

The Potential Applications and Challenges of ChatGPT in the Medical Field

Yonglin Mu , Dawei He 

Department of Urology, Children's Hospital of Chongqing Medical University, Chongqing, People's Republic of China

Correspondence: Dawei He, Department of Urology, Children's Hospital of Chongqing Medical University, No. 136, Zhongshan 2nd Road, Yuzhong District, Chongqing, 400014, People's Republic of China, Tel +86 18680856616, Email hedawei@hospital.cqmu.edu.cn

Abstract: ChatGPT, an AI-driven conversational large language model (LLM), has garnered significant scholarly attention since its inception, owing to its manifold applications in the realm of medical science. This study primarily examines the merits, limitations, anticipated developments, and practical applications of ChatGPT in clinical practice, healthcare, medical education, and medical research. It underscores the necessity for further research and development to enhance its performance and deployment. Moreover, future research avenues encompass ongoing enhancements and standardization of ChatGPT, mitigating its limitations, and exploring its integration and applicability in translational and personalized medicine. Reflecting the narrative nature of this review, a focused literature search was performed to identify relevant publications on ChatGPT's use in medicine. This process was aimed at gathering a broad spectrum of insights to provide a comprehensive overview of the current state and future prospects of ChatGPT in the medical domain. The objective is to aid healthcare professionals in understanding the groundbreaking advancements associated with the latest artificial intelligence tools, while also acknowledging the opportunities and challenges presented by ChatGPT.

Keywords: ChatGPT, clinical practice, healthcare, medical education, medical research, challenges

Introduction

In the 21st century, the innovation and advancement of AI technology are continually reshaping various aspects of the medical field. Particularly, the development of medical chatbots has provided patients with unprecedented convenience. Utilizing advanced Natural Language Processing (NLP) and machine learning, these chatbots are capable of real-time interaction with patients, offering health consultations, disease diagnosis support, and even mental health counseling.¹ Previous studies have shown that medical chatbots can enhance patient experience in relevant fields, improving the quality and efficiency of healthcare services.^{2,3}

ChatGPT, developed by OpenAI, is a sophisticated language model that utilizes deep learning techniques to generate human-like responses. It stands out as one of the largest publicly available language models.⁴ By training on a vast amount of textual data, ChatGPT can effectively capture subtle nuances and intricacies in human language. As a result, it is capable of providing contextually relevant and appropriate responses. Given the ever-increasing medical knowledge and the complexity of clinical practice, doctors face significant pressure in processing information. Consequently, both doctors and patients have shown interest in ChatGPT due to its ability to provide accurate and prompt responses across a wide range of topics.

The healthcare industry is abundant in data and possesses a substantial amount of text, creating an urgent demand for automation. The development of artificial intelligence enables improved processing and analysis of medical data, unveiling new associations between diseases and treatments.⁵ Since its launch, ChatGPT has shown tremendous potential in the medical field, introducing new interaction patterns between doctors and patients in clinical practice,⁶ as well as pioneering advancements in healthcare, medical education, and research.⁷

However, ChatGPT is not a specialized medical application and should not be solely relied upon for medical decision-making, much less to replace healthcare professionals.⁸ Frequently cited limitations of ChatGPT include

restricted capabilities, inaccuracies, unclear citation sources, and the necessity for verification. Potential risks embrace plagiarism, hallucination (misrepresenting sources), academic misconduct, and ethical concerns.⁹ Therefore, ChatGPT is more suitable as an auxiliary tool in the medical field, and the work and information it provides must undergo verification. In practical applications, errors in information generated by ChatGPT may impact an individual's health. Thus, stringent control and evaluation of the accuracy and safety of ChatGPT are particularly important.

As a double-edged sword, ChatGPT offers increased efficiency and creativity while also posing risks, such as perpetuating biases, violating the law, and disseminating false information. As artificial intelligence gradually integrates into the healthcare field, healthcare professionals need not only to understand how to use such tools but also to comprehend their limitations. Consequently, to explore ChatGPT's applications in the medical field comprehensively, this review employed a literature search across PubMed, Web of Science, and Google Scholar using "ChatGPT" and "medicine" as keywords, without time restrictions. Initial screenings focused on titles and abstracts to pinpoint studies directly discussing ChatGPT's medical applications, excluding non-relevant technical, non-medical, commentary, and abstract-only publications. Selected articles underwent full-text review for relevance, quality, and research integrity, emphasizing ChatGPT's roles in clinical practice, healthcare, medical research, and education, while discarding those with inadequate data or flawed designs. This article strives to evaluate the application, effectiveness, and advantages and disadvantages of ChatGPT in clinical practice, healthcare, medical education, and medical research, as well as to anticipate possible future research directions. Meanwhile, we will also analyze the challenges and limitations of ChatGPT's application in the medical field.

