

EMRs: AI/ML Learning for Different Clinical Disease States

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A Little About Me-

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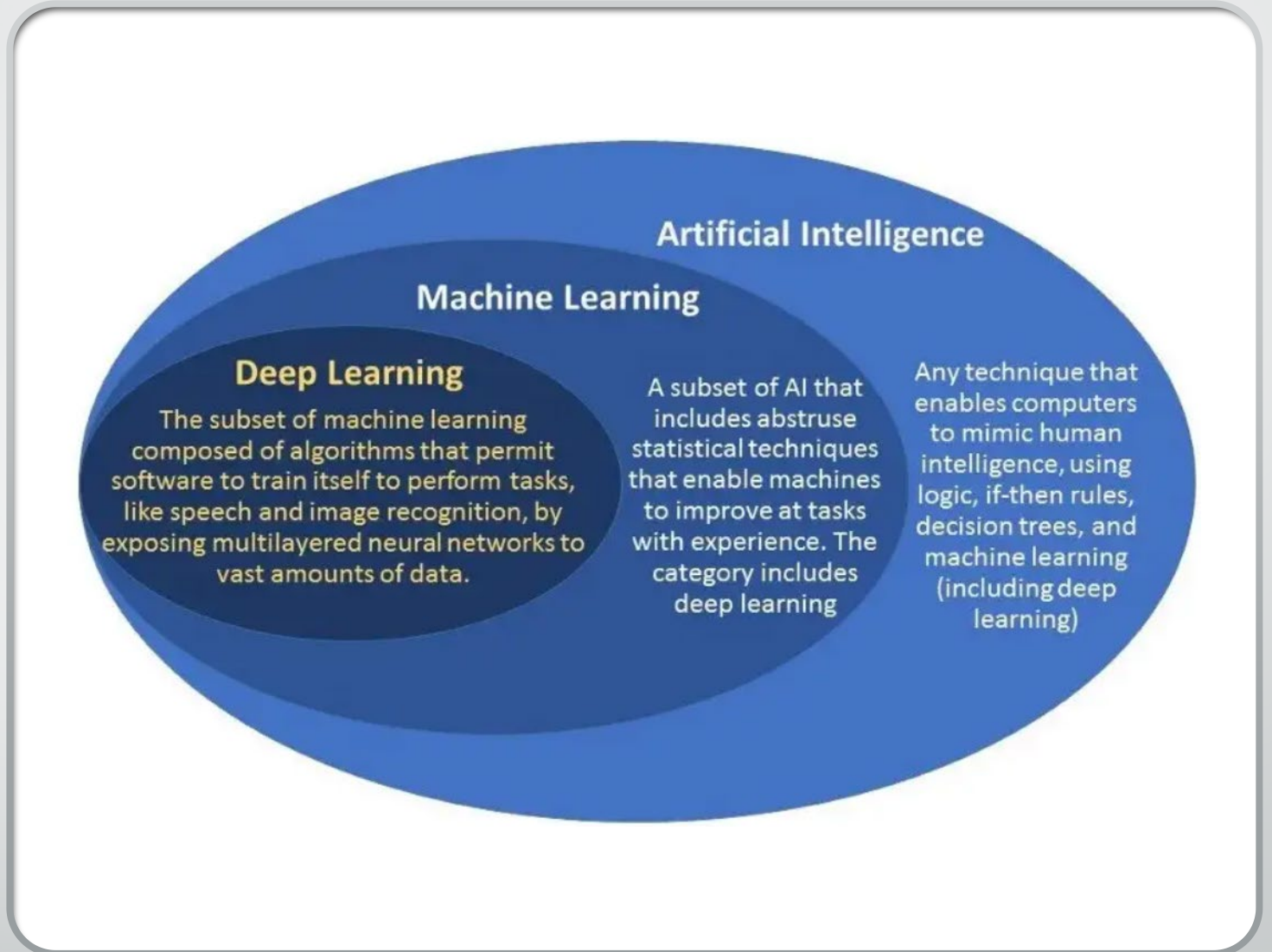


Presentation Overview

- This presentation provides an overview of the role and impact of artificial intelligence (AI) in healthcare, including its applications in diagnostics, predictive modeling, personalized medicine, and administrative tasks.
- Discuss the challenges that accompany AI deployment in healthcare, such as data security and privacy issues, algorithmic bias, and the 'black box' problem, along with strategies to address them.
- Proper AI implementation involves strict guidelines for training, robust legislation, and ethical considerations in leveraging AI in healthcare, balancing AI's potential benefits with the associated risks.
- Finally, we explore AI's future potential in healthcare. AI holds immense promise in revolutionizing healthcare, but successful implementation hinges on effectively addressing the existing challenges.

