

ChatGPT in medical writing: enhancing healthcare communication through artificial intelligence and human expertise

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ABSTRACT

This study explores the capabilities and limitations of ChatGPT, an advanced language model, in medical writing. Leveraging the GPT-4 architecture, ChatGPT has shown potential in aiding various stages of medical article creation, including planning, drafting, revising, and even submission processes. It can summarize extensive literature, suggest research questions, and assist in multi-language research, making it a versatile tool for initial research and planning. During revisions, ChatGPT's strengths lie in improving language, ensuring consistency, and enhancing readability. Despite its abilities, ChatGPT has several limitations. ChatGPT's training data only updates with each new version release, which could result in outdated or incomplete research. It also lacks the critical thinking, domain expertise, and ethical considerations that human researchers bring to medical writing. While ChatGPT can be a useful tool for routine tasks and initial drafts, human expertise remains critical for generating high-quality, ethical, and insightful medical research articles. Therefore, a hybrid approach that combines the computational power of ChatGPT with the intellectual and ethical rigor of human experts is recommended for optimizing medical writing processes.

Keywords: Artificial intelligence, language models, medical writing, research methodology

INTRODUCTION

In recent years, artificial intelligence (AI) has made significant advancements, offering innovative solutions across various industries, including the medical field.^{1,2} Among these AI applications, ChatGPT, an advanced language model developed by OpenAI, has emerged as a revolutionary tool with remarkable capabilities in generating human-like text.³ As ChatGPT has evolved from version 1.0 to 4.0, it has significantly advanced in capabilities. ChatGPT 1.0 offered basic text-based communication and small talk. Version 2.0 showed improvement in contextual understanding, provided more relevant responses, and recognized basic emotions. ChatGPT 3.0 introduced advanced algorithms for personalized responses and multilingual support. 3.5 version further enhanced natural language generation, story creation, and emotion recognition. The latest version, ChatGPT 4.0, added voice-based communication through integration with voice assistants and improved reasoning and decision-making. It also enhanced its ability to handle complex conversations by integrating with external data sources,

including real-time data.⁴ Leveraging the GPT-4 architecture, ChatGPT has demonstrated its potential in assisting with medical writing. This is a niche area that requires extensive knowledge, accuracy, and precision in language.^{5,6}

Medical writing is a multifaceted process involving several phases, including initial data collection, drafting, editing, and peer review.⁷ As medical writing serves as the foundation for disseminating crucial health-related information to both professionals and the general public, ensuring the accuracy and integrity of content is paramount. ChatGPT's proficiency in processing and analyzing vast amounts of information allows it to contribute effectively to each phase of medical writing, streamlining the process while maintaining high-quality standards.^{5,6} In this article, we will explore the various roles that ChatGPT can play in the medical writing phases, emphasizing its significance and potential benefits for healthcare communication.

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PLANNING AND RESEARCH

ChatGPT, an AI language model, offers a range of advantages and disadvantages when used in planning and research for medical article writing.^{5,6} ChatGPT can significantly reduce the time spent on initial research by quickly generating summaries, background information, and potential research questions, thereby helping researchers streamline their work.^{7,8} ChatGPT can rapidly generate a summary of recent studies on a specific disease, like Type 2 diabetes, summarizing key findings from various medical journals, thus speeding up the initial research phase (Figure 1). This efficiency allows medical professionals to focus on more complex tasks or explore additional research

avenues. The AI tool has been trained on a large volume of text, including medical literature, which allows it to provide relevant information, facts, and suggestions for researchers.⁹ Additionally, ChatGPT can work with multiple languages, helping researchers access and understand content in different languages and facilitate international collaboration.¹⁰ This multilingual support can aid in the dissemination of medical knowledge and foster global research networks.

Despite these benefits, ChatGPT's training data only updates with each new version release.⁴ It may not have information on more recent advancements, publications, or guidelines in the medical field.³ This limitation could result in gaps in knowledge and

The screenshot shows a chat window with the following content:

You
Could you generate a summary of recent studies for Type 2 diabetes?

ChatGPT
Recent studies in 2023 have made significant progress in understanding and managing Type 2 diabetes. Here's a summary of some key findings and advancements:

- American Diabetes Association's 2023 Standards of Care:** This comprehensive guide emphasizes updates in areas like obesity, hypertension, heart failure medication, social determinants of health, and lipid management. Notable updates include supporting higher weight loss (up to 15%) with new medications, recommendations related to sleep health and physical activity, broad consideration of social determinants of health, new hypertension diagnosis cut-offs, and the expanded role of specific medications [**].
- Large-Scale Genetic Study:** A significant study by Weill Cornell Medicine and the National Institutes of Health examined the complex genetics behind Type 2 diabetes. The research involved a comprehensive approach to understand the contribution of 20 genes, using CRISPR-Cas9 gene editing. This study highlighted the importance of understanding the genetic aspects of diabetes to improve treatment strategies [**].
- Johns Hopkins Research on Beta-Cells:** A study at Johns Hopkins Medicine found that beta-cells in Type 2 diabetes patients are deficient in a protein called PITPNA, crucial for insulin granule formation. By restoring PITPNA, insulin production is improved, offering a potential therapeutic option [**].
- Nature Communications Research:** A study published in Nature Communications focused on cotadutide, a medication that showed promise in reducing liver glycogen and fat in people with Type 2 diabetes who are overweight or obese. Another study identified the role of RFX6 in early-stage Type 2 diabetes, influencing chromatin architecture at multiple risk loci [**].
- Texas A&M University Study on p38 α MAPK and FOXO1 Protein:** This study revealed

At the bottom of the chat window, there is a text input field containing "Message ChatGPT..." and a green send button.