Clinical Practice

Clinical Decision Support and Optimization

Clinical decision-making is the process by which doctors diagnose, treat, and provide care for patients in clinical practice. This process relies on the doctors' clinical experience and professional knowledge, as well as the patients' clinical signs, symptoms, laboratory tests, and imaging information. In the context of intelligent clinical decision support systems,¹⁰ ChatGPT can be utilized as a tool that engages in dialogue with doctors, delivering up-to-date medical research results, clinical guidelines, and expert opinions. This assists doctors in making more accurate and scientifically-informed decisions. Rao's team subjected 36 published clinical segments from the Merck Sharpe & Dohme (MSD) Clinical Handbook to evaluation in ChatGPT.¹¹ The goal was to assess the accuracy of ChatGPT in final diagnosis and clinical management. The study yielded an impressive overall accuracy rate of 71.7% (95% CI 69.3–74.1%). However, compared to answering general medical knowledge, ChatGPT's accuracy rate was relatively poor in areas such as differential diagnosis and clinical management. In the field of pediatrics, Hsu-Ju Kao's team compared the performance of ChatGPT on eight clinical symptom prompts to the assessments of two pediatricians.¹² The findings revealed that ChatGPT performed at an equivalent level to a grade of C within the A-E range, with mean scores of -0.89 logits and 0.90 logits ($=\log$ odds), respectively. This study confirmed that ChatGPT has the potential to assist in clinical work and enable responsible clinical decision-making.

It is notable that the training process of the ChatGPT model relies on general medical knowledge available on the internet. Gathering a substantial amount of patient data for ChatGPT's training is very challenging due to the imperative to safeguard patient privacy, resulting in a certain level of non-scientific specificity in the medical-related responses provided by ChatGPT. Consequently, medical information generated by ChatGPT should be considered preliminary or supplementary and be subject to rigorous and meticulous review by medical professionals. Furthermore, it is imperative to establish a robust ethical framework and policy guidelines for the responsible use of ChatGPT in aiding clinical decision-making. Moreover, there is potential for enhancing the efficiency of diagnosis and treatment by thoroughly evaluating the diagnoses, nursing measures, and treatment plans proposed by ChatGPT for complex clinical cases, ultimately benefiting patients.

Intelligent Consultation Assistant

ChatGPT can interact with patients individually in natural language. It has the capability to collect and analyze a large amount of information such as medical history, symptoms, and signs in order to provide accurate preliminary diagnosis

and medical advice.¹³ In traditional consultation processes, face-to-face doctor-patient communication is usually required. However, due to time and geographical constraints, it is often difficult for patients to receive professional medical advice in a timely manner. Conversely, ChatGPT can offer real-time medical assistance to patients through online consultations or mobile applications, effectively addressing the issue of time and space limitations. Nevertheless, it is important to assess the accuracy and timeliness of ChatGPT's responses to medical inquiries, considering that answers may vary with changes in the way questions are asked and over time. Thus, Walker's team utilized the Ensuring Quality Information for Patients (EQIP) tool to evaluate the medical information provided by ChatGPT on five hepatopancreaticobiliary (HPB) diseases.¹⁴ The results indicated a 60% agreement (15/25) between the guideline recommendations and ChatGPT's responses, suggesting that the quality of medical information provided by ChatGPT is comparable to that of existing static Internet information. The authors propose that large-scale language models like ChatGPT may become the future standard for acquiring medical information by patients and healthcare professionals.

Conventional diagnostic methods involve meticulous analysis of visual and auditory data, imperative for navigating intricate medical scenarios. However, ChatGPT is only able to convert patients' expressions into written text, potentially leading to information loss and ambiguity. Hence, it is essential to consider converting raw data into a textual format while preserving the original data's integrity and richness, and developing intelligent models suitable for medical environments. It is widely acknowledged that the human touch in medicine is irreplaceable. While ChatGPT can help overcome obstacles such as distance, language, and culture, it lacks empathy and the ability to interpret body language. We should recognize that doctors' care and understanding of patients are also crucial.

Assisting in the Treatment and Management of Clinical Patients

In clinical practice, a significant information asymmetry exists between physicians and patients. Patients seek a thorough understanding of their condition, while clinical teams strive to access the latest and authoritative insights into the patient's status, in turn enabling them to deliver enhanced healthcare services. Due to its conversational and reasoning capabilities,¹⁵ ChatGPT is capable of communicating with healthcare professionals and providing initial diagnostic and therapeutic recommendations based on information regarding the patient's symptoms and medical history. Furthermore, it enables better informing and educating patients about their condition and symptoms.

ChatGPT can enable rational allocation of medical resources, enhance work efficiency, and prevent misdiagnoses and missed diagnoses through automated analysis. Gebrael's team retrospectively analyzed the effectiveness of ChatGPT in aiding healthcare providers in making triage decisions for patients with metastatic prostate cancer in the emergency room.¹⁶ The analysis revealed that ChatGPT had a sensitivity of 95.7% in identifying patients suitable for admission and a specificity of 18.2% in identifying patients who could be safely discharged. The authors concluded that ChatGPT displays high sensitivity in determining patient admission, accurately diagnosing patients, and providing additional treatment recommendations. Consequently, this study suggests that ChatGPT has the potential to enhance patient classification and improve the efficiency and quality of care in emergency situations.

