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Review

ChatGPT and healthcare: Is the future already here? Opportunities, challenges, and ethical concerns. A narrative mini-review

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Abstract. ChatGPT is an artificial intelligence (AI) powered chatbot trained on vast human language databases able to generate human-like answers to a wide variety of questions and topics. It uses natural language processing and machine learning algorithms to understand and answer users' questions simulating human interaction. ChatGPT has recently received wide attention for its performance in different areas of common life and it can be perfectly used in healthcare with great perspectives. It can improve patient outcomes, increase efficiency, disseminate medical knowledge, and has the potential to transform healthcare since it continues to evolve and play an increasingly important role. In this paper we analyze how this technology can impact healthcare and revolutionize the traditional approach to Medicine, by examining the opportunities for patients and health professionals (including medical education, research, and academic scientific production), but also the challenges and ethical issues concerning its use. We are at the very beginning of a new era, filled with light and shadow, and further improvements and regulations are needed to ensure its proper use in healthcare. (www.actabiomedica.it)

Key words: ChatGPT, artificial intelligence, AI, natural language processing, medical education, scientific writing, healthcare

ChatGPT: A new approach to old problems

ChatGPT is an artificial intelligence (AI) powered chatbot that can simulate human interactions. It was developed by OpenAI, an artificial intelligence research center founded in 2015 by a group of technology pioneers, including Elon Musk, Sam Altman, Greg Brockman, Ilya Sutskever, John Schulman, and Wojciech Zaremba, to develop AI designed for human applications (1,2). Launched in November 2022, ChatGPT is based on the "gpt-3.5-turbo" model in the GPT-3.5 series. It has been trained on vast human language databases, by using millions of data from Internet products, enabling it to generate human-like answers to a wide variety of questions and topics. It uses natural language processing (NLP) and machine learning algorithms to understand and answer users' questions in chat. NLP is a subfield of Artificial Intelligence (AI) that focuses on the interaction between computers and human language. It involves developing algorithms and computational models that enable computers to understand, interpret, and reproduce human language (3). NLP is used in many applications, including machine translation, emotional intelligence,

speech recognition, and chatbots. NLP algorithms often involve a combination of statistical models and rule-based techniques. These algorithms are trained from large collections of text, allowing them to learn patterns and relationships between words. Some of the main challenges in NLP include the ambiguity and complexity of human language and the need to account for cultural and linguistic differences. One of NLP's main areas of focus is machine translation, which includes automatic translation from one language to another. Machine translation has made significant strides in recent years and is now used in a wide variety of applications including online translation services and mobile apps (4). Another important aspect of NLP is sentiment analysis, which involves the authors analyzing the text to determine the tone or mood. It has many applications, including social media monitoring, customer analysis, and market research. Speech recognition is another important part of NLP that involves converting spoken words to text; it can be used for virtual assistants, dictation software, and voice control tools (5). Finally, chatbots are a rapidly growing field of NLP to interact with users like humans. Chatbots have many uses, including customer service, personal assistants, and mental health support. ChatGPT has received wide attention for its performance, including passing graduate-level exams in business, law, and medical schools; it can be perfectly used for global health research with great perspectives.

ChatGPT and healthcare: Opportunities for patients and healthcare professionals

ChatGPT has several potential applications in the healthcare field, including providing timely information and support to patients, answering health-related questions, providing advice on symptoms and treatment options, reminding patients to take their medication, or facilitating appointments (ultimately improving patient compliance and outcomes). It can contribute to the development of various health education materials to promote good health education in the community (6). It can improve the communication between patients and doctors, even facilitating virtual interaction, thus being especially useful in rural communities and remote areas where access to in-presence healthcare is limited. The use of AI-powered chatbots like Telemedicine and ChatGPT can improve access to healthcare and provide 24/7 medical advice and support from the comfort of your home (7). Given these facilities, integrating AI into chatbots and virtual assistants not only can improve patient care but even reduce healthcare costs in many ways. For example, it can simplify procedures, increase efficiency, and reduce costs associated with routine work, enabling medical personnel to focus on complex tasks. ChatGPT can also be used to provide information and support to patients in real-time, improving the quality of care they receive (8). ChatGPT can improve patient health education and make it easier for them to understand their health and make informed decisions about their care by creating tailored content based on the patient's literacy level and thinking level (9). This can lead to better patient outcomes and increased patient satisfaction (4,6,10).

