ChatGPT and Large Language Models in Healthcare: Opportunities and Risks

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***Abstract*—ChatGPT, a pre-trained large language model (LLM), has the potential to transform healthcare by providing valid clinical insights and reducing doctors' workload. There are already signs that such tools can be useful for automating the generation of patient discharge reports, clinical vignettes, and radiology reports. Such tools can also capture the vast medical knowledge base as demonstrated by ChatGPT clearing the United States Medical Licensing Examination (USMLE). Such tools promise to make healthcare more accessible, scalable, and efficient, leading to better patient outcomes. However, such tools are far from perfect and well-known to be susceptible to error, misinformation, and bias. In this paper, we review the potential applications of ChatGPT in healthcare and also identify potentials risks that must be addressed before ChatGPT and other LLM tools can be safely adopted in healthcare. First, we offer case studies on using ChatGPT for passing USMLE, identifying prevention methods for cardiovascular disease, generating patient discharge reports, generating clinical vignettes, and generating radiology reports. Second, we present the opportunities that ChatGPT offers in healthcare. By leveraging its language generation and processing capabilities, ChatGPT can streamline and improve a range of healthcare tasks, from digitizing clinical notes and improving the accuracy of diagnosis to revolutionizing medical education and empowering patients with personalized healthcare information. Finally, we reflect on the associated risks and conclude that caution is advised in interpreting the results of ChatGPT as these studies are preliminary and not entirely error-free.**

***Index Terms*—ChatGPT, Healthcare, Large Language Models, Medical Artificial Intelligence, Natural Language Processing.**

I. Introduction

Artificial Intelligence (AI) penetrating mainstream healthcare is not a new phenomenon, though it has recently acquired speed. Efforts are now underway to educate doctors about AI methods in healthcare. For example, Hu et al. [1] reported an attempt to provide a five-week training workshop on AI in medicine, a curriculum specifically designed for medical students to tailor the scope to clinical healthcare. The workshop has been offered three times now, reflecting its effectiveness and potential impact in bridging AI and healthcare. As of writing this, more than 500 AI algorithms for healthcare have received FDA clearance [2], [3]. Despite the fact that the FDA cleared the first AI algorithm in 1995, the momentum in clinical healthcare AI has primarily been witnessed only recently, with over 300 AI products receiving FDA clearance during the last four years, as summarized in Fig. 1. Notably, a significant portion of these AI products is for radiology-based studies, as can be seen in Fig. 2. However, the development of AI for text-based clinical studies, including the more complex unstructured clinical notes, is yet to reach maturity. In this connection, ChatGPT carries disruptive potential that can facilitate our ambitions of new horizons in clinical healthcare. With ChatGPT demonstrating a promising prospect in healthcare, we provide a discussion on the future of healthcare and the opportunities offered by ChatGPT.

ChatGPT is a pre-trained large language model (LLM) that employs advanced AI techniques, including Reinforcement Learning from Human Feedback (RLHF), to generate coherent and grammatically correct text. Healthcare professionals can utilize ChatGPT's human-like text generation to make informed decisions about diagnoses and treatments, improving patient outcomes and reducing healthcare costs. ChatGPT's potential to transform patient care by analyzing large amounts of medical data and providing personalized insights to doctors makes it promising for the healthcare industry.

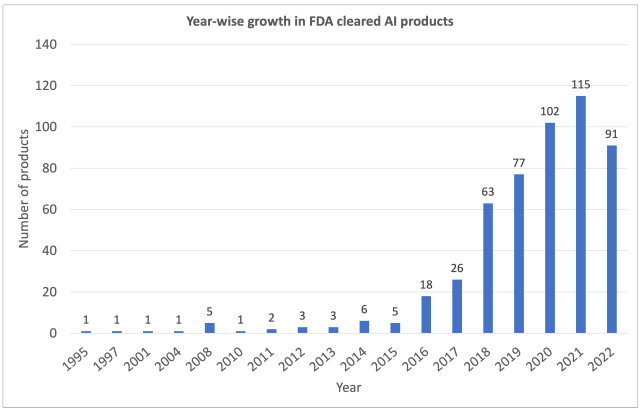

Fig. 1: Year-wise number of products with FDA clearance (data from [3]).

