Global Transitions 5 (2023) 50–54

Contents lists available at ScienceDirect

Global Transitions

journal homepage: www.keaipublishing.com/en/journals/global-transitions/

ChatGPT and global public health: Applications, challenges, ethical considerations and mitigation strategies

ABSTRACT

The advancement of deep learning and artificial intelligence has resulted in the development of state-of-the-art language models, such as ChatGPT. This technology can analyze large amounts of data, identify patterns, and assist in the analysis and understanding of risk factors for diseases. Despite its potential, the applications, challenges, and ethical considerations have not been yet fully explored in global health research. This paper examines the applications of ChatGPT in global health research, assesses the challenges in its use, and proposes mitigation strategies. Additionally, it describes the ethical considerations around the use of ChatGPT in global health research and suggests potential avenues for addressing these issues. This paper summarizes that it is crucial to understand the capabilities and limitations of this technology in order to fully realize its potential and ensure its responsible integration into global health research.

1. Introduction

The field of artificial intelligence (AI) has undergone substantial advancements in recent years, leading to the development of innovative technologies such as the Chat Generative Pre-Trained Transformer (ChatGPT) algorithm by OpenAI (San Francisco, CA, USA). ChatGPT is a pre-trained language model based on deep learning and AI that can process enormous volumes of data and uncover complex patterns virtually in any discipline [1]. It uses deep learning techniques to generate human-like text and has been trained on a vast corpus of diverse text data from the internet, which allows it to generate coherent and semantically meaningful text [2]. The training of the ChatGPT model is based on reinforcement learning, which incorporates feedback from human evaluators, including those who screen and label toxic text. This training methodology allows for real-time adaptation of the model's behavior in response to input from human reviewers. The utilization of reinforcement learning has resulted in a substantial improvement in the ChatGPT model's ability to understand user intentions, produce text that closely mimics human language, and sustain coherence throughout conversations [3]. This algorithm has the potential to be included in advanced healthcare research aiding in the creation of novel medicines and detection of disease risk factors.

ChatGPT has been increasingly used in healthcare research because of its ability to generate human-like content and to understand natural language inputs [4]. The model's ability to process large amounts of unstructured data quickly and accurately, makes it well-suited for a wide range of natural language processing tasks in healthcare research such as medical coding, clinical trial recruitment, and natural language understanding (NLU) of electronic health records (EHRs) and medical literature [3]. For instance, a recent paper discussed the potential of ChatGPT in the field of public health [5]. The author highlighted the importance of effective communication in public health and suggested that ChatGPT can be a useful tool for personalized health information, health education, and risk communication.

Another recent article [6] analyzed various clinical and research scenarios, including mental health counseling, patient triage, and medical risk factor identification. The authors found that while ChatGPT demonstrated promising results in some scenarios, such as patient triage, it posed several challenges in others, such as mental health counseling. The study also revealed potential ethical concerns regarding the use of ChatGPT in healthcare, including the risk of perpetuating societal biases in the model's outputs and the need to ensure patient privacy and confidentiality. The authors suggest that addressing these concerns will require the development of more robust techniques for detecting and correcting biases in language models, as well as ensuring that patient data is appropriately secured and protected.

The applications of ChatGPT as a tool for helping to advance global health research are wide and promising. However, little has been explored in this regard to identify its potential roles and bioethical implications in global health research. In this paper, we analyzed the applications of ChatGPT in global health research, its challenges, and mitigation strategies. We also discussed some of the ethical issues related to the use of ChatGPT and suggested ways forwards to address them.

https://doi.org/10.1016/j.glt.2023.05.001
2589-7918

2. Application of ChatGPT

2.1. Global health research — How ChatGPT can be used in global health research?

ChatGPT has a number of potential applications in global health research. One notable application is the analysis of administrative health data and electronic health records (EHRs) to facilitate the extraction of meaningful information. EHRs contain critical data about patients, including medical history, symptoms, and test results, which can inform improved patient outcomes [7]. The use of ChatGPT for the analysis of EHRs can make the process more efficient and may help reduce the risk of human error. For example, researchers from Stanford University measured the extent that clinical prediction models that leverage language model-based representations outperform those that rely on engineered features or simpler representation learning techniques. The authors found that language models are significantly better than a wide array of alternative representations for training clinical prediction models across a range of training set sizes [8]. Similarly, Rajkomar et al. applied deep learning algorithms in healthcare, specifically with regards to the processing and analysis of EHRs. They argue that deep learning techniques can lead to improved accuracy in various healthcare tasks, such as diagnosis and prediction, and can be scaled to handle large amounts of EHR data [9].