Some examples of ChatGPT applications in healthcare are explained in more detail below:

- Personal Health Information: ChatGPT has access to medical information available on the Internet and which is based on real clinical data, clinical procedures, and guidelines. This makes it useful to provide patients with updated information on their problems and personal counseling, ultimately reducing work in care centers.
- User-friendly content: ChatGPT can generate text from the first-person perspective of laymen and medical professionals (11). This makes it possible to record the symptoms given by illiterate patients, reconstruct them as prescribed by medical professionals, and make an appropriate diagnosis. This will encourage patients and enable them to make informed decisions.
- Medical Education and Research: ChatGPT can be used to deliver virtual teaching models to medical students around the world, especially those who do not have access to teaching materials (12,13). This will revolutionize and democratize medical education by liberating and disseminating knowledge and will improve the quality of physicians worldwide and

ultimately patient outcomes (14). It can also be used to create learning materials such as research papers and quizzes that can help medical students stay connected with new medical information and instruction. ChatGPT can create customized content based on medical students' learning needs and interests. This can help medical students learn better, and improve the quality of their learning and their medical education, to prepare them for their future careers. Physicians can improve their quality of work, communicate effectively with patients and other physicians, and continuously seek to improve their skills and knowledge by following the latest medical updates and guidelines. Furthermore, ChatGPT will facilitate clinical research through rapid analysis of large clinical data, identification of complex patterns in clinical data, and correlation between drug production (15,16).

- Reporting: ChatGPT can be used to generate different types of reports such as patient discharge information using short instructions (17). This saves doctors time and increases the accuracy and completeness of reporting. It also has the potential to be used in drug development and production, where large amounts of data from research articles and documents can be analyzed to identify drug targets and predict how compounds will interact with target proteins.

Based on these general considerations, ChatGPT can improve patient outcomes and access to healthcare in many ways.

Healthcare professionals can improve the quality of their work and their interaction with patients in several ways:

- Faster, more accurate diagnosis: ChatGPT can help doctors make faster, more accurate diagnoses by analyzing large volumes of medical data and providing recommendations to doctors. This can lead to early diagnosis of the disease and better treatment, and ultimately improve patient outcomes.
- Auto-complete medical text: ChatGPT can be used to complete all sentences in the medical text, ultimately saving doctors time.
- Extracting Information from Inappropriate Text: ChatGPT can extract and transcribe important information from harmless medical records or use it to create electronic medical records. This can digitize medical records and make it easier for doctors to access and verify patient information.
- Improved Efficiency: ChatGPT can help doctors generate reports like patient discharge information faster and more accurately (14). It can be used as a diagnostic tool during personal consultation, reducing the workload of primary care centers. This can help doctors focus on difficult cases, increasing the effectiveness of treatment with different tools, saving time for physicians, and ultimately improving patient outcomes by providing them with accurate and complete information (18).

Chat GPT in medical writing

ChatGPT can be a useful tool in medical writing, especially for creating the context or content of medical research articles. It can analyze the content of research articles and create summaries that capture key findings and conclusions in short, easy-to-read text. This saves time and effort for medical writers and researchers who need to review and write large abstracts of research papers. However, it is important to note that ChatGPT is not a substitute for human skill and judgment in medical writing. In fact, while it can create the contents quickly and efficiently, it cannot capture the nuance or complexity of research findings and may miss important research-related content or topics (19). This can lead to inaccurate or incomplete content and with the risk of bias and serious consequences for clinical writing. Another pitfall is the risk of plagiarism, because the content produced may be similar to original research papers or other sources. It is important to ensure that the content produced is original and accurately expressed in order not to encounter any ethical or legal problems (20,21). However, ChatGPT can be

used to create relevant content that is handled and distributed appropriately, which helps avoid distractions and ensures that the content produced is professional, fair, and legal. It is important to note that ChatGPT is not a substitute for human intelligence and judgment in detecting and preventing crime. Medical writers and researchers should always use their critical thinking and analytical skills to evaluate the content produced and ensure it is original and accurate (22). They should also use plagiarism detection software and other tools to identify potential plagiarism and ensure their work is fair and legal. Finally, there is a risk of over-reliance on ChatGPT, which can lead to a lack of thought and analysis in medical writing. It is important to use ChatGPT as a complement rather than a substitute for human intelligence and judgment and to evaluate the accuracy, completeness, and accuracy of the content produced (19,23,24).