Figure 1. ChatGPT's utility in medical research summarization

necessitate additional research to ensure accuracy and relevance. While generally reliable in the context of medical research, ChatGPT can occasionally produce incorrect or misleading information.⁵ This is particularly concerning in the medical field, where accuracy is critical. Researchers using ChatGPT must be vigilant and thoroughly verify any information provided by the AI tool to avoid perpetuating misinformation.^{5,6}

The use of AI-generated content in medical research raises ethical questions, such as the potential for plagiarism, the validity of AI-generated data, and the responsibility for any errors.^{6,11} Researchers must navigate these ethical considerations carefully when using ChatGPT to ensure the integrity of their work. Lastly, ChatGPT may not always be able to provide context-specific information or critically evaluate conflicting evidence, a crucial skill in medical research.⁷ Human researchers must continue to use their expertise and critical thinking skills to make informed decisions and assessments. We have given some prompts for planning and research prior to composing a medical article (Figure 2).

HUMAN RESEARCHERS' EXPERTISE CRUCIAL IN CREATING HIGH-QUALITY RESEARCH ARTICLES

Creating a research article involves several steps, including identifying the main topic, establishing a structure with main and subordinate headings, choosing and presenting evidence, and continuously reviewing and improving the outline (Figure 3).¹² Human researchers have the advantage of subject matter expertise, the ability to identify research gaps and prioritize information, and critical evaluation skills to select reliable and relevant evidence.¹³ Additionally, they can adapt and refine the article structure based on feedback from peers or experts in the field to ensure clarity, coherence, and readability.¹⁴

In contrast, ChatGPT's capabilities, such as identifying the main topic, generating headings, and selecting supporting evidence, are limited by its training data and lack of domain expertise. While it can make basic text revisions, it may struggle with addressing inconsistencies, redundancies, or structural gaps in an article.¹⁵

"Summarize a recent research article on [specific topic or medical condition]."
"Provide an overview of the current understanding of [specific disease or disorder]."
"Discuss the pros and cons of [specific treatment method] for [specific condition]."
"Explain the role of [specific factor, e.g., lifestyle, genetics] in the development or management of [specific medical condition]."
"Review the latest advancements in the treatment of [specific medical condition]."
"Analyze the implications of a recent medical breakthrough for [specific patient population]."
"Describe the challenges and potential solutions for improving healthcare access in [specific region or population]."
"Explain the significance of [specific medical study or clinical trial] and its impact on future research or clinical practice."
"Evaluate the effectiveness of [specific public health intervention] in addressing [specific health issue]."

Figure 2. Some prompts for planning and research prior to composing a medical article

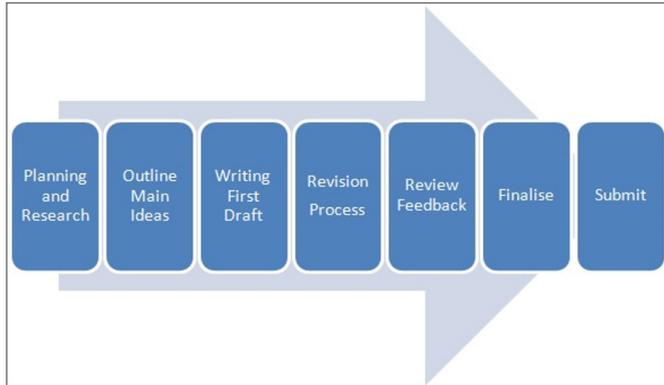


Figure 3. The process of creating a research article

While ChatGPT is an advanced language model capable of generating human-like text, unlike human researchers, it lacks the critical thinking skills necessary to identify gaps in research, question assumptions, and provide a balanced perspective on complex medical issues.¹⁶ This may lead to inaccuracies or oversimplifications in generated content.

Although ChatGPT can generate text that appears to convey intricate concepts, novel techniques, and specialized terminology, its understanding of complex

medical ideas is limited.¹⁶ Consequently, its inability to fully grasp these concepts may lead to misunderstandings or misrepresentations in the articles it generates.

