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EDITORIAL

Artificial Intelligence in Healthcare - Opportunities and Challenges

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Introduction

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks typically requiring human intelligence. It involves creating algorithms and models to process information, learn from data, and make decisions or predictions. The field is rapidly evolving and has the potential to greatly impact society. AI can be divided into narrow AI, which performs specific tasks like image recognition or natural language processing, and general AI, which exhibits human-like intelligence across a wide range of tasks. Machine learning, a subset of AI, enables computers to learn and improve from experience without explicit programming. It involves training models with large datasets to recognize patterns and make informed decisions. Deep learning, a subfield of machine learning, uses artificial neural networks inspired by the human brain's structure. Deep learning models, known as deep neural networks, excel in tasks like image and speech recognition by learning complex data representations. Overall, AI has the potential to transform various domains, and machine learning, particularly deep learning, is instrumental in achieving state-of-the-art performance in many AI applications.

AI is a fast-evolving field with the potential to transform many industries, including healthcare, finance, transportation, manufacturing, and entertainment. Its applications can automate repetitive tasks, enhance decision-making processes, improve efficiency, and enable innovative problem-solving approaches. In healthcare, the interest in leveraging AI is understandable due to the potential benefits it can offer. AI systems have the power to reduce unjustified variances in clinical practise, increase productivity, and stop unnecessary medical errors that could have a negative influence on the lives of many patients. The emergence of deep learning models capable of generating content with minimal human involvement has piqued public interest and triggered discussions about AI's role in medicine and other domains. However, despite these advancements and prospects, it may come as a surprise that the integration of machine learning algorithms into clinical settings is still relatively limited.

Application of AI in healthcare

AI and machine learning have the ability to make significant contributions across multiple domains within healthcare. These technologies can be applied to areas such as the analysis of medical images, predictive analytics, drug discovery, personalized medicine, and clinical decision support systems. By leveraging AI and machine learning, healthcare professionals can benefit from more precise and accurate diagnoses, optimized treatment plans, improved patient outcomes, and increased overall efficiency in healthcare delivery.

Medical Imaging

AI algorithms have demonstrated significant potential in the analysis of medical images, such as X-rays, MRIs, and CT scans, to assist in disease detection and diagnosis. By utilizing machine learning techniques, AI algorithms can identify patterns and anomalies within these images, supporting radiologists in making more accurate interpretations. This can lead to improved early detection of various conditions, including cancer, cardiovascular diseases, and neurological disorders [1].

Diagnostics and Decision Support

Indeed, AI has the potential to analyze vast amounts of patient data, including medical records, lab results, and symptoms, to aid

in diagnosis, treatment planning, and clinical documentation. Machine learning algorithms can be employed to extract meaningful insights from this data, enabling AI systems to provide evidence-based recommendations to clinicians. By leveraging AI, healthcare professionals can access valuable support in identifying potential treatment options, predicting outcomes, and optimizing clinical decision-making. This technology has the capacity to enhance the efficiency and accuracy of healthcare delivery while ensuring that treatment plans are tailored to individual patients, ultimately improving patient outcomes.

Precision Medicine

AI can play a significant role in analyzing large genomic datasets to uncover genetic patterns, identify biomarkers, and identify potential drug targets. By leveraging machine learning and data mining techniques, AI algorithms can extract valuable insights from genomic data, enabling the development of personalized medicine approaches. This means that treatments can be tailored to an individual's specific genetic profile, allowing for more targeted and effective therapies.

Drug Discovery and Development

AI algorithms have the potential to analyze large quantities of biological and chemical data, leading to a faster drug discovery process [2]. AI can aid in the identification of potential drug candidates, forecast their effectiveness and safety profiles, and optimize the design of drugs. As a result, the development of new drugs can be accelerated, and costs can be reduced [3].

Remote Monitoring and Predictive Analytics

AI can identify patterns and trends by using machine learning algorithms, which enables the early detection of deterioration or illness progression. This can permit prompt interventions, lower the risk of readmission to the hospital, and enhance patient outcomes. AI can speed up patient education, literature reviews, and information summaries.