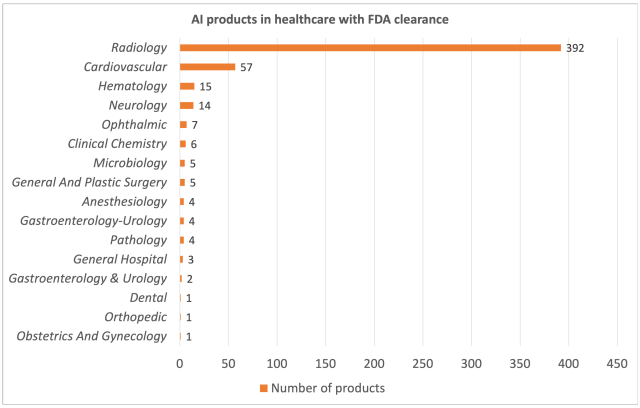

Fig. 2: Summary of healthcare AI products with FDA clearance. AI products using radiology lead in number compared to other modality (data from [3]).

ChatGPT has demonstrated impressive strengths in global accessibility, scalability, processing speed, and learning from feedback to remain up-to-date with medical knowledge and guidelines. Speed is a major strength of ChatGPT. ChatGPT can access and process terabytes of data in a time of the order of seconds. Thus, ChatGPT can help in improving the speed of diagnosis, particularly when patients may have difficulty describing their symptoms or cases where a decision would require doctors to go through large piles of reports and clinical notes. These capabilities have the potential to enhance patient care and medical decision-making, but significant risks associated with vulnerabilities like hallucinations and non-factual information must be addressed. It is necessary that ChatGPT's reliability and safety be subjected to a thorough clinical validation before implementing it in healthcare in line with the Hippocratic principle of "do no harm." In this paper, we aim to highlight the various opportunities and use cases for using ChatGPT in healthcare settings, as well as the challenges and risks that must be addressed before widespread adoption. We note that while this paper's discussion is mostly focussed on ChatGPT, these also extend more or less to other LLMs, for example, Google Bard[1], Meta LLaMA[2].

II. Recent Applications in Healthcare

ChatGPT can be very useful for report generation. In a study [4], ChatGPT was utilized to generate a patient discharge report using a brief prompt. Notably, the discharge report produced by ChatGPT included additional details that were not specified in the prompt (although this can be a potential drawback if incorrect information is included). Additionally, in [5], ChatGPT was employed to rephrase and summarize radiology reports, highlighting its potential to reduce patient waiting times and alleviate the workload of healthcare professionals. ChatGPT can also be used to assist in creating clinical vignettes, which are a valuable tool for healthcare education. A recent study [6] utilized ChatGPT to generate clinical vignettes that focused on common childhood diseases. In addition, ChatGPT was able to modify these vignettes to suit different literacy levels and perspectives, such as those of parents or physicians. The study also examined ChatGPT's ability to predict diagnoses from the vignettes, achieving a diagnostic accuracy of 75.6% on a set of 45 vignettes, which is comparable to physicians' performance of 72% on the same set.

ChatGPT excels in comprehending input prompts and generating natural text in a conversational style. In [7], doctors from Cleveland Clinic and Stanford University evaluated ChatGPT's responses to questions about cardiovascular diseases, finding 21 out of 25 responses "appropriate". On top of it, ChatGPT provided "comprehensible reasoning and valid clinical insights" while explaining the responses. In [8], ChatGPT's ability to pass the United States Medical Licensing Exam (USMLE) was evaluated, with scores close to the threshold achieved for all three exams. The USMLE encompasses a diverse range of medical knowledge, including basic biology, clinical rationale, medical management, and biomedical ethics. It is worth mentioning that preparation for the step 1 exam of the USMLE would usually require a dedicated study of more than 300 hours. Furthermore, passing the examination requires trained doctors and physicians to have acquired multiple years of training in clinical knowledge, management, and ethics.

III. Opportunities

Below are ChatGPT's potential significant contributions to healthcare (see Figure 3).

Report Summarization and Auto-Completion: The strength of ChatGPT lies in text generation, hence, it can be adopted for sentence completion in clinical notes, eventually saving the doctors' time, as demonstrated in [4], [5].