Healthcare

Reducing the Burden of Medical Documentation

The process of handling medical documents can be time-consuming and tedious, and within the busy work environment of clinicians, errors or omissions of information can occur.¹⁷ The accuracy of these documents is crucial for patient care and collaboration among healthcare teams. By acting as a language assistant or providing templates, ChatGPT can serve as a powerful tool for clinicians, helping them improve the quality and efficiency of their medical documents. Researchers presented ChatGPT with information such as current treatment, laboratory results, blood gas analysis parameters, and respiratory and hemodynamic parameters in a random order, requesting it to write daily medical records for a patient in the ICU. The results showed that ChatGPT could correctly classify most of the parameter indicators into their appropriate positions.¹⁸ Similarly, after doctors provided brief task descriptions, detailed concept explanations, and guidance explanations, ChatGPT could generate formal discharge summaries within seconds.¹⁹ The automation of this process can not only alleviate the documentation burden of doctors but also reduce potential safety hazards.

Furthermore, ChatGPT has also been used to generate accurate pathology reports and patient clinic letters. Dunn's team conducted a study where they evaluated the readability, accuracy, and quality of four dermatological pathology reports.²⁰ Two reports were from published studies by the authors, while the other two were generated by ChatGPT using patient information. These reports were blindly reviewed by 20 medical reviewers. The results indicated that the texts generated by ChatGPT scored higher in overall quality and readability compared to the ones from the published reports. In another study by Ali's team, 38 hypothetical clinical scenarios related to skin cancer were created to assess the readability, accuracy, and user-friendliness of clinical letters generated by ChatGPT and given to patients.²¹ The letters showed a median overall accuracy score of 7 (range 1–9) and a median overall humanness score of 7 (range 5–9). The weighted κ coefficient for accuracy was 0.80 ($p < 0.0001$), and for humanness, it was 0.77 ($p < 0.0001$). This study suggests that ChatGPT can generate clinical letters that achieve high overall accuracy and humanness scores, with a readability level comparable to clinician-generated letters.

Assisting Clinical Radiologic Decision-Making

Rao's team conducted a study comparing the responses of ChatGPT to the American College of Radiology (ACR) guidelines on breast cancer screening and breast pain.²² The results indicated that ChatGPT achieved high scores in breast cancer screening prompts and moderate scores in breast pain prompts. This suggests that ChatGPT is feasible for radiological decision-making and has the potential to enhance clinical workflow. Rao's team utilized 209 ACR standardized documents as a knowledge repository and developed a context-aware chatbot called accGPT.²³ They achieved this by integrating large-scale language models with external data. By using 50 clinical case files as examples, the authors demonstrated that accGPT performed exceptionally well, providing accurate recommendations and saving considerable time and cost. This study showcases the potential of ChatGPT, based on ACR guidelines, to substantially improve decision-making in clinical imaging studies.

It is essential to note that ChatGPT's privacy policy indicates that the content of all messages sent will be collected and utilized for subsequent model training.²⁴ Whenever sensitive information such as patient data or personal details is entered, whether it be for writing medical documents or uploading imaging materials, it may raise serious privacy concerns. Therefore, until regulatory authorities can ensure the resolution of privacy issues in medical records, doctors should treat the entry of patient information and data into ChatGPT with caution when using it to write medical notes. In the case of ChatGPT, an "anonymous conversation" option could be incorporated to ensure that chat content is not utilized for OpenAI's subsequent AI model training, thereby enhancing its security of use.

Medical Education

Assisting Students' Education

Traditional medical education mainly relies on textbooks and lectures by teachers, but it is difficult for teachers to keep up with all the medical knowledge that is constantly being updated and expanded.²⁵ ChatGPT can be used as a kind of virtual teaching assistant to provide the latest medical knowledge and research results.²⁶ Students can gain insight into the etiology, pathogenesis, and latest treatments of various diseases through dialogue with ChatGPT, and can also have ChatGPT generate personalized tutorials based on their level of understanding and learning needs. Educational professionals are dedicated to testing the accuracy of ChatGPT's ability to answer medical questions without professional training. For instance, Kamran Ali's team created 50 questions related to a dental course and entered them into ChatGPT to obtain responses to assess the accuracy of ChatGPT responses.²⁷ The mean ChatGPT scores in this study were in the range of 70–100% and showed satisfactory levels in all types of dental assessments. Meo's team created a topic-based question bank containing multiple-choice questions from various medical textbooks and university exam banks to study the ChatGPT's level of knowledge, multiple-choice questions in basic and clinical medicine and clinical medical education, education in terms of knowledge level, performance on multiple-choice exams and its impact on the medical examination system.²⁸ The results showed that ChatGPT obtained 37/50 (74%) scores in basic medicine and 35/50 (70%) scores in clinical medicine, with an overall mean score of 72/100 (72%). The authors concluded that the ChatGPT achieved satisfactory scores in both basic and clinical medicine subjects and demonstrated some degree of

comprehension and interpretation, suggesting that the ChatGPT may have a tutoring role for teachers as well as students in a medical education setting. Thus, educational professionals can utilize ChatGPT to generate a large question bank, which after careful review, editing, and revision, can be provided to students for self-assessment of their learning progress.