Chat GPT and Google Doctor: What's the difference?

ChatGPT and Google Search differ in many ways. Google Search provides a list of web pages that may contain the information the user is looking for (25), while ChatGPT is an artificial intelligence-powered chatbot that can chat with the user to provide personal information and additional details. It can understand natural language and generate human-like responses, while Google Search relies on keywords and algorithms to match user queries to web pages. Also, ChatGPT can provide detailed information on a variety of topics, while Google only searches for information available on the web. However, Google Search is generally faster and more efficient at retrieving data, while ChatGPT takes longer to generate a response due to its interactive nature. Finally, the choice between ChatGPT and Google Search is made based on the user's needs and preferences, as well as the type of information required. Patients should be taught how to use ChatGPT correctly and safely. While ChatGPT can be a valuable tool for patients to access medical information and support, it is important to ensure that patients understand its limitations and risks. Patients should be told that ChatGPT cannot replace medical advice from a qualified physician and that they should consult a regular physician for any concerns or problems (26). In addition, patients should be taught how to use ChatGPT correctly, including how to ask questions and interpret answers, and report errors or concerns. By providing patients with adequate advice and information, physicians can help ensure the safe and effective use of ChatGPT to improve patient care (27).

ChatGPT and its revolutionary role in healthcare: Challenges, limitations, and ethical issues

Some important issues and criticisms regarding the use of ChatGPT need to be resolved. While AI chatbots have the potential to revolutionize healthcare, there are some downsides and concerns to consider. One of the main issues is to ensure the accuracy and reliability of the information provided by chatbots. Because ChatGPT is data- and algorithm-dependent, it is important to ensure that it is trained with clear and accurate data so as not to harm patients (26). This will affect the accuracy and integrity of the model output. Another challenge is the need for quality data that may not be found in international health studies to inform the model. Finally, there are concerns about the interpretation of the generated sample and the potential for bias. To solve these problems, it should be confirmed that the data are diverse and representative, and regular analyzes of the samples should be performed. In addition, efforts should be made to improve the quality of data used in global health research and to develop methods for interpreting emerging trends. Collaboration with various groups of researchers and experts in the development and training of the process is also recommended to identify and fix errors that may lead to unfair benefits.

ChatGPT has several limitations, including its inability to comprehend intricate inquiries, its potential to spread misinformation and propaganda, and its susceptibility to bias and manipulation which can have severe consequences for individuals and society as a whole. The training data used to develop ChatGPT may not be representative of the diverse patient populations encountered in healthcare (with gender and racial biases), which could lead to biased results. This is true even when considering its use in scientific writing

since there is a risk that ChatGPT could produce content that is not original or accurate and so compromises academic integrity. Individuals from different cultural, linguistic, and socioeconomic backgrounds, as well as experts in fields such as ethics, law, and social science, should be involved in this revision process to ensure that ChatGPT is used in a way that is sensitive to the needs and perspectives of different communities and to prevent dataset bias. ChatGPT might not be able to differentiate between factual information and fiction, with a tendency to generate incorrect information. Inherent hallucination is a challenge where ChatGPT generates new data or information that does not exist. Researchers are addressing this challenge through algorithmic improvements, such as fine-tuning the model to reduce the likelihood of generating hallucinations. Other limits are represented by a lack of coherence where ChatGPT may generate responses that are not coherent or relevant to the conversation and by its over-detailed nature that can result in inappropriate answers when a direct answer is required. This is because ChatGPT tends to approach a topic from multiple angles, resulting in verbose and comprehensive responses that may not directly answer the user's question. This aspect can limit its effectiveness in tasks that require a direct answer or a concise response and it can result in inappropriate answers or irrelevant information that does not address the user's question. To address this limitation, new techniques should be developed to improve ChatGPT's ability to generate concise and accurate responses. Another challenge is the need to balance the benefits of technology with patient privacy and data protection. The use of artificial intelligence in healthcare requires the collection and storage of large amounts of personal health information, raising serious concerns about data privacy and security (28). Privacy and security safeguards must be in place to ensure that patient information is effectively protected and used. The use of AI in healthcare must comply with regulations such as the General Data Protection Regulation (GDPR) and the Health Insurance Portability and Accountability Act (HIPAA) to ensure patient rights are protected and chatbots are used fairly (28). To address this aspect, researchers should work to ensure that the model is used in a way that respects individual rights and freedoms, with the necessary safeguards to protect privacy and prevent abuse. Finally, the development and use of ChatGPT in global health research require transparency and accountability; this can be achieved through open communication and handshaking from researchers, policymakers, and other stakeholders. To overcome this limit policymakers and regulators should establish guidelines and standards for the ethical and responsible use of artificial intelligence (and chatbot systems), particularly in sensitive areas such as healthcare. Data and algorithms used by the chatbot should provide more transparency so that we can comprehend the reasoning behind their decision-making processes.