What is the difference between Artificial Intelligence and Machine Learning?

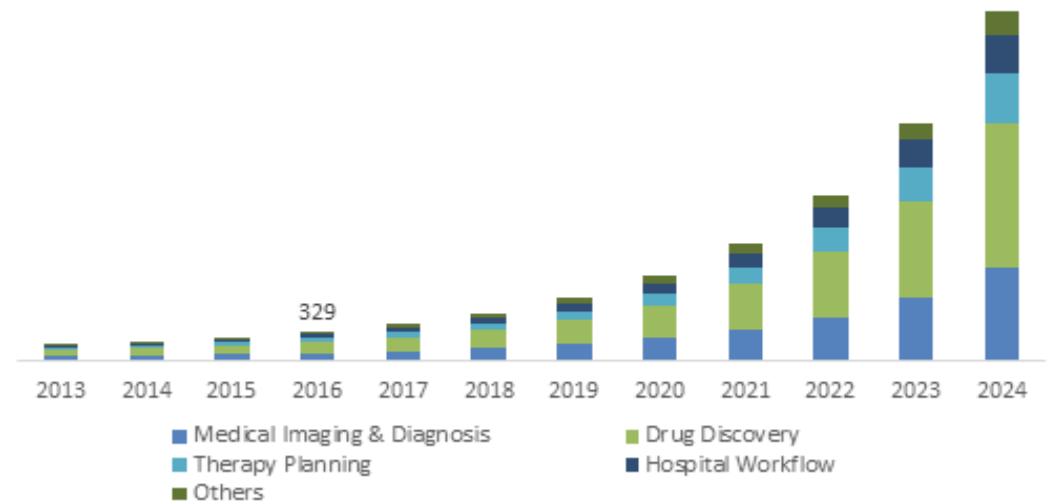
- Machine Learning is a subset of Artificial Intelligence.
- AI systems are programmed to perform tasks and follow set instructions, while ML systems learn from data and adapt to new scenarios.
- AI may not always need to learn from data, whereas ML relies heavily on data to make predictions.
- AI has a wider scope, including ML and other techniques, while ML has a more specific scope focusing on learning and decision making.
- AI is used in a variety of applications such as voice assistants and autonomous vehicles, while ML is used in specific applications like recommendation systems and image recognition.




The Rise of AI in Healthcare

- **Early 2000s - Emergence of AI in Healthcare:** The early 2000s saw the first applications of AI in healthcare, primarily in the form of decision support systems and computer-aided diagnosis
- **2010s - Rise of Machine Learning and Predictive Analytics:** With the advent of machine learning and broad EHR adoption, Machine learning algorithms were used to analyze large amounts of health data to predict patient outcomes and identify high-risk patient groups.
- **2020s - AI in Telemedicine and Remote Patient Monitoring:** With the rise of telemedicine due to the COVID-19 pandemic, AI has been increasingly used to provide remote patient monitoring and virtual care, even asynchronously.
- **2023- LLM emergence;** AI-powered chatbots, such as Chat-GPT, have powerful capabilities to enhance machine- human interaction