ChatGPT can also excel in assisting medical students to develop autonomous learning abilities. Students can engage in deeper learning of course materials without the guidance of teachers, unrestricted by time and location, which can foster better cognitive skills and the abilities to integrate and transfer knowledge. However, it is worth noting that students may lack a systematic and profound understanding of the content, and they may not be able to discern false information. Moreover, the lack of referencing information in ChatGPT may deprive students of the opportunity to acquire additional knowledge. Therefore, teachers should cultivate students' ability to use AI tools and inform them of the potential superficial and erroneous information received from ChatGPT, to prevent abuse and dependence.²⁹

Practical Simulation Training

ChatGPT will further enhance the depth and breadth of AI's application in the medical field, providing each student with a virtual assistant and an adaptive learning experience, moving simulated medical scenarios from outdoors to indoors, and generating patient case test scenarios to improve clinical interviewing skills.³⁰ The transition from medical school to hospital is challenging, and many medical schools have set up simulation centers for students, but expensive equipment, script writing, and other logistical support have implicitly increased the cost of teaching.

ChatGPT can serve as an interactive clinical simulation to help students with the pre-clinical transition, improving their abilities to communicate with patients, assess, and plan, thus helping them integrate into new teams more quickly. Doctor-patient communication is a fundamental skill for doctors, especially in the field of emergency and critical care medicine. Traditional doctor-patient communication teaching relies on standardized patients and clinical training, and ChatGPT may serve as a substitute. Some scholars have set up a training scenario for delivering bad news using ChatGPT, outlining training rules and assessment with a standardized scale, and recording the feedback from ChatGPT (patient role) to users. The study showed that ChatGPT performed well overall in handling sudden bad news and providing education on sudden bad news, and users could also rely on it to build specific scenarios they wanted to practice.³¹

However, the quality and accuracy of ChatGPT's simulations and feedback cannot be guaranteed. It also requires teachers to systematically evaluate the accuracy of ChatGPT simulations and strictly review whether there are any hidden social biases in the standardized question bank. Virtual assistants cannot assess and transmit the subtle factors in human communication, such as eye contact, gestures, tone, and expressions, indicating that the use of artificial intelligence cannot fully replace clinical teaching. In the future, ChatGPT may serve as an assistive tool for teachers to optimize the content and mode of medical student learning.

Medical Research

Efficient Analysis of Information Data

During the research process, researchers face the challenge of dealing with a substantial volume of literature and data materials in their quest for information retrieval and organization. In this regard, ChatGPT offers considerable assistance to researchers by facilitating quick access to the necessary research literature or data, as well as providing relevant knowledge interpretation and analysis through the utilization of natural language processing and machine learning techniques.³² In addition, ChatGPT possesses strong language translation capabilities, generating text with good logicity and coherence, making it highly readable. Even non-native English speakers can easily understand it.²⁴

In a study conducted by Philip Moons's team, researchers in cardiovascular care explored the potential use of ChatGPT. The responses garnered from this study indicated that ChatGPT can serve as a valuable tool for summarizing extensive amounts of textual data, such as research articles, clinical records, and patient records. Additionally, it demonstrated the capacity to generate structured data from unstructured text.³³ Moreover, they discovered that researchers could acquire proficiency in certain statistical methods by utilizing ChatGPT, and that ChatGPT exhibited promising performance when presented with syntax/scripts for analysis within any statistical program.

Biomedical research is fundamental to evidence-based medicine, with even minor errors posing a threat to the research process, hindering scientific progress, and potentially causing irreparable harm to patient care and treatment. However, the utilization of ChatGPT to supplement the reference list for review results has led to serious errors in the generated references. These inaccuracies, incompleteness, or even fabricated references undermine the integrity and authenticity of medical research.³⁴ Furthermore, deeming artificial intelligence models like ChatGPT as co-authors of academic research articles is inappropriate, as AI does not meet the standards of research authors and cannot be held accountable for the research findings.³⁵ Therefore, ensuring transparency in the application of artificial intelligence in manuscripts is vital for preserving the credibility of academic research. Additionally, it is imperative to establish policies and guidelines for the rigorous review of ChatGPT-assisted medical research outcomes, thereby ensuring responsible and ethical usage of artificial intelligence by researchers.

