Review Article

Artificial Intelligence: its Future and Impact on Acute Medicine

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Abstract

This commentary explores the potential impact of artificial intelligence (AI) in acute medicine, considering its possibilities and challenges. With its ability to simulate human intelligence, AI holds the promise for supporting timely decision-making and interventions in acute care. While AI has significantly contributed to improvements in various sectors, its implementation in healthcare remains limited. The development of AI tools tailored to acute medicine can improve clinical decision-making, and AI's role in streamlining administrative tasks, exemplified by ChatGPT, may offer immediate benefits. However, challenges include uniform data collection, privacy, bias, and preserving the doctor-patient relationship. Collaboration among AI researchers, healthcare professionals, and policymakers is crucial to harness the potential of AI in acute medicine and create a future where advanced technologies synergistically enhance human expertise.

Keywords

Artificial Intelligence, Machine learning, Data, Acute Medicine, Prediction

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Introduction

In 2016, a historic moment unfolded in artificial intelligence (AI) as the world witnessed AlphaGo, a computer program, defeating the reigning world champion of the ancient Chinese board game Go[1]. This pivotal event showcased AI's potential to exceed human capabilities in complex tasks requiring intuition, strategy, and decision-making - qualities equally crucial in the medical arena. The influence of AI extends far beyond the realm of board games, and the rapid advancement of AI technology is slowly but surely starting to impact the healthcare industry.

AI, a branch of computer science focusing on developing machines capable of simulating human intelligence, holds considerable promise for supporting acute medicine, where timely decision-making and effective interventions can be crucial for patient outcomes. As AI continues to evolve, there is increasing recognition of its potential to augment healthcare professionals' capabilities and improve healthcare services' quality and efficiency. By leveraging sophisticated algorithms and vast amounts of data, AI systems can analyze complex medical information, detect patterns, and support clinical decision-making in (acute) care settings. In this commentary, we will explore the concept of AI in healthcare, specifically its potential impact on acute medicine. We will examine its current landscape, future possibilities, and the challenges and considerations accompanying its integration.

Historical Perspective and Current Landscape

The origins of AI can be traced back to the seminal work of Sir Alan Turing, who questioned whether machines could think, and Dr. John McCarthy, who coined the term "artificial intelligence" in 1956. However, it is only in the relatively recent past that AI has made substantial and tangible contributions to various aspects of society, including the healthcare sector. With the shift to electronic health record (EHR) systems and monitoring devices, data-driven approaches in medicine gained momentum in the early 2000s. As physicians became increasingly inundated with data, AI solutions emerged to navigate the abundance of information and generate actionable insights. Rapid advancements in computing power during that time enabled increasingly sophisticated data analyses and algorithmic computations. There has been a remarkable surge in published studies on clinical AI tools in the last decade, exceeding 62,000 as of June 2023[2]. However, the most recent data from the US Food & Drug Administration (FDA) reveals that only 251 AI tools have received approval for medical use, with the majority concentrated in Radiology and Cardiovascular medicine[3]. The approved tools primarily focus on assessing electrocardiograms, laboratory results, and different imaging modalities, thus indirectly supporting patient care. However, there remains a scarcity of tools that directly enhance clinical practice by offering decision-making support for diagnostic or treatment procedures, especially in acute care. The notable disparity between the development and implementation of clinical AI tools, especially compared to other sectors, can be attributed to various factors, including an inadequate involvement of end-users (e.g., physicians) during development of clinically relevant algorithms, performance degradation over time and in new settings, insufficient evidence of clinical benefits, and a limited drive to change existing practices among healthcare professionals[4]. In the context of acute medicine, the diverse nature of care and the variability in data collection during the acute phase poses additional challenges in developing AI tools to support the diagnostic workup and treatment[5].

The Positive: Possibilities and Potential Impact

Now, equipped with a general understanding of AI's history in medicine, we can delve into its potential for enhancing acute care. The applications of AI in this domain hold immense possibilities, with notable focus areas including triage, providing suggestions for diagnostic workup, supporting clinical decision-making concerning medications and interventions, and offering accurate prognoses of disease progression or outcomes[6]. Over the last few years, we have seen the first examples of such tools being developed and tested within research environments, such as a risk prediction model to support ambulance transport decisions[7], an AI triage tool in the emergency department (ED)[8], a screening tool for early sepsis detection[9], a blood culture stewardship tool[10], a machine learning tool for predicting ciprofloxacin resistance[11], an AI audit system to minimize prescription errors[12], a tool for estimating time to emergency readmissions[13], and a model to predict admission to the neuro intensive care unit directly from the ED[14]. Furthermore, there is potential in harnessing AI tools before patients reach the ED or an acute care setting, leveraging data from devices and smartwatches for remote patient monitoring, alerting in a timely manner, and triage[15].

As time progresses, these tools will undergo rigorous testing and integration into practice, addressing their specific tasks and domains. The inherent diversity within the acute care setting presents challenges in developing comprehensive AI tools that can effectively manage the varying needs of all patients. Currently, those tools necessitate a selective approach, targeting specific problems and patient populations. However, in the more distant future, these systems hold the promise of expanding and interconnecting, enabling comprehensive clinical decision-making across the entire spectrum of acute care for individual patients.

While it will take some time to experience the impact of clinical AI tools, particularly given the need for cautious evaluation[16], AI in acute medicine may have more immediate effects in streamlining administrative tasks. The recent global hype surrounding Large Language Models (LLMs) for text generation, exemplified by the introduction of ChatGPT in November 2022, has refocused attention on leveraging AI to automate laborious administrative processes that burden the healthcare system[17]. ChatGPT has demonstrated its ability to generate high-quality discharge summaries by analyzing hospital visit notes[18]. It has prompted several hospitals to explore its integration into electronic health record systems for pilot testing in generating discharge letters. In this regard, AI is poised to make its way into the medical arena swiftly.