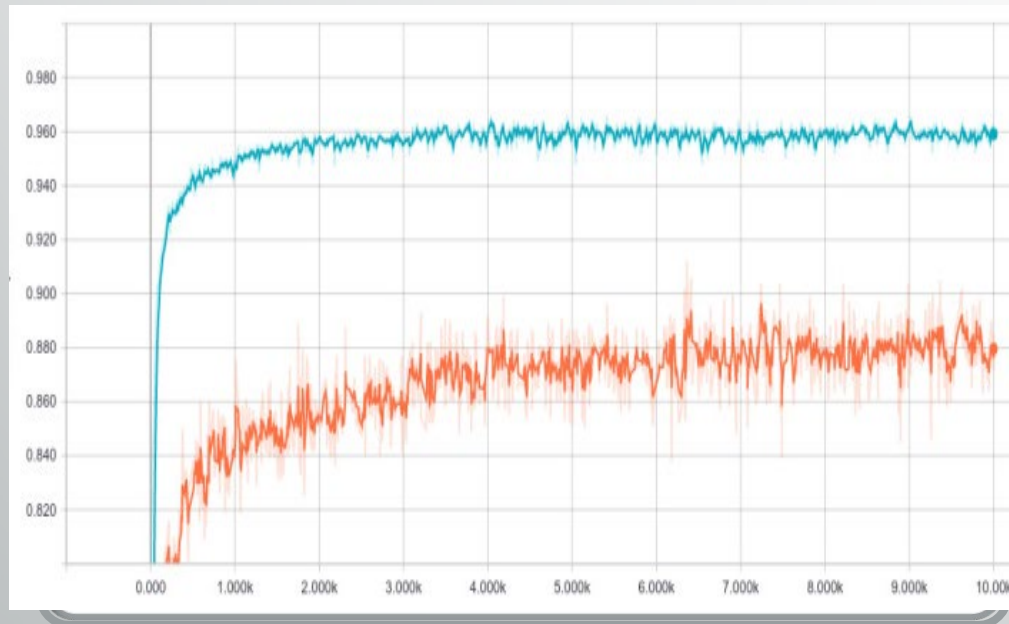
U.S. Healthcare Artificial Intelligence Market Size, By Application, 2013-2024 (USD Million)





Improving patient outcomes with Artificial Intelligence

AI Applications: Leverage Diagnostic Tests



- **Enhancing diagnostic capability with imaging-** AI has the potential to enhance disease screening processes. For instance, a study titled ["Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning"](#) demonstrated the use of AI in screening patients for common treatable blinding retinal diseases. The AI system showed performance far superior to that of human experts.
- **Predictive analytics-** In 2 recent papers presented in Ochsner Journal, Predictive AI has captured approximately 4200 septic patients in the past 2 years, decreasing sepsis RAMI by a significant margin.

AI Applications: Treatment of Complex Disease

- **Accelerated Drug Discovery:** AI tools, such as Google Cloud's Target and Lead Identification Suite, identify biological targets using virtual protein mapping, thus accelerating the drug discovery process ¹.
- **Advanced Precision Medicine:** AI and machine learning algorithms can integrate and summarize enormous amounts of data. This is particularly beneficial in precision medicine, where treatments are selected based on the individual patient's molecular profile ³⁴.
- **Clinical Trial Design:** AI can reshape key steps of clinical trial design to increase trial success rates. This includes optimizing patient selection and recruiting techniques, and effectively monitoring patients during trials. These advancements could potentially lower the pharma R&D burden and increase the efficiency of the drug development cycle ²⁵.
- **Drug Repositioning:** AI and machine learning can be used for drug repositioning, which involves finding new uses for approved or investigational drugs that are outside the scope of the original medical indication. ⁶.

1. [Google Cloud's new AI-powered healthcare research products](#) ↵ ↵²
2. [Artificial Intelligence for Clinical Trial Design](#) ↵ ↵² ↵³
3. [Digital pathology and artificial intelligence in translational medicine and clinical practice](#) ↵ ↵²
4. [Enabling Technologies for Personalized and Precision Medicine](#) ↵ ↵²
5. [Deep Learning in Drug Discovery and Medicine; Scratching the Surface](#) ↵ ↵²
6. [Rethinking Drug Repositioning and Development with Artificial Intelligence, Machine Learning, and Omics](#) ↵ ↵²