Drug Discovery

Drug discovery, the complex and time-consuming process of identifying and developing new drugs, traditionally relies on labor-intensive techniques such as trial-and-error experiments and high-throughput screening.³⁶ However, ChatGPT has the potential to expedite and enhance this process. By efficiently and accurately analyzing large amounts of data, ChatGPT can predict the pharmacokinetic, pharmacodynamic, and toxicity profiles of specific compounds.³⁷ Moreover, Heck suggests that ChatGPT could be utilized for protein drug discovery.³⁸ If a conversation containing amino acid sequences from a protein database, along with information on structural domains, specific functions, and conformations of proteins, is inputted into ChatGPT, it can be analyzed, investigated, and coded to generate novel protein sequences and structures. This capability can greatly assist in the development of protein drug design.³⁹ Additionally, in Wang's team's research on the development of anti-cocaine addiction drugs, ChatGPT fulfills three humanoid roles: idea generation, methodology clarification, and coding assistance, thus guiding researchers to adopt innovative methods and production pathways for creating effective drug candidates.⁴⁰ Previous case studies have already demonstrated the potential of AI in drug discovery.^{41–43} As a cutting-edge AI learning model, ChatGPT is expected to lead to unprecedented breakthroughs and discoveries, ultimately accelerating the development of new drugs.

However, when the academic community relies on information generated by artificial intelligence, unique human thinking and analysis may be influenced. This includes, but is not limited to, the process of drug discovery, where ChatGPT may reproduce recommendations from previous training data, causing researchers to worry about the originality and authenticity of the information it generates.⁴⁴ Although ChatGPT has special value for generating ideas, simplifying writing, and identifying resources, researchers should ultimately rely on their own professional knowledge, critical thinking, and unique insights to propose truly original arguments.

ChatGPT's Future Research Directions

Translational Medicine

Translational medicine research aims to efficiently convert the findings of fundamental research into innovative techniques and treatment protocols in clinical settings. This translation process often encounters challenges, including the overwhelming volume of data, complexity, and lack of expertise. ChatGPT can effectively aid medical researchers in overcoming these issues and making significant advancements. Mann discusses the utilization of artificial intelligence (AI) in analyzing big data as a means of identifying risk factors for diseases like diabetes and heart disease and predicting the treatment outcomes for patients with conditions such as sepsis and pneumonia.⁴⁵ However, if the training data is biased or incomplete, it could result in inaccurate outcomes that will inevitably impact patient care and treatment.⁴⁶ Consequently, future studies will concentrate on evaluating and enhancing the application of ChatGPT in translational medicine.

Personalized Medicine

Excellent doctors can comprehensively consider individual genetic profiling, physiological characteristics, psychological traits, behavioral habits, and social environmental factors of patients to make refined judgments on diagnostic and treatment strategies. ChatGPT offers the potential to deliver more accurate and tailored medical advice by utilizing

a person's genetic information and clinical data for analysis. In a study conducted by Lukac's team, the treatment recommendations of a multidisciplinary tumor board were compared with those generated by ChatGPT for 10 breast cancer patients.⁴⁷ The findings demonstrated that ChatGPT largely aligned with the universally recommended protocols for surgery, radiotherapy, and antibody therapy. Additionally, it successfully identified risk factors for hereditary breast cancer, highlighted age-related factors impacting chemotherapy, and accurately identified patients who required hormone therapy. In the future, the integration of ChatGPT with medical databases and expertise could potentially facilitate the provision of personalized precision medicine for both healthcare professionals and patients.⁴⁸

Challenges Faced by ChatGPT

Medicine should be rigorous and legitimate. Although ChatGPT shows great potential in the medical field, some limitations mentioned earlier still exist, and it is necessary to emphasize them repeatedly. Primarily, a dearth of comprehension regarding medical knowledge and a specialized medical background hampers ChatGPT's ability to delve into the intricacies of medical concepts and professional terminologies.⁴⁸ Consequently, the capacity of ChatGPT to address specific medical queries, diagnose ailments, or furnish precise medical recommendations is restricted, notwithstanding its capacity to generate responses that superficially appear rational, drawing from copious textual data. Hamed's team, in their evaluation of ChatGPT's performance in contextualizing and amalgamating clinical guidelines for diabetic ketoacidosis, discerned an alarming array of undisclosed and erroneous assertions, thereby rendering the synthesized guidelines unreliable and disorienting.⁴⁹ Future investigations must therefore emphasize augmenting the quantity and enhancing the quality of training data,⁵⁰ ensuring regular updates to said data,⁵¹ refining algorithms for medical information analysis, all with the intent of elevating the accuracy and timeliness in ChatGPT's generation of medical information.

Secondly, there are potential legal and ethical concerns associated with the utilization of ChatGPT. Improper use of ChatGPT may result in violations of copyright laws, health regulations, and other legal frameworks.⁵² The text generated by ChatGPT may contain instances of plagiarism and can perpetuate "illusions" - content generated by artificial intelligence models that are not grounded in reality, fabricating data or narratives. This may be caused by training data bias, lack of necessary information, limited understanding of the real world, or algorithmic limitations.⁵³ The unethical use of ChatGPT extends to the creation of forged data and even the generation of fake images, which can lead to academic misconduct. An effective plagiarism detection system should be utilized throughout the research and writing process. Additionally, it is important to note that ChatGPT lacks the ability to recognize the significance of information and can only reproduce existing research, lacking the capacity to generate unique insights like human scientists.⁵⁴ Therefore, it is essential to thoroughly investigate the ethical impact of ChatGPT on its users, and to establish global ethical standards for ChatGPT as a medical chatbot on an international scale.⁵⁵

