



Potential Use of Artificial Intelligence in Infectious Disease: Take ChatGPT as an Example

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Abstract

Over the past month, a new AI model called Chatbot Generative Pre-trained Transformer (ChatGPT), has received enormous attention in the media and scientific communities due to its ability to process and respond to commands in a humanistic fashion. As reported, five days after its launch, the number of registered users of ChatGPT exceeded one million, and its monthly active users had exceeded 100 million two months later, making it the most rapidly growing consumer application in history. The advent of ChatGPT has further brought about new ideas and challenges in the realm of infectious disease. In view of this, in order to evaluate the potential use of ChatGPT in clinical practice and scientific research of infectious disease, we conducted a brief online survey by using the publicly available ChatGPT webpage. Also, the present study also talks about the relevant social and ethical issues related to this program.

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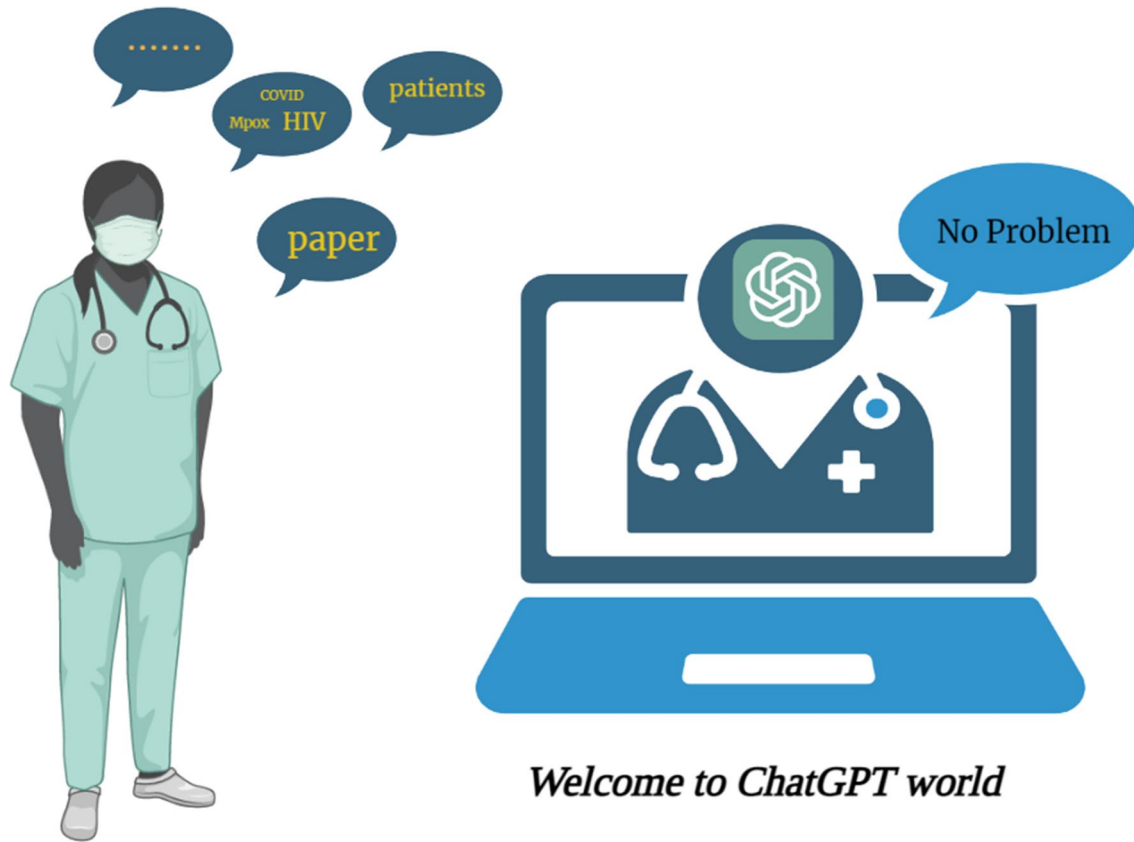
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Graphical Abstract