AI Applications in Mental Health

- **AI in Mental Health Services and Research:** AI has the potential to revolutionize mental health services and research. It can aid in planning mental health services, identifying, and monitoring mental health problems in individuals and populations. AI-driven tools can utilize digitized healthcare data to automate tasks, support clinicians, and deepen understanding of complex disorders. ¹.
- **AI-driven Mental Health Apps:** AI-driven mental health apps are becoming more accessible, enabling individuals to take charge of their mental well-being. Some of the most promising AI apps for mental health include Misü, Wysa, Breathhh, Youper, Sanvello, MindDoc, Replika, MoodMission, Together AI, Ladder, Kintsugi, Calm, Rootd, and MindShift CBT ².
- **AI-Enhanced Life Crafting for Mental Health and Academic Performance:** A study proposed integrating chatbot interventions aimed at the mental health of students with a life-crafting intervention that uses an inclusive curriculum-wide approach. The chatbot asks students to prioritize both academic as well as social and health-related goals and provides personalized follow-up coaching ^[^4^].

1. [World Health Organization](#)

[↩](#) [↩²](#) [↩³](#)

2. (<https://www.marktechpost.com/2023/04/11/best-aiBased> : [↩](#) [↩²](#) [↩³](#)

AI Applications in Telehealth

- **AI in Telemedicine:** AI technologies, such as deep learning and natural language processing, can enhance telemedicine by automating note-taking during patient consultations, predicting adverse events like hospital readmissions, and optimizing patient outcomes. ¹²
 - **Remote Patient Monitoring:** AI can enhance remote patient monitoring by providing continuous data collection, transmission, evaluation, and communication of large volumes of data from a patient to their healthcare provider. Multiple studies have shown reductions in readmissions, AICD discharges, and mortality³.
 - **Virtual Consultations:** AI can improve virtual consultations by enabling better disease surveillance and early detection, allowing for improved diagnosis, and supporting personalized medicine. It can also facilitate physician-to-physician consultation, patient education, data transmission, data interpretation, digital diagnostics, and digital therapeutics ³.
 - **Clinician Co-Pilot:** AI can provide value in healthcare by improving access to care, reducing costs, and enhancing the quality of healthcare services through copilot-type interface particularly among complex health systems ⁴

1. [Telemedicine for healthcare: Capabilities, features, barriers, and applications](#) ↩ ↩²

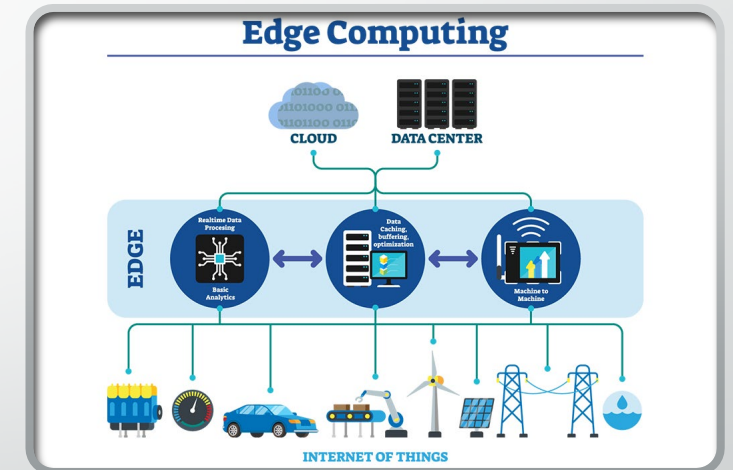
2. [Value-based Healthcare: Can Artificial Intelligence Provide Value in Orthopaedic Surgery?](#) ↩ ↩²

3. [Telehealth Basics podcast- ATA](#) ↩ ↩² ↩³ ↩⁴

4. [Value of Telemonitoring and Telemedicine in Heart Failure Management](#) ↩ ↩²

AI Applications: Health Management

- [Online Diabetes Self-Management Program](#)- Patients with type 2 diabetes in an online diabetes self-management program demonstrated reduced A1C at 6 and 18 months, had fewer symptoms, demonstrated increased exercise, and had improved self-efficacy and patient activation compared to usual-care control subjects.
- [National Sports AI Health Management Service System Based on Edge Computing](#) This paper discusses the combination of edge computing, artificial intelligence, and health management service systems to construct a comprehensive health management service platform.
- [CHAIMELEON Project: Creation of a Pan-European Repository of Health Imaging Data for the Development of AI-Powered Cancer Management Tools](#). This paper discusses the CHAIMELEON project, which aims to set up a pan-European repository curated datasets for future AI experimentation in cancer management