Knowledge Extraction from Unstructured Text: Clinical notes and electronic health records are mostly unstructured data. ChatGPT can extract key information from unstructured clinical notes and turn this into structured notes or use it to

[1]https://bard.google.com/

[2]https://ai.facebook.com/blog/large-language-model-llama-meta-ai/

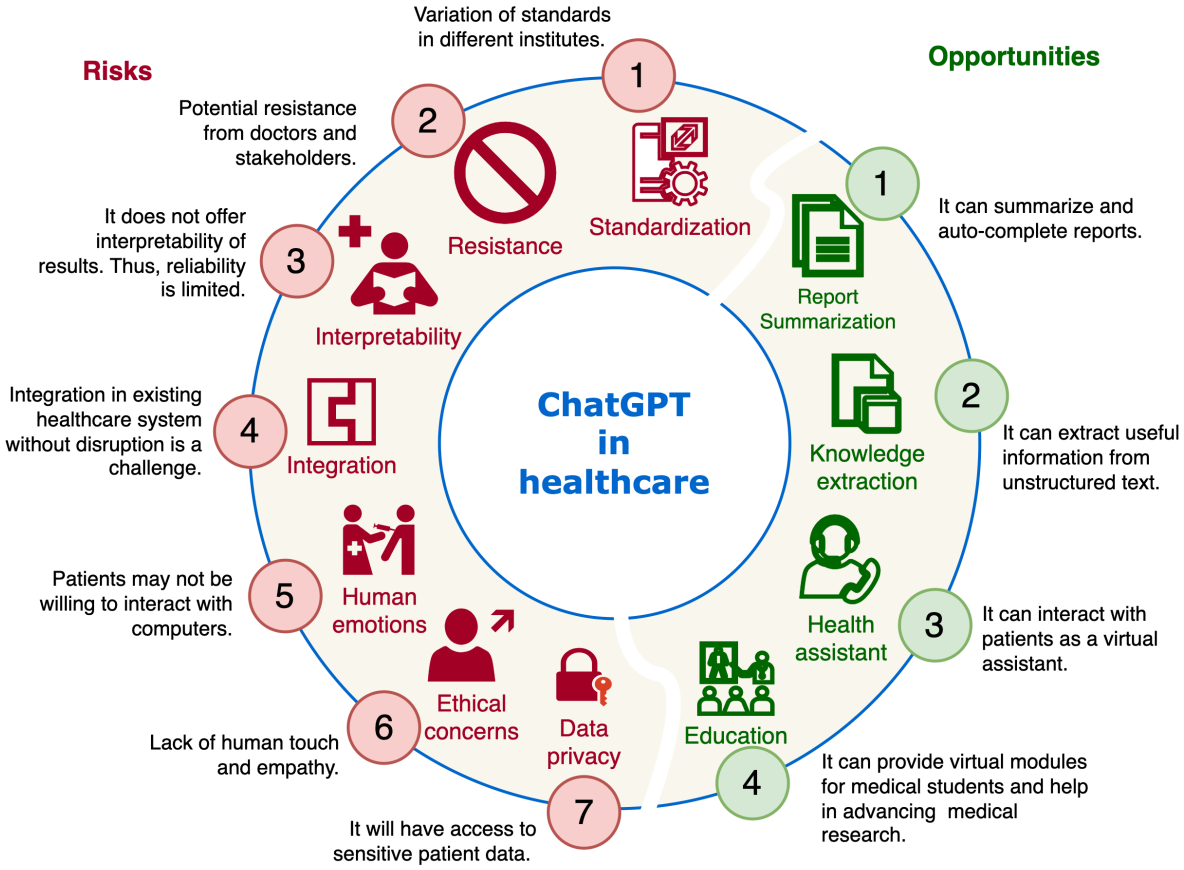

Fig. 3: Key opportunities and risks for ChatGPT in healthcare.

generate electronic health records. Thus, digitizing of healthcare data will also be supported.

Personal Health Advice: Ideally, ChatGPT can access all the publicly available medical data on the Internet. Hence, it can be fine-tuned on authentic medical literature and standard clinical guidelines [6]. Thus, it can be used as a basic diagnosis and personal consultancy tool, eventually reducing the workload from primary healthcare centers. As demonstrated in [7], ChatGPT will open new ways for the public to interact with digital healthcare and personalized medicine consultancy.

Accessible Customized Content: ChatGPT can generate text from the first-person perspective of naïve individuals as well as expert physicians. Accordingly, it can input the text related to disease symptoms given by low literacy patients, restructure them as if they were written by expert physicians, and provide suitable diagnoses. Effectively, this would empower patients and lead them to make informed decisions.