Finally, utilizing ChatGPT for medical analysis entails dealing with personal medical histories and sensitive patient information, making data security a crucial aspect. However, ChatGPT currently lacks optimization in this regard, potentially posing risks of data leaks and privacy breaches.⁵⁶

Conclusion

In summation, ChatGPT is an advanced linguistic model with extensive applications and advantages within the realm of medical science. ChatGPT can provide relatively accurate diagnoses and medical advice, optimize physicians' decision-making and treatment processes; assist in writing medical documents and reports, gaining more time for attending to patients; aid in medical education by providing updated medical knowledge and personalized learning materials; and serve as a powerful auxiliary tool for scientific research, accelerating the research process and improving efficiency. Future research on ChatGPT may focus on enhancing its understanding and generative capabilities to provide more accurate and personalized medical advice. Efforts are expected to be dedicated to addressing ethical and privacy concerns associated with deploying artificial intelligence in healthcare, ensuring data protection and fair algorithms. At the same time, we should also recognize the limitations of ChatGPT's application in the medical field, which should be regarded as an auxiliary tool and not a substitute for

the authoritative opinions and decisions of medical professionals. Physicians and researchers ought to exercise prudent and judicious employment of ChatGPT while proactively addressing potential hazards, ensuring the welfare of patients and the integrity of research. The future development of ChatGPT holds considerable and far-reaching implications, necessitating our acceptance and appropriate utilization in order to ultimately furnish superior clinical services.

Data Sharing Statement

Please contact the corresponding author for data requests.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work. None of the authors have direct conflicts of interest with OpenAI.

References

1. Xu L, Sanders L, Li K, Chow J. Chatbot for Health Care and Oncology Applications Using Artificial Intelligence and Machine Learning: systematic Review. *JMIR Cancer*. 2021;7(4):e27850. doi:10.2196/27850
2. Chow J, Wong V, Sanders L, Li K. Developing an AI-Assisted Educational Chatbot for Radiotherapy Using the IBM Watson Assistant Platform. *Healthcare*. 2023;11(17):567.
3. Rebelo N, Sanders L, Li K, Chow J. Learning the Treatment Process in Radiotherapy Using an Artificial Intelligence-Assisted Chatbot: development Study. *JMIR Form Res*. 2022;6(12):e39443. doi:10.2196/39443
4. Chatterjee J, Dethlefs N. This new conversational AI model can be your friend, philosopher, and guide. and even your worst enemy. *Patterns*. 2023;4(1):100676. doi:10.1016/j.patter.2022.100676
5. Meskó B. The Impact of Multimodal Large Language Models on Health Care's Future. *J Med Internet Res*. 2023;25:e52865. doi:10.2196/52865
6. Liu S, Wright AP, Patterson BL, et al. Using AI-generated suggestions from ChatGPT to optimize clinical decision support. *J Am Med Inform Assoc*. 2023;30(7):1237–1245. doi:10.1093/jamia/ocad072
7. Hosseini M, Gao CA, Liebovitz DM, et al. An exploratory survey about using ChatGPT in education, healthcare, and research. *PLoS One*. 2023;18(10):e0292216. doi:10.1371/journal.pone.0292216
8. Wójcik S, Rulkiewicz A, Pruszczyk P, et al. Beyond ChatGPT: what does GPT-4 add to healthcare? The Dawn of a new era. *Cardiol J*. 2023. doi:10.5603/cj.97515
9. Guleria A, Krishan K, Sharma V, Kanchan T. ChatGPT: ethical concerns and challenges in academics and research. *J Infect Dev Ctries*. 2023;17(9):1292–1299. doi:10.3855/jidc.18738
10. Liu S, Wright AP, Patterson BL, et al. Assessing the Value of ChatGPT for Clinical Decision Support Optimization. *medRxiv*. 2023.
11. Rao A, Pang M, Kim J, et al. Assessing the Utility of ChatGPT Throughout the Entire Clinical Workflow. *medRxiv*. 2023.
12. Kao HJ, Chien TW, Wang WC, Chou W, Chow JC. Assessing ChatGPT's capacity for clinical decision support in pediatrics: a comparative study with pediatricians using KIDMAP of Rasch analysis. *Medicine*. 2023;102(25):e34068.
13. Johnson D, Goodman R, Patrinely J, et al. Assessing the Accuracy and Reliability of AI-Generated Medical Responses: an Evaluation of the Chat-GPT Model. *Res Sq*. 2023.
14. Walker HL, Ghani S, Kuemmerli C, et al. Reliability of Medical Information Provided by ChatGPT: assessment Against Clinical Guidelines and Patient Information Quality Instrument. *J Med Internet Res*. 2023;25:e47479. doi:10.2196/47479
15. Sonntagbauer M, Haar M, Kluge S. Artificial intelligence: how will ChatGPT and other AI applications change our everyday medical practice? *Med Klin Intensivmed Notfmed*. 2023;118(5):366–371. doi:10.1007/s00063-023-01019-6
16. Gebrael G, Sahu KK, Chigarrira B, et al. Enhancing Triage Efficiency and Accuracy in Emergency Rooms for Patients with Metastatic Prostate Cancer: a Retrospective Analysis of Artificial Intelligence-Assisted Triage Using ChatGPT 4.0. *Cancers*. 2023;15(14). doi:10.3390/cancers15143717
17. Madadin M, Alhumam AS, Bushulaybi NA, et al. Common errors in writing the cause of death certificate in the Middle East. *J Forensic Leg Med*. 2019;68:101864. doi:10.1016/j.jflm.2019.101864
18. Cascella M, Montomoli J, Bellini V, Bignami E. Evaluating the Feasibility of ChatGPT in Healthcare: an Analysis of Multiple Clinical and Research Scenarios. *J Med Syst*. 2023;47(1):33. doi:10.1007/s10916-023-01925-4
19. Patel SB, Lam K. ChatGPT: the future of discharge summaries? *Lancet Digit Health*. 2023;5(3):e107–e108. doi:10.1016/S2589-7500(23)00021-3
20. Dunn C, Hunter J, Steffes W, et al. Artificial intelligence-derived dermatology case reports are indistinguishable from those written by humans: a single-blinded observer study. *J Am Acad Dermatol*. 2023;89(2):388–390. doi:10.1016/j.jaad.2023.04.005
21. Ali SR, Dobbs TD, Hutchings HA, Whitaker IS. Using ChatGPT to write patient clinic letters. *Lancet Digit Health*. 2023;5(4):e179–e181. doi:10.1016/S2589-7500(23)00048-1
22. Rao A, Kim J, Kaminen M, et al. Evaluating ChatGPT as an Adjunct for Radiologic Decision-Making. *medRxiv*. 2023.