Development of AI “Virtual Scribes”

- **Reduction of Clinician Burnout:** AI scribe technology can significantly reduce clinician burnout by automating the process of documentation, reducing time by 20-30%¹.
- **Cost and Efficiency:** AI scribes can be more cost-effective and efficient than human scribes. They can work round the clock, do not require training, and their performance does not degrade over time².
- **Improved Patient Interaction:** AI scribes allow physicians to have more face-to-face interaction with their patients. ³.
- **Advancements in AI and Big Data:** The use of AI and LLMs and biomedical research promises to revolutionize healthcare. ⁴



1. [How AI Scribe Technology Can Cut Clinician Burnout from EHR](#) ↩ ↩²
2. [Fully Automated Medical Scribes Using AI | Healthcare IT Today](#) ↩ ↩²
3. [DeepScribe - AI-Powered Medical Scribe](#) ↩ ↩²
4. [Artificial intelligence in sleep medicine: background and implications for clinicians](#) ↩ ↩²

The Rise of Large Language Models



AI Applications: AI Chatbot (LLM) Technology:

- [Benefits, Limits, and Risks of GPT-4 as an AI Chatbot for Medicine | NEJM](#)-
 - Large Language models (LLMs) can generate useful medical notes from a provider-patient interaction
 - Physicians can interact with LLMs during a medical consult¹.
 - LLMs have potential in clinical settings and medical research, but it should be used with careful consideration, because it is fallible¹.
 - The role of this new type of AI in healthcare needs to be understood and discussed publicly, especially as the approach to healthcare and medicine evolves alongside the rapid evolution of AI. GPT-4 is seen as an "opening of a door to new possibilities as well as new risks"¹.

Large Language Models in Medical Note Taking

- **Automated Documentation:** Large language models can facilitate automated medical note-taking, reducing the administrative burden on physicians. This can be further accelerated by voice-text solutions which can infer appropriate intent. (Source: [Healthcare IT News](#))
- **Information Extraction:** These models can extract relevant information from patient narratives, aiding in the creation of structured medical notes, particularly building from patient entered data and questionnaires. (Source: [Journal of Biomedical Informatics](#))
- **Clinical Decision Support:** Language models can analyze patient notes to provide real-time decision support while the provider is writing the note, or infer based on previous notes about decisions that need to be made or considered. (Source: [Journal of the American Medical Informatics Association](#))
- **Patient Engagement:** Large language models can be used to create patient-friendly summaries of medical notes, enhancing patient engagement and understanding. They also can be used as a meta “filter” between doctor/patient interactions to enhance patient compliance with medical plans. (Source: [Journal of Medical Internet Research](#))

Large Language Models in Medical Consultation

- LLMs can provide valuable information to patients and healthcare professionals by providing summations of large volumes of patient data, augmenting the performance of healthcare professionals.
- LLMs can be used for "curbside consultations" for certain simple questions by training on curated "best practice" toolsets to help physicians with patient care. These models have shown promise in providing safe and accurate responses to clinical questions.
- LLMs can be used as an educational tool for both patients and healthcare professionals, especially given the human-interactive nature of the product as well as its ability to understand the nature of specific questions

[Stanford AI Project]

(<https://l.keymate.ai?url=https%3A%2F%2Fhai.stanford.edu%2Fnews%2F>{

Large Language Models in Medical Knowledge Assessment Tests

- GPT-4 performed at or near the passing threshold for both the MCAT and the USMLE Step 1 exams.
- For the MCAT, GPT-4 scored in the 99.6th percentile, which is equivalent to a score of 527 out of 528. [1](#).
- For the USMLE Step 1, GPT-4 also performed at or near the passing threshold, which is typically around 60% accuracy.
- GPT-4 is being used in medical education to create virtual tutors that can answer students' questions, provide explanations, and even simulate patient interactions.