ChatGPT can be used to analyze community health data to predict future health outcomes. For example, ChatGPT can analyze routine health data to predict the risk of certain diseases in a community, such as diabetes or cardiovascular diseases enabling early detection and rapid response thereby reducing the spread of infectious diseases [10]. Subsequently, ChatGPT can also be potentially utilized to improve the accuracy and efficiency of disease surveillance in community health settings. A recent article discussed how ChatGPT could be utilized to provide accurate and timely advice on antimicrobial use, thereby reducing the burden on consulting infection doctors and improving patient outcomes [11]. The article highlights how ChatGPT can provide evidence-based guidance on antimicrobial use, taking into account factors such as patient history, microbiological results, and local resistance patterns. This could potentially reduce the need for consulting infection doctors to provide advice, thereby freeing up their time for more complex cases and reducing the risk of antibiotic overuse.

The authors also acknowledge the potential challenges of implementing ChatGPT in clinical practice, such as concerns about the reliability and safety of the model's outputs, as well as ethical considerations regarding data privacy and patient consent.

ChatGPT can be used to generate educational materials on various health topics promoting better health education in the community. For example, it can be used to generate easy-to-understand educational materials on the causes and prevention of infectious diseases. It can also be used to facilitate virtual consultations between patients and healthcare providers, particularly in rural and remote communities where access to healthcare is limited. ChatGPT can also be used to provide information and support to patients in real-time, improving the quality of care they receive [12,13].

Another potential application of ChatGPT in global health research is in the field of drug discovery [14]. Natural language processing (NLP) has become an essential tool in the drug discovery process, helping researchers to analyze vast amounts of data from a variety of sources. One of the most promising applications of NLP in drug discovery is the use of language models such as ChatGPT to perform tasks such as text mining, chemical data analysis, and toxicity prediction. ChatGPT has the potential to analyze large datasets of scientific literature and databases, identifying potential drug targets and predicting how compounds may interact with protein targets. It can also predict the toxicity of new compounds, which is a major challenge in drug discovery. In addition, ChatGPT can analyze drug-drug interaction data and clinical trial data, providing valuable insights into potential drug interactions and the most promising drugs for clinical trials. By leveraging its language processing capabilities, ChatGPT can help researchers to accelerate the drug discovery process and identify new treatments for a wide range of diseases. The identification of genetic abnormalities in underlying diseases is critical for developing novel therapies [12]. ChatGPT can analyze vast amounts of genomic data to identify new therapeutic targets. Furthermore, ChatGPT can aid in drug development process by enabling the identification of compounds that bind to specific sites and inhibit disease-causing proteins [15].

2.2. Global health education — How ChatGPT can be used in global health education?

The potential applications of ChatGPT technology in the field of global health academia are numerous and diverse. One of these is in the analysis of scientific literature [16]. Scientific publications contain a vast amount of information, and manual identification of relevant information can be time-consuming and labor-intensive. ChatGPT can be used to automate this process, enabling researchers to extract relevant information quickly and accurately from a large number of publications [17]. In addition to its potential use in the analysis of scientific literature, ChatGPT technology can also be used in the development of global health educational materials. The generation of learning aids such as summaries, flashcards, and quizzes using ChatGPT can greatly enhance the learning experience by helping students retain information. Furthermore, the use of ChatGPT in the creation of interactive educational tools such as virtual simulations and chatbots can greatly enhance the learning experience, making it more engaging and effective. These innovative uses of ChatGPT technology have the potential to make a significant impact in the field of global health research and education [18].

If used properly, ChatGPT can be used to teach young researchers about the importance of keeping a keen eye on the research process. However, it should be noted that although ChatGPT is able to synthesize data and write in an expert manner, often it cannot distinguish between factually correct and incorrect data [16]. It is, therefore, important to teach young researchers not only the importance of checking the outputs but also how to utilize ChatGPT to the extent that it is helpful for the research process and purpose [19,20].

