Equinox Issue

SCHOLARLY REVIEW ONLINE

Potential benefits and risks of advanced AI in healthcare

By Deetya Shekhar

Introduction

Artificial intelligence (AI) has emerged as a transformative force across various sectors, with healthcare being at the forefront. AI's capabilities in identifying patterns, processing vast amounts of data, and making predictions have paved the way for significant medical advancements. However, these opportunities come with both benefits and risks. This paper explores the potential benefits and risks of using advanced AI in healthcare, considering its impact on patient care, medical research, surgical advancements, and the healthcare industry.

Healthcare involves several stages: preventive healthcare, screening, diagnostics, and treatment. For instance, when a patient visits a physician and requires diagnostic tests, they may be referred to the radiology department for procedures such as ultrasounds, X-rays, CT scans, or MRIs. This process spans preparation, planning, acquisition, and review.

Benefits of Advanced AI in Healthcare

Enhanced Diagnostic Accuracy

One of the most promising benefits of AI in healthcare is its potential to improve diagnostic accuracy. AI algorithms can analyze medical images, such as X-rays, CT scans, and MRIs, with a high degree of precision, often surpassing human capabilities. For instance, a study by Stanford University demonstrated that an AI model could detect pneumonia from chest X-rays with higher accuracy than radiologists (Armitage, 2018). Similarly, an experiment by Google Health showed that an AI system could identify breast cancer in mammograms more accurately than human experts, reducing false positives and false negatives (Google Health, 2024). AI systems have shown remarkable success in detecting early signs of diseases such as cancer, cardiovascular conditions, and neurological disorders, leading to earlier detection, timely interventions, and improved patient outcomes.

Companies like Philips, GE Healthcare, and Siemens Healthineers have developed AI algorithms to enhance patient care and improve diagnostic accuracy. Examples include:

- SmartSpeed (Philips): An AI-based imaging technology that uses a Compressed-SENSE deep-learning algorithm to improve speed and image quality, increasing imaging by up to three times and providing up to 65% greater resolution (Philips, 2024).

- AI-Rad Companion (Siemens): A suite of applications using deep learning algorithms to assist radiologists by highlighting abnormalities and comparing results to reference values (Siemens Healthineers, 2024).

- Edison AI Platform (GE Healthcare): A comprehensive AI platform that integrates data from various sources, applies advanced analytics, and delivers insights to support clinical and operational decision-making. The platform hosts a variety of applications tailored to different medical fields (GE Healthcare, 2024).

Personalized Treatment Plans

AI can revolutionize personalized medicine by analyzing a patient's genetic information, medical history, and lifestyle data to tailor individual treatment plans. This approach ensures that patients receive the most effective treatments with minimal side effects. For example, IBM Watson's AI has been used in oncology to recommend treatment options based on a comprehensive analysis of patient data and the latest medical research (Kahn et al., 2020). Clinical trials have shown that Watson for Oncology's treatment recommendations matched those of oncologists in 93% of cases, highlighting its potential to enhance decision-making in cancer care. Personalized treatment plans can enhance the efficacy of therapies and reduce the trial-and-error approach traditionally associated with medical treatments.

Robotic Systems for Surgery

Robotics, particularly in surgery, is a rapidly growing field. Notable examples include:

- da Vinci® Surgical Robot: Enhances surgical precision and control, reducing errors and making surgeries less invasive. It uses 3D high-definition vision and wrist-mounted controls for precise incisions.

- Firefly: A near-infrared fluorescence capability developed by Intuitive to help visualize vessels and tissue perfusion, enhancing surgical outcomes.

- SureForm Staplers: Integrated with AI to ensure consistent and optimal stapling during surgeries, making real-time adjustments to prevent tissue damage.

Robotic Systems for Infection Control and Cancer Treatment

- Xenex Germ-Zapping Robot: Uses pulsed UV rays to disinfect hospital rooms, reducing hospital-acquired infections (HAIs) like MRSA.

- CyberKnife: A robotic system delivering precise radiation therapy to tumors, minimizing exposure to healthy tissues and offering non-invasive treatment options.

Operational Efficiency

In addition to clinical applications, AI can significantly improve operational efficiency within healthcare institutions. AI-powered systems can optimize scheduling, manage hospital resources, and streamline administrative tasks, leading to cost savings and better resource utilization. For example, an AI-driven platform developed by LeanTaaS has been used to optimize operating room schedules in hospitals, resulting in increased utilization and reduced wait times for surgeries (LeanTaaS, 2024). AI can predict patient admission rates, allowing hospitals to allocate staff and resources more effectively. This optimization can reduce waiting times, improve patient satisfaction, and enhance the overall quality of care.