USMLE Self Assessment	GPT-4 (5 shot)	GPT-4 (zero shot)
Step 1	85.21	83.46
Step 2	89.50	84.75
Step 3	83.52	81.25
Overall Average*	86.65	83.76

1. [MCAT Performance](#) ↵
2. [USMLE Performance 1](#) ↵
3. [USMLE Performance 2](#) ↵

1. Medical News Today: [GPT-4: The Next Generation of AI in Medical Education](#)



With Great Power
Comes Great
responsibility

Large Language Models: Inherent Challenges

- **Data Privacy and Security:** Large language models have access to vast amounts of data, which can potentially include sensitive patient information. Ensuring the privacy and security of this data is a significant challenge. ¹
- **Interpretability and Explainability:** Understanding the reasoning behind the predictions made by large language models can be difficult. This lack of transparency can be a barrier to trust and adoption by healthcare professionals. ¹
- **Bias and Fairness:** Large language models can inadvertently learn and replicate biases present in the training data, leading to unfair outcomes or misdiagnoses. ²
- **Complexity of Medical Language:** The complexity and specificity of medical language can pose a challenge for large language models, potentially leading to misunderstandings or inaccuracies. ³

1. [The Verge: The Problem with AI in Healthcare](#) ↩ ↩²
↩³ ↩⁴
2. [Nature: Bias and Fairness in AI](#) ↩ ↩²
3. ["Global systems biology, personalized medicine and molecular epidemiology"](#) ↩
↩²

Large Language Models and "Hallucinations"

- ChatGPT, a large language model (LLM), can create seemingly plausible but scientifically incorrect content, known as "hallucination", potentially causing misinformation in crucial sectors like healthcare.
- The training data can influence hallucinations in LLMs, as models may reflect inaccuracies, misinformation, or biases present in the data, resulting in hallucinated responses.
- LLMs often function as a "black box", making their decision-making process opaque and potentially leading to harmful or incorrect outputs in critical situations.
- LLMs can generate inconsistent text when asked for longer passages, which is particularly problematic for complex or jargon-heavy data such as medical information.

[1. ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns](#) ↩ ↩² ↩³ ↩⁴ ↩⁵ ↩⁶ ↩⁷ ↩⁸

[2. MIT Technology Review](#)

[3. Science Journals — AAAS \(escholarship.org\)](#)

Ethical Considerations of AI

- Sam Altman, OpenAI's CEO, cautioned that AI's power could drastically alter society, necessitating government regulation to prevent significant harm, especially if AI technology goes awry.
 - **"My worst fear is that we, the technology industry, cause significant harm to the world. If this technology goes wrong, it can go quite wrong."**
- The hearing underscored AI's potential to propagate disinformation and biases, with lawmakers expressing concerns about AI-generated content's threat to democracy.
- Privacy and job losses were also discussed, emphasizing the need for transparency in AI operations, its training data, and decision-making processes to mitigate these concerns.
- The hearing saw bipartisan support for stricter AI regulation and increased disclosure, with some senators proposing a new regulatory body for AI and other emerging technologies, a suggestion that Altman endorsed.



- [Senate hearing highlights AI harms and need for tougher regulation](#)
- [ChatGPT creator Sam Altman testifies in Congress about AI risks](#)

The Largest Existential Threat to Mankind

- Elon Musk has repeatedly warned about the potential dangers of AI, stating that it could lead to "civilization destruction" if not properly managed and regulated. [1](#)
- Musk is among a group of tech leaders who have signed an open letter calling for a six-month pause in the "out of control" race for AI development. He supports government regulation of AI, stating that once AI is in control, it could be too late to implement regulations. [2](#)
- Despite his warnings, Musk is deeply involved in the growth of AI through his various companies and has plans to create a rival to the AI offerings by tech giants like Microsoft and Google. [3](#)