ChatGPT also holds potential for enhancing the traditional educational framework by grading assignments and providing real-time feedback to students [21]. By employing GPT-3 for tasks such as grading written assignments, exams, and quizzes, instructors could concentrate on providing constructive feedback and support, while students receive timely and accurate evaluation of their performance. These benefits have the potential to improve the overall learning experience for students.

3. Challenges with ChatGPT

While the potential applications of ChatGPT in global health research are promising, several challenges must be addressed in order to fully realize its potential. Firstly, the use of large quantities of text data to train the model raises concerns regarding potential biases in the model's algorithms. The data used to train the model may reflect existing societal biases and perpetuate them [6], thereby impacting the accuracy and fairness of the model's outputs [18]. This phenomenon arises because the model's output is only as

good as the data used to train it. If the data used for training contains bias or lacks diversity, the model's outputs may be less accurate and perpetuate existing biases. Consequently, decision-making processes based on the model's output can have significant real-world consequences, especially in natural language processing applications.

The perpetuation of stereotypes and discrimination is a significant risk, resulting in unfair treatment or discrimination in areas such as loan approvals and hiring. To mitigate the impact of bias in training data, it is imperative to ensure that the data is diverse, representative, and free of bias. Techniques such as data augmentation and bias mitigation strategies can be employed to address these challenges. In addition, regular evaluation of the model's outputs for bias and corrective action if bias is detected is necessary.

Moreover, another significant challenge from a global health perspective is the lack of available data in low- and middle-income countries (LMICs) and the predominance of data from high-income countries (HICs). This situation may limit the model's accuracy and applicability to diverse populations, particularly in LMICs, where healthcare systems and patient needs differ significantly from HICs. Consequently, training the model with data from only HICs may result in a model that is not representative of the broader global population, leading to inaccuracies and bias in the model's outputs.

Moreover, the quality of data used for analysis with ChatGPT is also of critical importance. For ChatGPT to be utilized effectively in the analysis of EHRs, the data must be comprehensive, accurate, and consistent. Ensuring the privacy and security of patient information also requires robust data governance and management policies. Moreover, there should be comprehensive and expert supervision of ChatGPT data analysis as there might still be errors in it.

Furthermore, the use of ChatGPT in global health research requires interdisciplinary expertise in both machine learning and health research. In order to utilize the model effectively in solving real-world health problems, collaboration between experts in both domains is necessary. Researchers must possess a deep understanding of both the model and the health issues they aim to address in order to fully leverage its potential.

4. Examples where ChatGPT can be counterproductive

The widespread adoption of pre-trained language models, such as ChatGPT, in various applications raises important concerns about their potential risks to patients, companies, governments, and other stakeholders. The way these models are trained, which relies on human trainers, has inherent limitations and potential pitfalls that may result in unintended consequences. Given that ChatGPT has not yet been fully used in global health research, In Table 1, we explore three hypothetical scenarios where the use of ChatGPT or other language models could be harmful and why caution must be exercised when interacting with human beings in real-time. We also present potential recommendations on how to mitigate such scenarios.

5. Ethical considerations and mitigation strategies

Privacy: The utilization of large language models like ChatGPT in research necessitates the consideration of data privacy and security, which may contain personally identifiable information. Researchers must ensure the anonymity of this data and the implementation of appropriate measures for data security. Furthermore, informed consent from participants should be obtained prior to the collection and analysis of sensitive data.

Bias: The training data used to develop language models like ChatGPT may perpetuate existing biases, potentially leading to biased or unjust results in research, particularly when examining sensitive topics such as race, gender, or socioeconomic status. To mitigate this risk, researchers must use diverse and representative data during the training process and take steps to account for any potential biases.

Lack of Transparency: The complex inner workings of language models like ChatGPT make it challenging for researchers to fully understand how their results are generated, leading to a lack of transparency in the results. To address this, researchers should make available the training data, parameters and settings, and evaluation methods used in their research, and make their code and data publicly accessible.

Academic Integrity: The versatility of language models like ChatGPT in writing about various subjects, including academic papers, raises concerns regarding academic plagiarism, the act of using someone else's work without proper citation [19,20]. Researchers must ensure that they adhere to academic ethical standards and cite original sources.