The Negative: Challenges and Considerations

While the potential of AI in acute care is promising, its translation to clinical practice faces many barriers[4]. Although various sectors, such as travel and banking, have embraced the use of AI, its integration into the healthcare sector has been comparatively slower. One of the critical technical challenges lies in robust data collection and interoperability, exacerbated by the inconsistent and unreliable nature of data in electronic health records (EHRs) due to poor uniformity in data entry practices among healthcare professionals[19]. On top of that, acute care encompasses a wide range of conditions and settings, resulting in varying data points measured for different patients, which adds to the complexity and heterogeneity of the data. This diversity poses significant obstacles to developing comprehensive AI model. Standardizing data collection methods, harmonizing data formats, ensuring interoperability across different healthcare systems and devices, and conducting randomized controlled trials of algorithms are critical steps in overcoming these challenges and harnessing the full potential of AI.

Ethical considerations also come to the forefront in the application of AI, particularly concerning patient privacy and control. Protecting patient data, allowing patients to control their data, and ensuring compliance with privacy regulations are paramount[20]. These concerns become particularly crucial when dealing with free text data and other healthcare documents, as the unstructured nature of these data may unknowingly contain sensitive information. It is essential to implement appropriate anonymization and data de-identification techniques when mining free text fields to safeguard patient privacy. The recent introduction of ChatGPT has shed light on these concerns, as privacy breaches have led to temporary shutdowns of the tool in various countries while awaiting further investigation[21]. These incidents highlight the pressing need to address privacy challenges and establish robust data protection mechanisms when implementing AI in healthcare settings.

Addressing bias in AI algorithms is another critical ethical consideration. Biased algorithms can perpetuate disparities in healthcare outcomes, reinforcing existing inequalities. Ensuring that AI tools are trained on diverse and representative datasets, accounting for various demographic groups and clinical scenarios, is essential. Transparency and accountability are also integral to ethical AI deployment[4]. Healthcare professionals, patients, and other stakeholders should have access to clear and understandable explanations of AI algorithms and their decision-making processes. Furthermore, an additional challenge arises from the highly lucrative nature of developing clinical AI tools, which has resulted in the proliferation of proprietary algorithms. The added layer of concealment to protect intellectual property makes it even more difficult for physicians to gain meaningful insights into the inner workings of these algorithms[16]. Establishing transparent practices and guidelines for AI development and deployment builds trust, enhances explainability, and enables meaningful collaboration between AI systems and human caregivers.

Finally, the potential impact of AI on the doctor-patient relationship should be carefully considered. While AI can improve clinical decision-making, it is vital to maintain the human element and ensure that AI is used as a supportive tool rather than replacing the expertise and judgment of healthcare professionals. Striking the right balance between AI-driven automation and human involvement is essential to avoid the potential pitfalls of over-reliance on technology.

A use case: blood culture predictions in the emergency department

To provide a concrete example illustrating the challenges and considerations in developing medical AI, we will share our team's experience with an AI tool for predicting blood culture outcomes in the emergency department, which may help withhold unnecessary analyses for low-risk patients[10]. After obtaining ethical approval and privacy clearance for a retrospective study, we could quickly access the data through with help of our business intelligence unit. However, extensive cleaning procedures were required to eliminate erroneous data points. Once the data were cleaned, the development of a prediction model prioritizing explainability and adaptability was relatively swift. External validations involved gathering data from multiple centers, necessitating time-consuming efforts, including data sharing agreements, adherence to local protocols, and clearance from privacy officers and boards of directors. Interoperability issues between systems, and varying data formats between centers, posed additional roadblocks and required extra efforts by the study team. When the model was validated and finalized, it was subsequently integrated into the clinical workflow of our EHR system, requiring substantial investment and frequent update meetings with the business intelligence unit. After running the model in the background of the EHR system for several months, without predictions being visible to the physicians, we observed that its real-time performance aligned with the development phase. Still, continuous monitoring will always remain necessary to detect potential performance drifts. We then "locked" the model to pursue a randomized trial to evaluate its potential clinical benefits. Ethical approval guidelines for AI trials and certifications in healthcare have not kept pace with AI advancements, and often still mandate static, "locked" models, limiting the use of more robust continual learning methods and retraining. The process of ethics approval has thus far taken over a year, as both local and national regulatory bodies are involved when testing software as a medical device. Despite the project spanning several years and presenting numerous challenges, we have made significant progress and are poised to conduct one of the first and largest randomized trials with an AI tool in acute care. The project's success thus far can be attributed to interdisciplinary collaboration, leveraging expertise from diverse fields, and a clear focus on selecting a well-defined situation with predictable outcomes and considering the potential clinical use and impact from the outset. It is crucial to prioritize the clinical application and impact in the early phases of clinical AI modeling for long-term success, an aspect that is often overlooked.

Conclusions

In conclusion, we examined the potential impact of AI in acute medicine, considering both the possibilities and challenges associated with its integration, and using our personal experience to further illustrate those challenges. AI has the potential to significantly impact acute medicine by enhancing clinical decision-making and consequently improving patient outcomes. Tailored AI tools for acute care hold promise for the future, while the use of AI in streamlining administrative tasks offers immediate benefits. Interdisciplinary collaboration among AI researchers, healthcare professionals, and policymakers is crucial to overcome challenges related to data collection, interoperability, privacy, bias, transparency, and preserving the doctor-patient relationship. By addressing these challenges, we can utilize the full potential of AI in acute medicine and create a future where advanced technologies synergistically enhance human expertise to deliver high-quality care to patients in need.

Conflicts of Interest

All authors have nothing to disclose

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