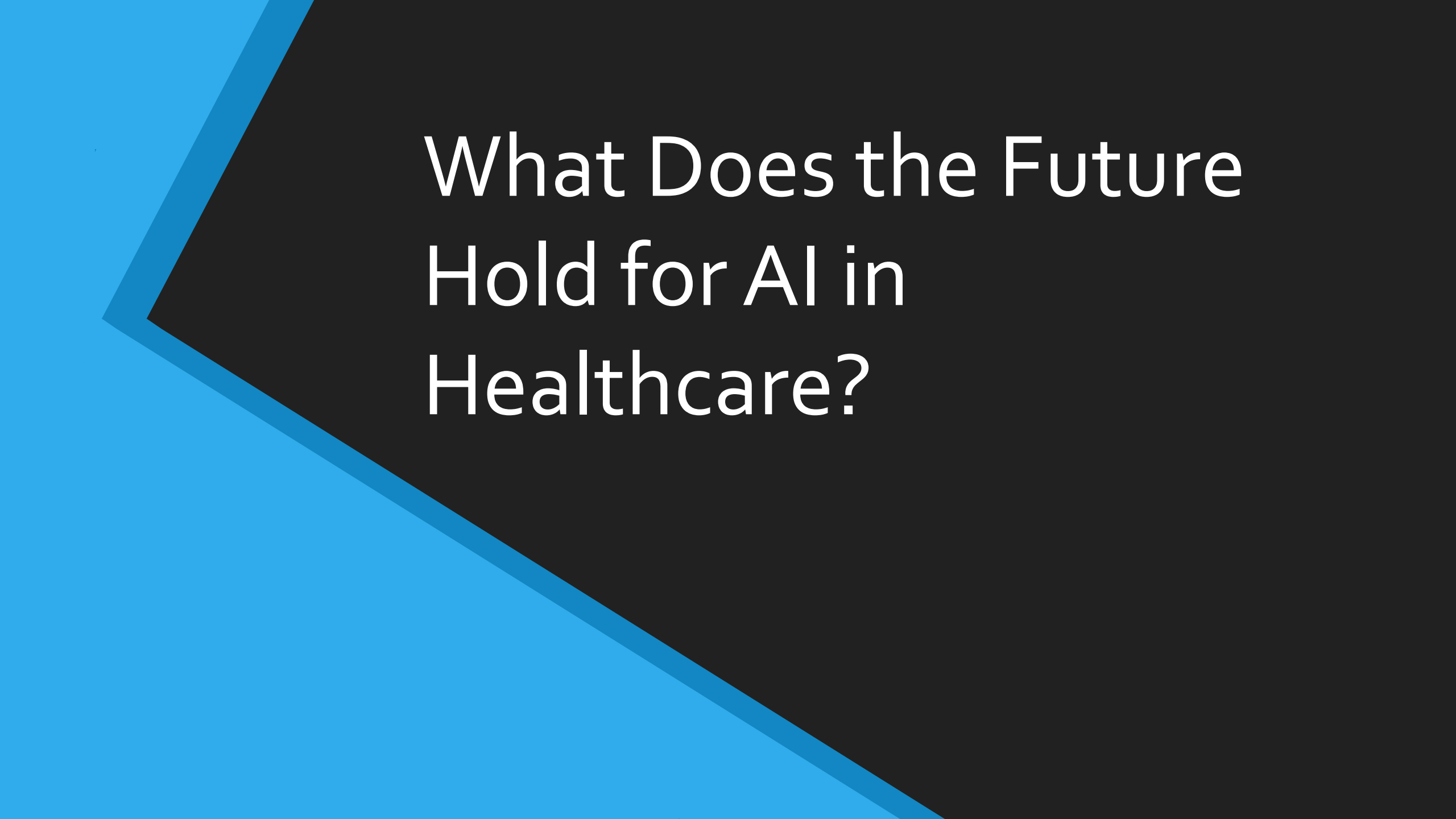
1. [CNN Business](#) ↔ ↔² ↔³
2. [BBC News](#) ↔
3. [Forbes](#) ↔

The Ethical Impact of AI on Healthcare Professionals

- **Informed Consent and Autonomy:** AI systems in healthcare should respect the autonomy of patients, requiring informed consent for their use.
- **Privacy and Data Protection:** AI systems must ensure the privacy and security of patient data, protecting it from potential breaches.
- **Algorithmic Fairness and Bias:** AI systems should be designed and trained in a way that prevents biases and promotes fairness in healthcare outcomes.
- **Social Gaps and Justice:** The use of AI in healthcare should not exacerbate social inequalities but should aim to promote justice and equal access to healthcare resources.