23. Rau A, Rau S, Zoeller D, et al. A Context-based Chatbot Surpasses Trained Radiologists and Generic ChatGPT in Following the ACR Appropriateness Guidelines. *Radiology*. 2023;308(1):e230970. doi:10.1148/radiol.230970
24. Hwang SI, Lim JS, Lee RW, et al. Is ChatGPT a “Fire of Prometheus” for Non-Native English-Speaking Researchers in Academic Writing? *Korean J Radiol*. 2023;24(10):952–959. doi:10.3348/kjr.2023.0773
25. Lee H. The rise of ChatGPT: exploring its potential in medical education. *Anat Sci Educ*. 2023. doi:10.1002/ase.2270
26. Mohammad B, Supti T, Alzubaidi M, et al. The Pros and Cons of Using ChatGPT in Medical Education: a Scoping Review. *Stud Health Technol Inform*. 2023;305:644–647. doi:10.3233/SHTI230580
27. Ali K, Barhom N, Tamimi F, Duggal M. ChatGPT-A double-edged sword for healthcare education? Implications for assessments of dental students. *Eur J Dent Educ*. 2023.
28. Meo SA, Al-Masri AA, Alotaibi M, Meo M, Meo M. ChatGPT Knowledge Evaluation in Basic and Clinical Medical Sciences: multiple Choice Question Examination-Based Performance. *Healthcare*. 2023;11(14). doi:10.3390/healthcare11142046
29. Han Z, Battaglia F, Udayar A, Fooks A, Terlecky SR. An explorative assessment of ChatGPT as an aid in medical education: use it with caution. *Med Teach*. 2023;1–8. doi:10.1080/0142159X.2023.2271159
30. Scherr R, Halaseh FF, Spina A, Andalib S, Rivera R. ChatGPT Interactive Medical Simulations for Early Clinical Education: case Study. *JMIR Med Educ*. 2023;9:e49877. doi:10.2196/49877
31. Webb JJ. Proof of Concept: using ChatGPT to Teach Emergency Physicians How to Break Bad News. *Cureus*. 2023;15(5):e38755. doi:10.7759/cureus.38755
32. Datt M, Sharma H, Aggarwal N, Sharma S. Role of ChatGPT-4 for Medical Researchers. *Ann Biomed Eng*. 2023. doi:10.1007/s10439-023-03336-5
33. Moons P, Van Bulck L. ChatGPT: can artificial intelligence language models be of value for cardiovascular nurses and allied health professionals. *Eur J Cardiovasc Nurs*. 2023;22:e55–e59. doi:10.1093/eurcn/zvad022
34. Branum C, Schiavenato M. Can ChatGPT Accurately Answer a PICOT Question? Assessing AI Response to a Clinical Question. *Nurse Educ*. 2023;48(5):231–233. doi:10.1097/NNE.0000000000001436
35. Tang A, Li KK, Kwok KO, et al. The importance of transparency: declaring the use of generative artificial intelligence (AI) in academic writing. *J Nurs Scholarsh*. 2023. doi:10.1111/jnu.12938
36. Asselah T, Durantel D, Pasmant E, Lau G, Schinazi RF. COVID-19: discovery, diagnostics and drug development. *J Hepatol*. 2021;74(1):168–184.
37. Blanco-González A, Cabezon A, Seco-González A, et al. The Role of AI in Drug Discovery: challenges, Opportunities, and Strategies. *Pharmaceuticals*. 2023;16(6):891. doi:10.3390/ph16060891
38. Heck TG. What artificial intelligence knows about 70 kDa heat shock proteins, and how we will face this ChatGPT era. *Cell Stress Chaperones*. 2023;28(3):225–229. doi:10.1007/s12192-023-01340-1
39. Zhao A, Wu Y. Future implications of ChatGPT in pharmaceutical industry: drug discovery and development. *Front Pharmacol*. 2023;14:1194216. doi:10.3389/fphar.2023.1194216
40. Wang R, Feng H, Wei GW. Chatbots in Drug Discovery: a Case Study on Anti-Cocaine Addiction Drug Development with ChatGPT. *ArXiv*. 2023.
41. Lv H, Shi L, Berkenpas JW, et al. Application of artificial intelligence and machine learning for COVID-19 drug discovery and vaccine design. *Brief Bioinform*. 2021;22(6). doi:10.1093/bib/bbab320