Accelerated Drug Discovery

The drug discovery process is notoriously time-consuming and expensive. AI has the potential to expedite this process by analyzing vast datasets to identify potential drug candidates and predict their efficacy and safety. Machine learning algorithms can sift through existing medical literature, clinical trial data, and chemical databases to find promising compounds, significantly reducing the time and cost associated with bringing new drugs to market. For instance, Insilico Medicine used AI to identify a new drug candidate for fibrosis in just 46 days, a process that typically takes several years (Yao, 2023). This acceleration can lead to faster development of treatments for diseases that currently have limited therapeutic options.

Risks of Advanced AI in Healthcare

Data Privacy and Security

The integration of AI in healthcare involves handling massive amounts of sensitive patient data. Ensuring the privacy and security of this data is a critical concern. AI systems are vulnerable to cyberattacks, which can lead to data breaches and unauthorized access to personal health information. Protecting patient data requires robust encryption methods, strict access controls, and continuous monitoring for potential security threats. Failure to safeguard this information can undermine patient trust and lead to significant legal and ethical repercussions. A notable case is the 2017 WannaCry ransomware attack, which affected the UK's National Health Service (NHS) and exposed vulnerabilities in healthcare data security (NHS England, 2023).

Bias and Fairness

AI algorithms are trained on existing data, which may contain biases reflecting historical and societal inequalities. If not carefully addressed, these biases can perpetuate or even exacerbate disparities in healthcare. For instance, a study published in Science found that an AI algorithm used to predict which patients would benefit from extra medical care was less likely to recommend Black patients than white patients, despite similar levels of need (Kahn et al., 2020). AI systems trained on data predominantly from a particular demographic may perform poorly for underrepresented groups, leading to unequal treatment outcomes. Ensuring fairness and eliminating bias in AI systems requires diverse and representative training data, as well as continuous evaluation and adjustment of the algorithms.

Regulatory and Ethical Challenges

The rapid advancement of AI in healthcare poses significant regulatory and ethical challenges. Establishing clear guidelines and standards for AI applications is essential to ensure patient safety and ethical use. Regulatory bodies must balance innovation with oversight, ensuring that AI systems are thoroughly tested and validated before deployment. Ethical considerations, such as informed consent, transparency, and accountability, must also be addressed to maintain public trust and prevent misuse of AI technologies. The European Union's General Data Protection Regulation (GDPR) and the proposed Artificial Intelligence Act are examples of regulatory efforts to address these challenges (European Union, 2018; European Union, 2021).

Dependency and Skill Degradation

As AI systems become more integrated into healthcare, there is a risk of over-reliance on technology, leading to the degradation of essential medical skills among healthcare professionals. Dependence on AI for routine tasks may result in reduced clinical expertise and critical thinking abilities. It is crucial to maintain a balance between leveraging AI for efficiency and preserving the core competencies of healthcare practitioners. Continuous education and training programs can help professionals stay adept at both using AI tools and retaining their clinical skills.

Conclusion

The implementation of advanced AI in healthcare presents a dual-edged sword, offering significant benefits while posing substantial risks. Enhanced diagnostic accuracy, surgical precision, personalized treatment plans, operational efficiency, and accelerated drug discovery highlight the transformative potential of AI. However, data privacy and security concerns, bias and fairness issues, regulatory and ethical challenges, and the risk of dependency must be carefully managed. As AI continues to evolve, a collaborative effort involving healthcare providers, policymakers, technologists, and patients is essential to harness its potential while mitigating its risks. Balancing innovation with responsibility will be key to realizing the full promise of AI in healthcare.

References

Advent Health University. (2022, February 10). Robotics in healthcare: Past, present, and future. Advent Health University. https://www.ahu.edu/blog/robotics-in-healthcare

Alemzadeh, H., Raman, J., Leveson, N., Kalbarczyk, Z., & Iyer, R. K. (2016). Adverse events in robotic surgery: A retrospective study of 14 years of FDA data. PLOS ONE, 11(4), e0151470. https://doi.org/10.1371/journal.pone.0151470

Armitage, H. (2018). Artificial intelligence rivals radiologists in screening X-rays for certain diseases. Stanford Medicine News Center. https://med.stanford.edu/news/all-news/2018/11/ai-outperformed-radiologists-in-screening-x-rays-for-certain-diseases.html

Case Western Reserve University. (2015, December 28). 5 medical robots making a difference in healthcare at CWRU. Case Western Reserve University. https://online-engineering.case.edu/blog/medical-robots-making-a-difference