Virtual Assistants and Chatbots

Virtual assistants and chatbots powered by AI may communicate with patients, offer simple medical advice, respond to questions, and prioritise patients based on their symptoms. These systems can make healthcare information more accessible and help patients take control of their health.

AI-Bot Chat GPT

AI-Bot Chat GPT, or simply ChatGPT, is unsupervised deep learning AI-based conversational model powered by the GPT (Generative Pre-trained Transformer) architecture developed by OpenAI (https://chat.openai.com/) [4]. It uses deep learning techniques to generate plausible text responses (upto 50 K characters) to user inputs. ChatGPT has been trained on a diverse range of internet text to develop a broad understanding of language and can engage in conversations on a wide array of topics. It aims to provide helpful and natural-sounding responses to users' queries and prompts.

Challenges encountered in AI

It is difficult to translate AI research in a secure and timely manner into clinically verified and properly regulated systems that can benefit everyone. It is crucial to ensure the accuracy, understandability, and moral application of AI algorithms. AI models must be transparent and comprehensible, especially when making important judgements on medical care. To secure patient information, privacy and data security issues must also be resolved. Further work is required to reduce brittleness and enhance generalizability, eliminate algorithmic bias/unfairness themes, and improve interpretability of machine learning predictions [6].

Retrospective versus prospective studies

Most studies on AI translation in clinical practice have relied on retrospective data, which means they have used past data with known labels to train and test the algorithms. However, to truly understand how useful AI systems can be, we need to conduct prospective studies where the algorithms are tested on real-world data that may differ from the training data.

The absence of peer-reviewed, randomised controlled trials as the gold standard for evidence

The importance of high-quality peer-reviewed randomized controlled trials (RCTs) in reporting machine learning studies cannot be overstated. It is crucial for machine learning studies to adhere to best practice recommendations, such as the Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD) guidelines. By following these guidelines, researchers can ensure transparency and provide a solid foundation for evaluating the reliability and validity of their machine learning models.

Metrics often do not reflect clinical applicability

It is crucial for clinicians to comprehend how proposed algorithms can enhance patient care within their existing workflow. However, many research papers fail to address this aspect. To address this gap, potential approaches have been proposed, such as decision curve analysis. This method aims to quantify the overall benefit of using a model to guide subsequent actions, providing a more comprehensive understanding of the clinical applicability and impact of the algorithm.

Difficulty in Comparing Several Algorithms

Comparing algorithms across studies in an objective manner poses challenges due to the variability in methodologies, populations, sample distributions, and characteristics used in each study. To ensure fair comparisons, it is essential to subject algorithms to evaluations on the same independent test set that accurately represents the target population. Additionally, using consistent performance metrics is crucial. Without these standardized practices, clinicians may struggle to determine which algorithm is most likely to deliver optimal performance for their patients.

Difficulties in Generalising to New Population and Circumstances

Most AI systems currently lack reliable generalizability and clinical applicability for a wide range of medical data types. These systems often suffer from limitations and blind spots that can lead to erroneous and detrimental decisions. To address these challenges, it is necessary to incorporate site-specific training methods to adapt existing AI systems for new populations. This is especially crucial for complex tasks such as electronic health record (EHR) predictions. By tailoring the training process to specific healthcare settings and populations, AI systems can be fine-tuned to improve their performance and ensure better clinical applicability.

Present area of healthcare in which AI has been established and evolving

Public health

- Outbreak identification by internet traffic monitoring
- Contact tracing during outbreak
- Tracking of cases, association with local risk factors, outcomes.