1. [Ethical Issues of Artificial Intelligence in Medicine and Healthcare](#) ↔ ↔²

2. [Legal and Ethical Consideration in Artificial Intelligence in Healthcare](#) ↔ ↔²

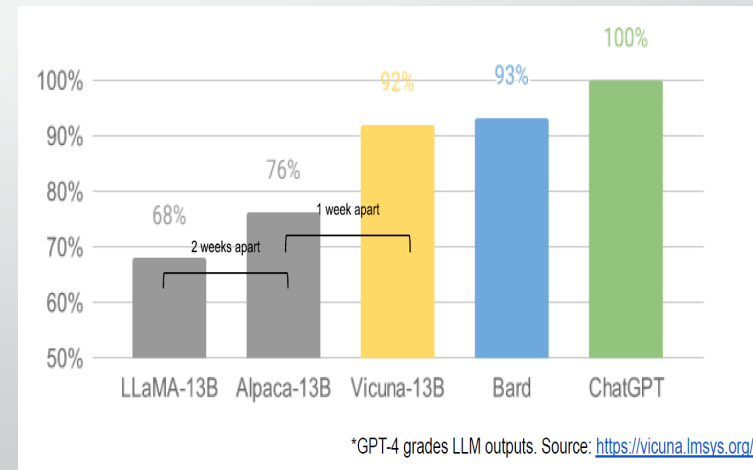


What Does the Future
Hold for AI in
Healthcare?

The Open Source Revolution: Outpacing Giants in AI Innovation

- Open source AI is rapidly outpacing tech giants like Google and OpenAI, solving major open problems and delivering faster, more customizable, and more private models.
- Open-source models are demonstrating astonishing capabilities with significantly less resources, challenging the dominance of large-scale models.
- The open source community's ability to iterate quickly and cheaply on models, coupled with the use of small, highly curated datasets, is driving rapid innovation.
- Developing small, curated datasets drastically reduces the time to train these models, and they are already available and can be used on a laptop.

[Google "We Have No Moat, And Neither Does OpenAI" \(semianalysis.com\)](#)



AI's Potential Future Developments in Healthcare

- The AI in healthcare market is expected to grow from USD 14.6 billion in 2023 to USD 102.7 billion by 2028, at a CAGR of 47.6%¹.
- Increasing focus on developing human-aware AI systems, despite lack of skilled AI workforce and ambiguous regulatory guidelines¹.
- Deep learning, a subset of machine learning, is projected to hold a significant share in the AI healthcare market, especially in imaging, diagnostics, and drug discovery¹.
- The use of AI in patient-facing applications, such as smartphone apps and homecare systems, is expected to grow at the highest rate¹.

Charting the Course: Navigating the AI Revolution in Healthcare

- **Embrace AI and Machine Learning:** Physicians need to understand and embrace the potential of AI and machine learning in healthcare.
- **Continuous Learning and Adaptation:** The medical field must commit to continuous learning and adaptation to new technologies.
- **Ethical Considerations:** Physicians must be prepared to navigate the ethical considerations that come with AI in healthcare.
- **Patient-Centered Approach:** Despite the rise of AI, maintaining a patient-centered approach is crucial.

1. [Emerging Technologies to Combat the COVID-19 Pandemic](#) ↩

2. [Brave new world: service robots in the frontline](#) ↩ ↩²

3. [Artificial Intelligence \(AI\) in Healthcare and Medical Research: Why a Strong Computational/AI Bioethics Framework Is Required](#) ↩ ↩²

4. [Artificial Intelligence—The Revolution Hasn't Happened Yet](#) ↩ ↩²

5. [Artificial Intelligence in Health Care: Anticipating Challenges to Ethics, Privacy, and Bias](#) ↩

Conclusions

- **AI will NOT replace physicians-** However, Physicians who use AI will be more effective than those who do not
- **The pace of change might accelerate greatly-**Because of rapid development, it is very difficult to predict how much change might occur but expect it to be swift.
- **There are myriad of ethical concerns-** AI represents almost untapped potential, but also great danger for misuse.
- **Be skeptical-** There will be lots of vendors promising very exciting things. Don't believe them unless you have someone you trust review the product.



Discussion and Questions