Medical Education and Research: A relatively straightforward application of ChatGPT is to use it for medical education purposes. So, it could be used to provide virtual training modules to medical students worldwide, particularly those with limited access to training material. Overall, it will transform medical education through democratizing and disseminating knowledge [6]. Similarly, it will also revolutionalize the education of patients who can get personalized healthcare information. Likewise, ChatGPT will help in advancing medical research through faster analysis of large medical data, identification of complex patterns in healthcare data, and relationship extraction for drug design.

IV. Risks

Current studies on ChatGPT are preliminary and not necessarily completely free from errors. So, caution is advised while interpreting the results, as reported by the studies [4], [5]. While ChatGPT has many potential opportunities in healthcare, some of the risks associated with the use of ChatGPT in healthcare, are summarized below.

Ethical concerns: ChatGPT is a computer program and cannot be a substitute to human touch and empathy that doctors and medical professionals provide. So, patients may feel uncomfortable with a machine diagnosing them. Eventually, healthcare may lead to dehumanization. Lack of transparency, accountability, explanability, and fairness are fundamental concerns associated with results generated by ChatGPT.

Human emotions and respect: Patients interacting with ChatGPT-based tools may feel they are not being treated with the respect and dignity that they deserve, and may not be willing to divulge their full medical history to a machine.

Data privacy: In healthcare, data privacy is a critical concern, and patient data must be protected at all times. ChatGPT

requires access to sensitive patient data to provide personalized recommendations, which raises concerns about data security and privacy. It is essential to ensure that appropriate measures are in place to protect patient data and that patients are fully informed about the use of their data.

Interpretability and Reliability: ChatGPT's recommendations lack transparency due to its opaque nature, which hinders acceptance from healthcare professionals where explainability is vital. Additionally, biases in the training data may affect accuracy and lead to incorrect diagnoses or treatment recommendations. It is crucial for medical professionals to carefully review and validate ChatGPT's recommendations before using them in clinical decision-making.

Standardization: There is currently a lack of standardization in the implementation of ChatGPT in healthcare. This means that the way the model is used and the types of data it is trained on can vary widely between institutions and healthcare systems. This lack of standardization can make it difficult to compare and evaluate the performance of different ChatGPT models, and it can also lead to inconsistencies in patient care.

Integration with existing healthcare systems: The integration of ChatGPT with existing healthcare systems presents a significant challenge as healthcare systems are complex. ChatGPT must be integrated into existing electronic health record systems and clinical workflows without disrutption to the existing clinical workflows. For developing economies where the digital divide is huge and healthcare data is not entirely digitized, the potential of ChatGPT will be restricted due to a lack of usable data.

Resistance from stakeholders: Incorporating ChatGPT into healthcare does not necessarily imply that doctors will benefit from the financial gains; rather, corporates may do so. Potential resistance from doctors cannot be ruled out, as they will not benefit from the revenue generated. Private healthcare that incorporates such systems may tend to ask for an increased price as a cost for their faster and better systems.

Tradeoffs between human errors and machine errors: Both humans and machines are fallible and have their own strengths. Hospitals and healthcare centers have shown to be susceptible to patient safety lapses, with a reported 25% of patients in hospitals experiencing harm due to human errors [9]. Similarly, ChatGPT can make mistakes, including hallucinating non-factual information and providing biased advice [10]. The question of how to use these tools in medical education can benefit from the educational insights developed in other domains [11]. It is important to develop a hybrid human-machine based system with a functional split that leverages the strengths of both humans and machines and mitigates the errors made by both.

V. Conclusion

ChatGPT has proved to be a disruptive technology tool for natural language processing and medical AI applications. In this paper, we presented the potential of ChatGPT to transform healthcare. Through a brief discussion of the case studies, we showed that ChatGPT has attracted doctors and healthcare researchers to use it for diagnosis, clinical note generation, and medical education. We listed key opportunities offered by ChatGPT in the healthcare domain. Finally, we have also provided a brief description of the associated challenges and preventive measures that one must consider while using the tool in healthcare applications. While the discussion around opportunities in transforming healthcare is focussed on ChatGPT, many of the insights and possibilities discussed here would be equally applicable to other language models as they are now pouring in (for example, Google Bard, Falcon, Meta LLaMA). The field of LLMs is rapidly evolving, with new knowledge and models continuously emerging. It is not uncommon for new concepts to be developed and novel results to be published while we are drafting this work. This dynamic nature of the field emphasizes the importance of continually updating and remaining adaptable in our comprehension and utilization of ChatGPT/LLMs.

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