Keywords Infectious disease · Artificial intelligence · ChatGPT · Chatbots

Introduction

In the last decade, artificial intelligence (AI) in the form of machine learning and natural language processing has permeated many domains of science. With the steady development of AI technology and its highly integration in the health industry, AI has received increasing attention and the scope of its application in the medical field is also expanding. Over the past month, a new AI model called Chatbot Generative Pre-trained Transformer (ChatGPT), has received enormous attention in the media and scientific communities due to its ability to process and respond to commands in a humanistic fashion. ChatGPT is fine-tuned from the large language model (LLM) GPT-3.5, that trained based on massive text data obtained from the Internet through reinforcement and supervised learning methods [1]. Even more, this program is considered to be a turning point of AI techniques and the beginning of a new technological revolution. As reported, five days after its launch, the number of registered users of ChatGPT exceeded one million, and its monthly active users had exceeded 100 million two months later, making

it the most rapidly growing consumer application in history. According to previous research, ChatGPT seemed to be omniscient, and could reply to even whimsical requests quickly and fluently [2].

Infectiology is a discipline that focused on the occurrence, prevalence, prevention, control, and treatment of infectious diseases. Currently, the world is faced with many emerging infectious diseases such as coronavirus disease (COVID-19), Monkeypox, influenza, HIV/AIDS etc. Especially owing to the outbreak of COVID-19 in 2020, the world economy has been hit hard and millions of people lost their lives. Application of AI in the field of infectious diseases is not a novelty. For example, during the COVID-19 epidemic, AI played an important role in early detection, optimizing pharmaceutical and non-pharmaceutical intervention strategies, prediction models, telemedicine, and so on [3]. Recently, the advent of ChatGPT has further brought about new ideas and challenges in the realm of infectious disease [2]. In view of this, in order to evaluate the potential use of ChatGPT in clinical practice and scientific research of infectious disease, we conducted a brief online survey by using the publicly available

webpage at <https://chat.openai.com/chat> (Fig. 1). Also, the present study is devoted to explore the relevant social and ethical issues related to this program.

How can ChatGPT be Applied in Infectious Disease?

As an AI language model, ChatGPT is able to be applied in infectious disease in a variety of ways: (1) Information dissemination: ChatGPT can be used to disseminate accurate and up-to-date information about infectious diseases to the general public, healthcare professionals, and policy-makers. (2) Disease surveillance and monitoring: this program could be trained to monitor news and social media platforms for signs of outbreaks or disease clusters, and to alert health authorities to potential threats. (3) Diagnosis and treatment: ChatGPT may assist healthcare providers in diagnosing infectious diseases by processing patient data and providing potential diagnoses and treatment options. (4) Risk assessment and modeling: it can be used to model the spread of infectious diseases and estimate the risk of transmission in different populations and settings. (5) Vaccine development: ChatGPT could help researchers identify potential vaccine targets by analyzing genomic data and predicting the antigenicity of different viral proteins. Overall, ChatGPT's ability to process natural language and generate

human-like responses makes it a valuable tool in the fight against infectious diseases.

ChatGPT in Clinical Practice of Infectious Disease

Generally speaking, the potential uses of ChatGPT in clinical practice of infectious disease mainly include the following aspects: (1) Differential diagnosis: ChatGPT has great potential in assisting healthcare providers in the differential diagnosis of infectious diseases by processing patient symptoms, medical history, and laboratory results, and providing potential diagnoses and treatment options. (2) Treatment recommendations: ChatGPT could provide reasonable treatment recommendations based on the patient's clinical presentation, disease severity, and comorbidities. (3) Patient education: Like an encyclopedia, ChatGPT could provide patients with educational resources on infectious diseases, including prevention strategies, treatment options, and post-treatment care. For example, as shown in Fig. 1, when we proposed several questions about COVID-19 and COVID-19 vaccines, we got the detailed answers just the like the professional doctors. (4) Telemedicine: If ChatGPT is integrated into telemedicine platforms, it allows patients to receive better quality care and guidance from healthcare providers remotely. (4) Data analysis: After analyzing large amounts of patient data, ChatGPT can help to identify patterns and