A potential approach to addressing these challenges is the responsible usage of ChatGPT in academic research [21]. Researchers should meticulously document the data and parameters utilized to train the model, and explicitly state in the publication that the model was employed in the creation of some or all content. Furthermore, researchers must properly acknowledge all sources utilized by the model. Incorporating ChatGPT in the research process can help performing tasks such as extracting relevant information from sources, summarizing scientific papers, or contributing to the introduction or background section of the paper, thus enabling the researcher to maintain control over the ideas and information included in the final report. It is crucial to emphasize that the usage of ChatGPT in academic research must align with the institution's academic integrity policy, which typically includes provisions on plagiarism, proper citation, and the utilization of AI-generated content [16].

Researchers from Stanford university have launched a machine generated text detection model which uses a probability curvature to detect if a written passage is generated using a model such as ChatGPT [23]. OpenAI has also launched their own detection tool which is called AI classifier but there are several limitations to the tool including that in evaluations, it only identified 26% of AI generated texts accurately while falsely identify 9% of human written text as AI generated [24]. Another potentially inhibiting limitation of these tools is that anyone wishing to solely use ChatGPT for their writing and research purposes is likely to change aspects of what the software develops. Thus, detection software would be more unlikely to detect those. However, it is imperative to utilize detection software as ChatGPT becomes more mainstream in global health research to abide by academic integrity regulations.

The Indian Council of Medical Research (ICMR) recently published a set of guidelines [25] to address these concerns and ensure the responsible use of AI in these fields. The guidelines cover a range of issues related to AI, including data collection and analysis, algorithm development, and the use of AI in clinical decision-making. One key principle emphasized in the guidelines is the need for transparency and explainability in AI systems. This means that AI systems should be designed in such a way that their decisions can be understood and justified by human experts. The guidelines also address the issue of bias in AI, which can lead to unfair or discriminatory outcomes. To address this, the guidelines recommend that data used to train AI systems be diverse and representative of the population as a whole. Additionally, AI systems should be regularly audited to identify and correct any bias that may be

Table 1
Hypothetical scenarios showing how ChatGPT can be counterproductive and ways to address them.