Cleveland Clinic. (2021). Robotic surgery: Robot-assisted surgery, advantages, disadvantages. Cleveland Clinic. https://my.clevelandclinic.org/health/treatments/22178-robotic-surgery

European Union. (2018). General data protection regulation (GDPR). General Data Protection Regulation (GDPR). https://gdpr-info.eu/

European Union. (2021, September 7). The EU Artificial Intelligence Act. The Artificial Intelligence Act. https://artificialintelligenceact.eu/

Ferrarese, A., Pozzi, G., Borghi, F., Marano, A., Delbon, P., Amato, B., Santangelo, M., Buccelli, C., Niola, M., Martino, V., & Capasso, E. (2016). Malfunctions of robotic system in surgery: role and responsibility of surgeon in legal point of view. Open Medicine, 11(1). https://doi.org/10.1515/med-2016-0055

GE Healthcare. (2024). Health information technology. GE Healthcare India. https://www.gehealthcare.in/products/healthcare-it

Google Health. (2024). Advancing breast cancer detection with AI. Google Health. https://health.google/caregivers/mammography

Grant, C. (2022, October 3). Algorithms are making decisions about health care, which may only worsen medical racism. American Civil Liberties Union. https://www.aclu.org/news/privacy-technology/algorithms-in-health-care-may-worsen-medical-racism/

Harvard T. H. Chan School of Public Health. (2019, November 7). Study: Widely used health care algorithm has racial bias. Harvard T. H. Chan School of Public Health News. https://www.hsph.harvard.edu/news/hsph-in-the-news/study-widely-used-health-care-algorithm-has-racial-bias/

Intuitive Surgical. (2024). Safety information. Intuitive Surgical. https://www.intuitive.com/en-us/about-us/company/legal/safety-information

Jain, A., Brooks, J. R., Alford, C. C., Chang, C. S., Mueller, N. M., Umscheid, C. A., & Bierman, A. S. (2023). Awareness of Racial and Ethnic Bias and Potential Solutions to Address Bias With Use of Health Care Algorithms. JAMA Health Forum, 4(6), e231197–e231197. https://doi.org/10.1001/jamahealthforum.2023.1197

LeanTaaS. (2024). LeanTaaS Healthcare Predictive Analytics & Capacity Management. LeanTaaS. https://leantaas.com/

NHS England. (2023, April 21). NHS England business continuity management toolkit case study: WannaCry attack. Www.england.nhs.uk. https://www.england.nhs.uk/long-read/case-study-wannacry-attack/

Obermeyer, Z., Powers, B., Vogeli, C., & Mullainathan, S. (2019). Dissecting racial bias in an algorithm used to manage the health of populations. Science, 366(6464), 447–453. https://doi.org/10.1126/science.aax2342

Pacilè, S., Lopez, J., Chone, P., Bertinotti, T., Grouin, J. M., & Fillard, P. (2020). Improving breast cancer detection accuracy of mammography with the concurrent use of an artificial intelligence tool. Radiology: Artificial Intelligence, 2(6), e190208. https://doi.org/10.1148/ryai.2020190208

Philips. (2024). AI-enabled solutions. Philips. https://www.philips.com/a-w/about/artificial-intelligence/ai-enabled-solutions
Ramirez, V. B. (2023, June 28). In a first, an AI-designed drug is being tested in humans to see if it actually works. Singularity Hub. https://singularityhub.com/2023/06/28/a-drug-designed-entirely-by-ai-is-starting-its-first-human-trials/

Robotnik. (2022, January 27). Application of robotics in the medical field & healthcare. Robotnik. https://robotnik.eu/applications-of-robotics-in-medicine/

Siemens Healthineers. (2024). AI-Rad Companion. Siemens Healthineers. https://www.siemens-healthineers.com/en-in/digital-health-solutions/ai-rad-companion
Silvestrini, E. (2021, March 10). da Vinci robotic surgery complications—risks and malfunction. Drug Watch. https://www.drugwatch.com/davinci-surgery/complications/

Yao, R. (2023, June 27). Insilico medicine uses generative AI to accelerate drug discovery. NVIDIA Blog. https://blogs.nvidia.com/blog/insilico-medicine-uses-generative-ai-to-accelerate-drug-discovery/

Zou, F., Tang, Y., Liu, C., Ma, J., & Hu, C. (2020). Concordance study between IBM watson for oncology and real clinical practice for cervical cancer patients in china: A retrospective analysis. Frontiers in Genetics, 11. https://doi.org/10.3389/fgene.2020.00200