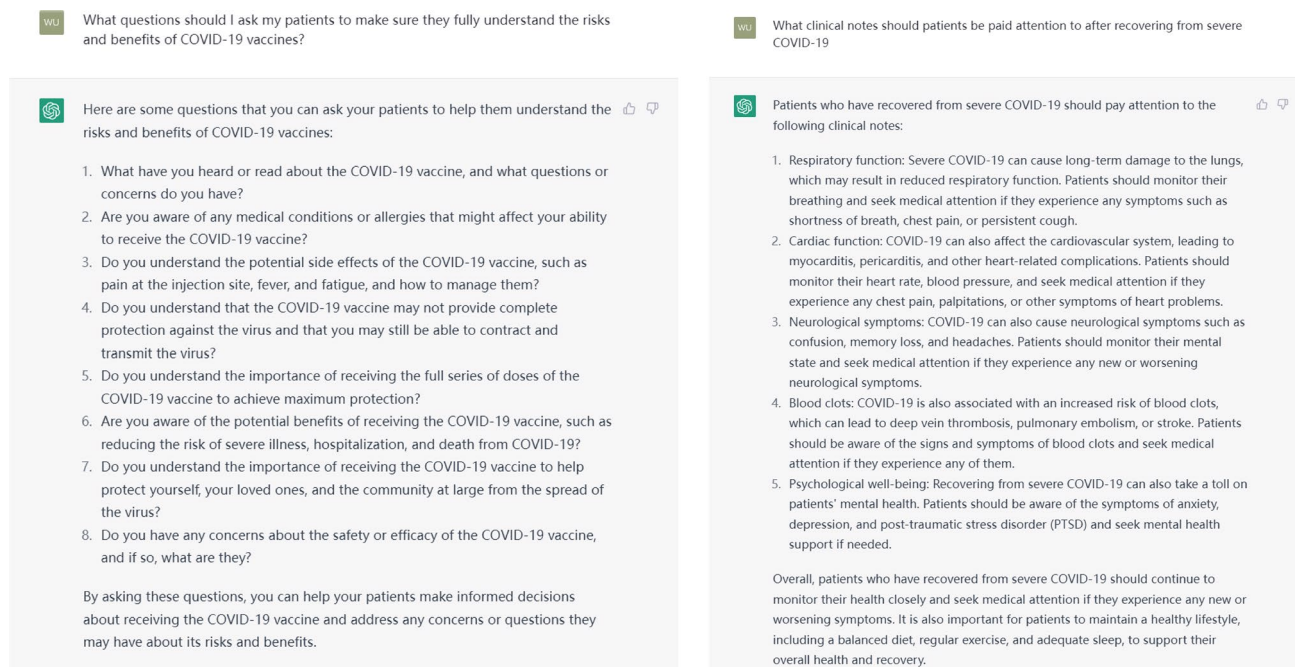


Fig. 1 Answers from ChatGPT when we asked “What questions should I ask my patients to make sure they fully understand the risks and benefits of COVID-19 vaccines?” and “What clinical notes should patients be paid attention to after recovering from severe COVID-19?”

trends in the spread of infectious diseases, which may directly inform public health strategies and policy decisions. All in all, ChatGPT could help to improve the accuracy and efficiency of clinical decision-making in the field of infectious disease. However, it is important to note that ChatGPT should not replace the clinical judgment of healthcare providers and should be used as a complementary tool in clinical practice.

ChatGPT in Scientific Writing of Infectious Disease

Title

Many journal instructions on how to write scientific articles state that title is the most important part of a research article, as it provides the core information of a work. In general, ChatGPT could aid in finding an appropriate title for a research article in the field of infectious disease. ChatGPT is a machine learning model that has been trained on a large corpus of text data and can generate natural language responses based on the input it receives. By inputting key phrases or topics related to the research article, this program could generate multiple potential titles that accurately reflect the content of the research and use appropriate terminology. However, it is important to note that ChatGPT is not a substitute for human expertise and judgment. Although it has the capacity to provide helpful suggestions for titles, researchers should always validate the generated titles and ensure that they accurately reflect the content and context of the research article. Additionally, researchers should consider other factors such as the target audience, journal requirements, and ethical considerations when selecting a title for their research article.