S.No.	Scenario	Recommendations on how to mitigate
1.	*Scenario 1 - Bias in the Analysis of Patient Data: In a hypothetical scenario, a research team employed the use of ChatGPT to analyze patient data in order to identify potential risk factors for a specific medical condition. However, due to the presence of biases in the training data utilized to develop ChatGPT, the model also manifested biases, leading to an increased likelihood of unfairly classifying certain populations as being at a higher risk than others. This constitutes a widely documented issue in the literature* [22] *and calls for the development of more effective methods to detect and correct biases in language models.*	To mitigate the scenario where ChatGPT exhibits biased behavior in medical risk factor identification, it is crucial to employ bias detection and correction techniques during the development and training of the model. These techniques can involve auditing the training data to identify any biases, such as demographic disparities or underrepresentation of certain populations, and addressing these issues through data augmentation or collection of more diverse and representative data. Additionally, it is essential to ensure that the model's outputs are continuously monitored for bias and corrected as necessary. This can be achieved by implementing bias mitigation strategies, such as counterfactual data augmentation or fairness regularization, which are designed to minimize or eliminate the impact of biases in the model's outputs. Another approach to mitigating biases in ChatGPT is to involve diverse teams of researchers and experts in the development and training process. This can include individuals from different demographic backgrounds and with different levels of expertise in the specific medical condition being analyzed. By incorporating multiple perspectives and knowledge bases, biases can be identified and corrected more effectively, leading to more accurate and fair model outputs.
2.	*Scenario 2 - Inappropriate Responses in Healthcare Service:* Another hypothetical scenario involves the use of ChatGPT to generate responses in a healthcare service chatbot. Given that the model was trained on a large amount of text data from the internet, it may inadvertently provide responses that are rude or insensitive, resulting in negative experiences for recipients and potentially damaging the reputation of the provider. In a healthcare setting, a similar issue could result in not only a failure to provide proper medical care, but also in patients avoiding accessing medical care for further illnesses due to discomfort with the healthcare setting	To mitigate the scenario where ChatGPT generates inappropriate or insensitive responses in a healthcare service chatbot, it is crucial to ensure that the model is trained on relevant and diverse data specific to healthcare contexts. This can be achieved by incorporating data from medical professionals and healthcare organizations during the model's training. Additionally, it is important to employ bias mitigation strategies to ensure that the model's outputs do not perpetuate existing stereotypes or discrimination in healthcare settings. To further address the issue, healthcare service chatbots powered by ChatGPT should be programmed to understand the context and tone of the conversation. This can be achieved by using additional data sources, such as medical literature and professional guidelines, to provide a better understanding of appropriate language and behavior in healthcare settings. Furthermore, the chatbot should be programmed to recognize and respond appropriately to instances where a user expresses discomfort or dissatisfaction with the response provided. To ensure the quality of care provided by the chatbot, it is also necessary to incorporate a feedback loop that allows users to provide feedback on the appropriateness and helpfulness of the responses provided. This can help to identify and correct any issues with the model's responses, as well as provide insight into the needs and preferences of users. Finally, it is important to regularly evaluate and update the model to ensure that it continues to provide accurate and appropriate responses in healthcare settings. This can include retraining the model on updated data or incorporating additional features to improve the model's accuracy and responsiveness.
3.	*Scenario 3 - Inappropriate Responses in Mental Health Care: In a hypothetical scenario, a research team is using ChatGPT to make responses for a chatbot that talks to mental health clinic patients. However, because the model is not trained on data that is specific to mental health, it may not be able to understand the nuances of certain mental health conditions and thus may generate inappropriate or unhelpful responses. It has also been noted that ChatGPT fails to consider when patients are at risk of harming themselves in a mental health crisis and the affirmative speech of a ChatGPT powered chatbot can propel the patient towards active harm instead of bringing them back from the brink* [20].	To address the issue of ChatGPT' s failure to consider the risk of self-harm in mental health crises, additional data and context-specific features can be included during training. This can include training the model to identify specific language patterns or keywords that may indicate a patient is at risk of self-harm or suicide. Furthermore, the chatbot should be programmed to recognize these signals and provide appropriate responses, such as referring the patient to a mental health professional or a crisis helpline. Finally, the affirmative speech of a ChatGPT-powered chatbot can propel a patient towards active harm, such as suicide. Therefore, it is essential to incorporate safety features, such as assessing patient risk and providing appropriate resources or referrals, in the chatbot's programming. This can include implementing a chatbot “escape” function, which will alert a mental health professional or emergency services if the patient's language patterns indicate an immediate risk of harm.

present. Another important issue addressed in the guidelines is the need for informed consent when using AI in biomedical research and healthcare. Patients and study participants should be fully informed about how their data will be used and should have the right to opt out if they choose. Additionally, the guidelines recommend that AI systems used in clinical decision-making should be subject to the same rigorous testing and evaluation as traditional medical interventions. The ICMR guidelines provide a comprehensive framework for the responsible use of AI in biomedical research and healthcare. By emphasizing the importance of transparency, fairness, and informed consent, these guidelines can help ensure that AI is used in a way that benefits patients and society as a whole.

6. Conclusion

The deployment of advanced language models, such as ChatGPT, presents a significant opportunity to revolutionize global health research. In particular, the ability of ChatGPT to efficiently and accurately process large volumes of EHRs has the potential to improve patient outcomes and facilitate the identification of disease risk factors, as well as the development of novel treatments. However, the successful integration of these models into global health research will require advances in multiple domains, including data governance, cross-disciplinary collaboration, machine learning techniques, and the enhancement of global health research expertise.

ChatGPT also offers the potential to enhance academic research, but its usage should be executed in a transparent and ethical manner by documenting the data and parameters utilized, citing original sources, and adhering to institutional academic integrity policies.

Funding

This work did not receive any funding.

CRediT authorship contribution statement

Ateeb Ahmad Parray: Conceptualization, Coordination, Manuscript drafting, Feedback Incorporation, Manuscript finalization. **Zuhrat Inam:** Manuscript drafting, Feedback Incorporation, Manuscript finalization. **Diego Ramonfaur:** Manuscript drafting, Feedback, Proof Reading. **Shams Shabab Haider:** Feedback, Proof Reading. **Sabuj Kanti Mistry:** Manuscript drafting, Feedback, Proof Reading. **Apurva Kumar Pandya:** Feedback, Proof Reading.

Declaration of competing interest

The authors have no relevant financial or non-financial interests to disclose.

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10 February 2023
Available online 23 May 2023

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