org/10.1007/s12525-021-00475-2.
[4] Ayodele, Taiwo Oladipupo. *New Advances in Machine Learning.* Edited by Yagang Zhang, InTech, 2010.

95%.[5] Furthermore, AI has beaten radiologists across several diagnostic categories in a South Korean study, which compared AI diagnosis of breast cancer to radiologists'. AI was able to diagnose breast cancer with 90% accuracy, compared to a radiologists' 78%, and was superior at detecting breast cancer early on.[6]

Outside of diagnosis, AI is already being used and tested for multiple other medical fields. In the field of clinical lab testing, AI has improved efficiency in the testing of blood cultures, susceptibility, molecular platforms, and is standard practice in these areas for several facilities. Moreover, ML systems have proven to boost efficiency in the emergency department, helping expedite workflow, resource allocation, and triaging through analysis of patient data. Powerful computers at a hospital at Humber River Hospital in Toronto are already able to use AI to accurately predict how many patients will arrive in the ER, two days in advance.[7] Additional fields AI is present in include predictive analytics, personalized treatment, mental health support, dose optimization, therapeutic drug monitoring, radiology, and genomic medicine.[8] In the pharmaceutical sector, the McKinsey Global Institute estimates that AI and ML technologies could bring in $60 billion to $110 billion yearly to the pharmaceutical industry value chain. Many pharmaceutical companies already use AI, such as protein structure prediction systems AlphaFold2 and ESMFold, who use deep learning to enhance prediction accuracy.[9] Finally, AI chatbots are commonly used to help with low-stakes organizational tasks and providing explanations, such as answering FAQs and summarizing information to improve patient education.[10]



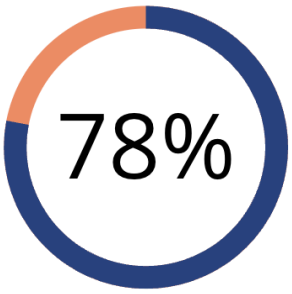
However, in a US-based study 60% of participants still expressed discomfort with the implementation of AI into their medical care.[11] Despite the technologies promising performance, it is still in its infancy and brings with it a multitude of hazards and errors, such as data privacy. Due to the expensive nature of AI technologies, they often require commercial partners in order to spread into the

[5] Zeltzer, Dan, et al. "Diagnostic Accuracy of Artificial Intelligence in Virtual Primary Care." Mayo Clinic Proceedings Digital Health, vol. 1, no. 4, n.d., pp. 480–489, https://doi.org/10.1016/j.mcpdig.2023.08.002.
[6] Kim, Hyo-Eun, et al. "Changes in Cancer Detection and False-positive Recall in Mammography Using Artificial Intelligence: A Retrospective, Multireader Study." The Lancet Digital Health, vol. 2, no. 3, 6 Feb. 2020, pp. e138–e148, https://doi.org/10.1016/s2589-7500(20)30003-0.
[7] Cuttler, Marcy. "Transforming Health Care: How Artificial Intelligence Is Reshaping the Medical Landscape." CBC, 26 Apr. 2019, https://www.cbc.ca/news/health/artificial-intelligence-health-care-1.5110892.
[8] Alowais, Shuroug A., et al. "Revolutionizing Healthcare: The Role of Artificial Intelligence in Clinical Practice." BMC Medical Education, vol. 23, no. 1, 22 Sept. 2023, https://doi.org/10.1186/s12909-023-04698-z.
[9] Viswa, Chaitanya Adabala, et al. "Generative AI in the Pharmaceutical Industry: Moving From Hype to Reality." McKinsey & Company, 9 Jan. 2024, https://www.mckinsey.com/industries/life-sciences/our-insights/generative-ai-in-the-pharmaceutical-industry-moving-from-hype-to-reality.
[10] "Artificial Intelligence (AI) Chatbots in Medicine: A Supplement, Not a Substitute." PubMed, National Library of Medicine, 25 June 2023, https://doi.org/10.7759/cureus.40922. Accessed 14 Feb. 2025.
[11] Esmaeilzadeh, Pouyan. "Use of AI-based Tools for Healthcare Purposes: A Survey Study From Consumers' Perspectives." BMC Medical Informatics and Decision Making, vol. 20, no. 1, 22 July 2020, https://doi.org/10.1186/s12911-020-01191-1.

public, and many end up being owned by large private companies. In these scenarios it is difficult to encourage these companies to prioritize patient data privacy over monetization.[12] This is best seen in 2016, when Google, after acquiring European AI company DeepMind, partnered with the Royal Free London NHS Foundation Trust to use DeepMind's ML for assistance in the management of acute kidney injury. During this partnership Google was afforded access to 1.6 million patient records without patient consent, obtaining this data on an "inappropriate legal basis", according to a senior advisor in England's Department of Health.[13]

Ethical concerns are another issue with AI. Due to what is coined the "Black Box Problem", programmers are not able to see what leads an AI to its ultimate decision, making it almost impossible to hold someone accountable if AI makes a deadly error.[14] Since AI and ML systems are trained on data collected by humans, they can inherit human biases, which often infiltrate these systems. Due to these biases issues like the under-representation of minority groups and presence of stereotypes in data sets are common, and yield significant issues, such as in a study conducted on facial recognition softwares from four years ago. The softwares incorrectly identified less than 1% of white males, but over 33% of black women.[15]

Due to the sophistication of AI technologies, they are at risk of breaching themselves in an issue called data reidentification. Even when datasets are anonymized by removing pertinent patient identifiers, certain AIs can still reidentify individuals. In a physical activity cohort study, 85.6% of adults and 69.8% of children were able to be fully reidentified, despite the use of an anonymized dataset.[16] This brings us to the main dilemma in the industry today: as AI algorithms become more sophisticated, and their training data expands, the risk of breaching private patient data increases in turn.



Of people reidentified from an anonymized dataset

All of these threats have inspired a push for stricter legislation of AI, as there still remains no comprehensive global regulatory framework to keep business in check.[17]

However, despite the flaws of AI in healthcare today, there is a promising tomorrow. In all medical disciplines and all across the globe, this technology holds the power to make significant positive change, and will continue to be refined by the world's premier and impassioned minds.

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[12] Murdoch, Blake. "Privacy and Artificial Intelligence: Challenges for Protecting Health Information in a New Era." BMC Medical Ethics, 15 Sept. 2021, https://doi.org/10.1186/s12910-021-00687-3.
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