Abstract

Generally, the writing principles for abstract should as follows: keep it concise; focus on the key points; follow a structured format; use relevant keywords; check for accuracy and clarity and consider the audience. ChatGPT may aid in writing a condensed abstract for a research article in the field of infectious disease by generating a summary of the study's key findings, methods, and conclusions.

Introduction

According to ChatGPT's self-reports, it possesses the abilities to help scholars writing the introduction section of a research article in the field of infectious disease. Here are some ways ChatGPT may help: (1) Provide background information: ChatGPT could suggest relevant background

information on the topic of the research article, such as the epidemiology and clinical features of the infectious disease being studied. (2) Identify knowledge gaps: ChatGPT helps identify knowledge gaps in the field related to the research question, and suggest ways the research article could contribute to filling those gaps. (3) Provide context: ChatGPT could suggest ways to place the research question and the research article within the broader context of infectious disease research, such as by discussing previous research on the topic. (4) Create a logical flow: ChatGPT could suggest a logical flow for the introduction section, including how to introduce the research question, state the objectives of the study, and provide a brief overview of the research methods and results.

Method

Moreover, ChatGPT could provide assistance in writing the methods section of a research article in the field of infectious disease by generating suggestions based on the input provided. Here are some ways ChatGPT can aid in writing the methods section: (1) Provide a framework: Provide a framework for structuring the methods section, such as a checklist or a set of guidelines, to ensure that all the necessary information is included. (2) Generate suggestions: generate suggestions for describing the study design, participant selection, data collection, and statistical analysis. These suggestions could be used as a starting point and refined to fit the specific study. (3) Check for clarity: check for clarity and consistency in language use throughout the methods section. It is able to suggest alternative words or phrasing to make the section more understandable. (4) Identify gaps: identify potential gaps or inconsistencies in the methods section that need to be addressed, such as missing information or contradictory statements. (5) Provide examples: provide examples of well-written methods sections in the field of infectious disease, which could be used as a reference for formatting and style.

Results

ChatGPT could also aid in writing the results section of a research article in the field of infectious disease. (1) Organize data: organize the data, such as using tables, graphs, or diagrams to help readers understand the results more easily. (2) Explain the findings: suggest how to explain the findings clearly and concisely, including statistical analyses and any patterns or trends observed in the data. (3) Interpret the results: suggest how to interpret the results, including any potential limitations or biases in the study design or data collection. (4) Check for accuracy: this program could help check for accuracy and

consistency in reporting the results, including ensuring that all necessary information is included and that the data is reported accurately.

Discussion

Finally, ChatGPT could aid in writing the discussion section of a research article in the field of infectious disease. Here are some ways ChatGPT may help: (1) Summarize key findings: suggest how to summarize the key findings from the study, including any patterns or trends observed in the data. (2) Interpret the results: suggest how to interpret the results and discuss their implications, including any potential limitations or biases in the study design or data collection. (3) Discuss the significance: suggest how to discuss the significance of the findings in the broader context of infectious disease research, including how they relate to previous research in the field and potential future directions for research. (4) Address any unanswered questions: suggest how to address any unanswered questions or limitations of the study, including suggestions for future research. (5) Provide a conclusion: suggest how to provide a clear and concise conclusion that summarizes the key points of the discussion section.

Can ChatGPT Replace Infectious Disease Doctor?