42. Karki N, Verma N, Trozzi F, et al. Predicting Potential SARS-COV-2 Drugs-In Depth Drug Database Screening Using Deep Neural Network Framework SSnet, Classical Virtual Screening and Docking. *Int J Mol Sci*. 2021;22(4):1573. doi:10.3390/ijms22041573
43. Marchant J. Powerful antibiotics discovered using AI. *Nature*. 2020. doi:10.1038/d41586-020-00018-3
44. Bhargava DC, Jadav D, Meshram VP, Kanchan T. ChatGPT in medical research: challenging time ahead. *Med Leg J*. 2023;258172231184548.
45. Mann DL. Artificial Intelligence Discusses the Role of Artificial Intelligence in Translational Medicine: a JACC: basic to Translational Science Interview With ChatGPT. *JACC Basic Transl Sci*. 2023;8(2):221–223. doi:10.1016/j.jacbts.2023.01.001
46. Huynh LM, Bonebrake BT, Schultis K, Quach A, Deibert CM. New Artificial Intelligence ChatGPT Performs Poorly on the 2022 Self-assessment Study Program for Urology. *Urol Pract*. 2023;10(4):409–415. doi:10.1097/UPJ.0000000000000406
47. Lukac S, Dayan D, Fink V, et al. Evaluating ChatGPT as an adjunct for the multidisciplinary tumor board decision-making in primary breast cancer cases. *Arch Gynecol Obstet*. 2023;308:1831–1844. doi:10.1007/s00404-023-07130-5
48. Temsah MH, Jamal A, Aljamaan F, Al-Tawfiq JA, Al-Eyadhy A. ChatGPT-4 and the Global Burden of Disease Study: advancing Personalized Healthcare Through Artificial Intelligence in Clinical and Translational Medicine. *Cureus*. 2023;15(5):e39384. doi:10.7759/cureus.39384
49. Hamed E, Eid A, Alberry M. Exploring ChatGPT’s Potential in Facilitating Adaptation of Clinical Guidelines: a Case Study of Diabetic Ketoacidosis Guidelines. *Cureus*. 2023;15(5):e38784. doi:10.7759/cureus.38784
50. Ferdush J, Begum M, Hossain ST. ChatGPT and Clinical Decision Support: scope, Application, and Limitations. *Ann Biomed Eng*. 2023. doi:10.1007/s10439-023-03329-4
51. Vaishya R, Misra A, Vaish A. ChatGPT: is this version good for healthcare and research? *Diabetes Metab Syndr*. 2023;17(4):102744. doi:10.1016/j.dsx.2023.102744
52. Dave T, Athaluri SA, Singh S. ChatGPT in medicine: an overview of its applications, advantages, limitations, future prospects, and ethical considerations. *Front Artif Intell*. 2023;6:1169595. doi:10.3389/frai.2023.1169595
53. Choi W. Assessment of the capacity of ChatGPT as a self-learning tool in medical pharmacology: a study using MCQs. *BMC Med Educ*. 2023;23(1):864. doi:10.1186/s12909-023-04832-x
54. King MR. A Conversation on Artificial Intelligence, Chatbots, and Plagiarism in Higher Education. *Cell Mol Bioeng*. 2023;16(1):1–2. doi:10.1007/s12195-022-00754-8
55. Chow J, Sanders L, Li K. Impact of ChatGPT on medical chatbots as a disruptive technology. *Front Artif Intell*. 2023;6:1166014. doi:10.3389/frai.2023.1166014
56. Sallam M. ChatGPT Utility in Healthcare Education, Research, and Practice: systematic Review on the Promising Perspectives and Valid Concerns. *Healthcare*. 2023;11(6):67.

International Journal of General Medicine**Dovepress****Publish your work in this journal**

The International Journal of General Medicine is an international, peer-reviewed open-access journal that focuses on general and internal medicine, pathogenesis, epidemiology, diagnosis, monitoring and treatment protocols. The journal is characterized by the rapid reporting of reviews, original research and clinical studies across all disease areas. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/international-journal-of-general-medicine-journal>