Another concern is the potential absence of human interaction which is the key to the patient-physician relationship and an essential part of patient care, and the need to ensure that the tool is used according to Hippocrates' law of "do no harm" (29,30). Solving ethical issues and complementing ChatGPT and integrating it into treatment is important to ensure technology is used while improving the quality of care for all patients, and protecting their privacy, safety, and security.

ChatGPT today and tomorrow: Future perspectives

ChatGPT has promising future perspectives in healthcare: some possible future directions include improving conversational capabilities, personalization, multimodal design, and trustworthiness. ChatGPT's limitations can be addressed through further research and development, such as incorporating new training data, refining the model's architecture, or developing new evaluation metrics to assess its performance. Additionally, exploring new techniques is essential to improve ChatGPT's ability to generate concise and accurate responses, as well as address its limitations in areas such as reasoning, mathematical problem-solving, and reducing bias. Researchers are addressing this challenge by developing methods to detect and correct biased content through algorithmic improvements (to upgrade the model's understanding of context) and by incorporating personalized prompts to enhance user satisfaction and quality. Increasing domain knowledge in a particular topic or domain, such as healthcare, could be accomplished by fine-tuning a particular

dataset. This may result in answers that are more precise and tailored. For instance, if we want to increase ChatGPT's capacity to offer tailored responses to customers in the medical field, we could do so by including more information about medical history and contemporary medical advancements in blogs, social media platforms, and periodicals. Additionally, more diverse data and a deeper comprehension of linguistic nuance would ultimately lead to more personalized recommendations and responses. Furthermore, researchers are working to improve the model's accuracy and reduce the likelihood of generating false or misleading content through techniques such as fact-checking and advanced verification. ChatGPT should improve multimodal design by incorporating multiple modes of communication, such as text, images, and voice, to enhance the user experience by developing new techniques for multimodal processing and integrating different modalities into the model's architecture.

ChatGPT has the potential to revolutionize healthcare by assisting with diagnostic accuracy and precision. For example, in the field of image analysis, the generation of meaningful insights from the textual information provided by ChatGPT can be possible by the platform which should have the capability of processing different types of image data, such as medical images, and pathology slides. Furthermore, ChatGPT could be improved to enhance the efficiency of medical workflows by automating certain tasks, such as report writing and data analysis. It is not only a secondary aspect since this could free up health professionals' time to focus on more meaningful work, such as patient care and research.

The benefits of ChatGPT for the future should be considered in all areas (including education) by enhancing its efficiency to improve personalized and collaborative learning, access to information, language skills, and time efficiency. Anyway, care should be taken in order not to be dependent on ChatGPT since it could hinder the development of important life skills, such as critical thinking and problem-solving.

Conclusions

ChatGP can improve patient outcomes, increase efficiency, disseminate medical knowledge, and has the potential to transform healthcare as it continues to evolve and play an increasingly important role. Anyway, some ethical issues should not be underrated, such as the accuracy and reliability of the information, the need for data privacy and security, the need for transparency and accountability, and the potential to replace human interaction between health professionals and patients. We've started something brand new whose real potentials have just been partially explored: it is now up to us to familiarize ourselves with this technology, by interpreting the potential and limits, to improve AI, the efficiency of our work, and the quality of healthcare worldwide.

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