The answer is a resounding no. ChatGPT cannot replace an infectious disease doctor. Although ChatGPT could provide useful information and answer general questions related to infectious diseases, it cannot replace the expertise, training, and experience of a qualified infectious disease doctor. Infectious disease doctors undergo years of education and training to specialize in the prevention, diagnosis, and treatment of infectious diseases. They have a deep understanding of the complex biology and epidemiology of infectious diseases, as well as the latest advances in diagnostic tools and treatments. In contrast, ChatGPT is a machine learning model that is designed to generate responses based on the input data it has been trained on. ChatGPT cannot provide the same level of expertise, judgment, and personalized care that an infectious disease doctor could provide. Overall, ChatGPT could complement the work of infectious disease doctors by providing quick and accurate information to patients and healthcare providers. However, it is far from replacing the vital role of infectious disease doctors in providing expert care, making treatment decisions, and ensuring the best possible outcomes for patients with infectious diseases.

What Problems will ChatGPT Bring in the Field of Infectious Disease?

Although ChatGPT could bring many benefits to the field of infectious disease, such as providing quick and accurate information to healthcare providers and patients, there are also some potential problems that may arise. Here are a few examples: (1) Misinformation: ChatGPT usually generates responses based on the input data it has been trained on. However, if the input data contains misinformation or biased information, then the responses generated by ChatGPT may also contain inaccuracies. (2) Lack of human interaction: Despite ChatGPT could provide quick responses to questions, it cannot replace the value of human interaction in healthcare. Patients may require emotional support or nuanced explanations that ChatGPT may not be able to provide. (3) Legal and ethical concerns: The use of ChatGPT in healthcare raises legal and ethical concerns regarding patient confidentiality, liability, and accuracy of information. Healthcare providers must ensure that the use of ChatGPT complies with legal and ethical standards. (4) Accessibility: ChatGPT requires internet access and may not be accessible to all patients or healthcare providers, particularly in areas with limited connectivity. (5) Language barriers: ChatGPT is currently available in a limited number of languages, which may pose a challenge for healthcare providers and patients who speak languages other than those supported by ChatGPT. These are some potential problems that may arise with the use of ChatGPT in the field of infectious disease. However, with proper training, validation, and monitoring, these issues may be addressed gradually over time to ensure that ChatGPT is used effectively and ethically in healthcare.

Conclusion and Outlook

Till here, as you might have already guessed, apart from a few edits and supplementary notes, most of the above questions about the strengths and weaknesses of ChatGPT in the field of infectious disease were answered from ChatGPT itself. The present study analyzed the most concerned questions about the use of ChatGPT in the infectious disease domain. From this investigation, we can draw the conclusion that ChatGPT is really a useful tool in the infectious disease field whether in terms of clinical practice or in scientific research. ChatGPT not only saves time for researchers, but also helps to organize the structure of their articles, providing useful guides on title, abstract, introduction, method, results, and discussions, which assist researchers in completing their scientific

writing more quickly and accurately. Additionally, for those researchers whose native language is not English, ChatGPT could be a good auxiliary tool to help improve their writing.

However, it has to be mentioned that this program also has some limitations. From the above answers, it is not difficult to see that some answers may be too vague or inaccurate, which may affect the accuracy of the research. Meanwhile, the current ChatGPT strives for overall correctness, safety, and superficial rigor in the process of answering questions, but lacks details and reference data. More specifically, we think the current technical level of ChatGPT is not good enough to support their own diagnostic functions, thus has a certain rate of misrecognition and potential safety hazards [4]. In addition, due to the seriousness of the medical field and the ethical constraints involved, guidance and regulation are required for the use of this new technology to ensure their proper use. In view of this, many institutions have decided to ban the use of ChatGPT in scientific work, which may not be effective for this “one size fits all” approach [5].

Nevertheless, the potential for ChatGPT in the infectious disease field is enormous [6, 7]. Through the acquisition of vast medical knowledge and patient case studies, ChatGPT may become an “encyclopedia” of medical information for physician retrieval and learning. In the near future, with the continuous development of AI technology, we believe that ChatGPT will play an increasingly important role. Meanwhile, it is essential to recognize the limitations of these technologies and carefully guide and regulate their use. Moreover, we also need to continue to collect more data and information to better train and improve ChatGPT and other AI models to achieve better medical applications.

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Competing of interest The authors declare no conflict of interest.

Ethical approval This study does not include any individual-level data and thus does not require any ethical approval.

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