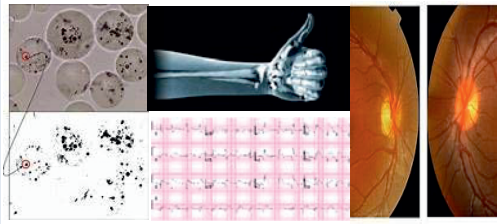
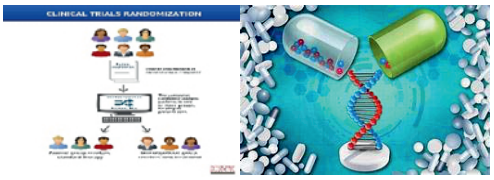


Image Analysis

- Real time diagnostic decision support
- Risk stratification for early detection/diagnosis
- Reduced need for intervention such as biopsies
- Improved diagnostic confidence
- Enables precision medicine (individualized therapy)
- Reduced missed diagnoses



Clinical trial, Drug discovery and development

- Support for decision-making during trial planning, patient identification, recruitment, and retention Monitoring of outcomes and adverse effects, remote database monitoring.
- Tracking of cases, association with local risk factors, outcomes.

Retrieval of Medical Information

- Utilization of multiple source of information about the patient to help in making diagnosis.
- Use of internet search engine.

Operations and Administration

- Billing
- Patient data collection, and follow-up

Future area of healthcare in which AI has begun to have an influence

- Giving in-person guidance on specific inquiries to make with respect to a patient's medical history or physical examination findings to look for. Listening and writing a clinical notes.
- Serving as a teacher and an assessor in medical education.

Logistical difficulties in Implementing AI Systems

The problem lies in the fragmented nature of data storage in various medical systems such as imaging archives, pathology systems, electronic health records (EHRs), electronic prescribing tools, and insurance databases. It is challenging to integrate these disparate data sources. While the implementation of standardized data formats like Fast Healthcare Interoperability Resources (FHIR) holds promise for better data aggregation, it does not directly address the issue of inconsistent semantic coding in EHR data.

Achieving robust regulation and rigorous quality control

Creating a proactive regulatory framework will instill trust in clinicians and healthcare systems. It is crucial to acknowledge that AI learning is an ongoing process, and it is preferable to incorporate regular system-wide updates accompanied by evaluations of clinical significance.

Human barriers to AI adoption in healthcare

Even with the presence of highly effective AI systems that overcome the aforementioned challenges, significant barriers to AI adoption in healthcare persist due to human factors. It remains crucial to prioritize clinical applicability and patient outcomes, while also advancing algorithmic interpretability methods. Additionally, efforts should be made to improve the understanding of the interactions between humans and computers in healthcare settings.

Despite the increasing importance of AI in healthcare and research on healthcare students' knowledge and attitudes towards AI, few studies incorporate the best evidence and provide overviews in this subject [7]. In this regard, the work by Mishra et al. [8] published in this issue of the journal is important. The authors utilized a prospective observational survey to investigate Knowledge and Attitude about AI in Medicine among 395 Under-Graduate Students of a tertiary care institution in North India's. To collect information about artificial intelligence and its deployment, a validated pre- and post-test questionnaire was created. The majority of the study's participants were men (55%), with an average age of 23 years.

The study by Mishra et al had many interesting conclusions. Nearly half of the undergraduates (49.5%) had never heard of AI. This may worry medical schools because it is predicted that future doctors would fall behind in the transition to an AI-driven healthcare system. The majority of college students do not think that AI can be used for good and improve diagnostic capabilities in medicine. However, following educational efforts, knowledge and attitude have changed. Face-to-face instruction, training manuals, and thorough instructions are therefore essential for putting AI technology into use, understanding how it operates, and increasing students' awareness of its benefits.

Conclusion

Recent advances in AI give an exciting prospect to improve healthcare. However, most healthcare data are not freely available for machine learning, necessitating rigorous evaluation of ethical, legal, and societal concerns. Robust, prospective clinical assessments will be required to confirm that the AI system is safe and effective, as well as to quantify technical correctness in order to incorporate how AI affects quality of care, clinical practise productivity, and patient outcomes. Continued research, awareness and educational activities, open debate, and collaborative efforts will be required to fully utilise AI's capabilities while guaranteeing patient safety, privacy, and equitable access to healthcare.

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