ChatGPT’s limited understanding of ethical guidelines in medical research could lead to unintentional ethical breaches, such as in patient privacy or conflict of interest disclosure, underscoring the need for human oversight.¹⁷⁻¹⁹ It is required for all authors to submit an international committee of medical journal editors (ICMJE) disclosure form when publishing their work (Figure 4). Without the human capacity to navigate ethical challenges, the generated content may not meet the high standards of integrity and professionalism expected in the medical field.

The contextual awareness and historical understanding that human researchers bring to medical topics may not be fully captured by ChatGPT.²⁰ As a result, it may struggle to draft articles that are insightful, relevant, and contribute meaningfully to the ongoing discourse in the field. This limitation could lead to superficial or outdated content that does not accurately reflect current debates and future directions.

ICMJE DISCLOSURE FORM

Date:

Your Name:

Manuscript Title:

Manuscript Number (if known):

In the interest of transparency, we ask you to disclose all relationships/activities/interests listed below that are related to the content of your manuscript. "Related" means any relation with for-profit or not-for-profit third parties whose interests may be affected by the content of the manuscript. Disclosure represents a commitment to transparency and does not necessarily indicate a bias. If you are in doubt about whether to list a relationship/activity/interest, it is preferable that you do so.

The author’s relationships/activities/interests should be defined broadly. For example, if your manuscript pertains to the epidemiology of hypertension, you should declare all relationships with manufacturers of antihypertensive medication, even if that medication is not mentioned in the manuscript.

In item #1 below, report all support for the work reported in this manuscript without time limit. For all other items, the time frame for disclosure is the past 36 months.

	Name all entities with whom you have this relationship or indicate none (add rows as needed)	Specifications/Comments (e.g., if payments were made to you or to your institution)
Time frame: Since the initial planning of the work		
1	All support for the present manuscript (e.g., funding, provision of study materials, medical writing, article processing charges, etc.) No time limit for this item.	<input type="text" value="None"/> <input type="text"/> <input type="text"/> <input type="text" value="Click the tab key to add additional rows."/>

Figure 4. ICMJE disclosure form

Lastly, ChatGPT lacks emotional intelligence, which is essential when addressing sensitive topics or discussing significant implications for patient care and well-being.²¹ Without the human capacity for empathy, compassion, and ethical responsibility, it may generate content that is insensitive, disrespectful, or fails to consider the potential impact of the information presented.²²⁻²⁴ This limitation hinders its ability to communicate complex medical information with the appropriate level of sensitivity and understanding.

CHATGPT'S VALUE IN THE REVISION PROCESS OF MEDICAL ARTICLES

ChatGPT's benefits can be utilized during the revision process, where its ability to maintain a consistent writing style, work with multiple languages, refine language and grammar, and identify inconsistencies can improve the overall presentation and readability of the article.²⁵ ChatGPT can also generate alternative phrasings, restructure sentences, and suggest improvements in clarity and conciseness, enhancing the final draft while adhering to the stylistic requirements of various medical journals and conferences.²⁶

Another advantage of ChatGPT in the revision process is its ability to quickly process large volumes of text, which can be particularly beneficial when working on lengthy or complex medical articles.^{5,6} This time-saving aspect allows researchers to focus on other essential aspects of their work, such as data analysis or experimental design, without sacrificing the quality of their written output. Additionally, ChatGPT can detect repetitive phrases or overused terms and suggest more varied language to diversify the content and maintain reader engagement.

ChatGPT can assist authors in revising medical articles by identifying and suggesting the removal of unnecessary information, ensuring coherence throughout the text, and addressing potential biases.²⁶⁻²⁸ Its ability to detect redundant statements or irrelevant content helps to create a more focused and concise article. Additionally, ChatGPT can help maintain a logical flow, checking for coherence between the introduction, main points, and conclusion, as well as within each section. Moreover, it can highlight areas where potential biases might be present, promoting a more objective presentation of evidence and claims.

THE IMPORTANCE OF HUMAN EXPERTISE IN REVIEWING MEDICAL ARTICLES

During the revision process, ChatGPT's benefits become evident, particularly in maintaining a consistent writing

style, working with multiple languages, refining language and grammar, and identifying inconsistencies, all of which improve the overall presentation and readability of the article.²⁹ Colleagues and mentors can provide insights that stem from their own research experiences and familiarity with the field, which can help the author refine their argument, clarify their presentation, and address any gaps or inconsistencies.²⁹

On the other hand, ChatGPT may fall short in the review process of medical articles for several reasons. Firstly, it lacks the deep understanding of specific research areas and the contextual knowledge that human reviewers possess.⁶ This limits its ability to evaluate the relevance and importance of the article's findings within the broader context of the field or suggest additional sources or ideas that could strengthen the article.

Furthermore, human reviewers can assess the article's tone, readability, and potential impact on the target audience, offering suggestions for how to better engage readers and convey the significance of the research.²⁹ Their ability to empathize with the audience allows them to provide invaluable guidance on how to communicate complex information in a clear and accessible manner. ChatGPT, however, does not possess emotional intelligence or the capacity to empathize with the audience, which can hinder its ability to accurately gauge the tone or potential impact of the article.²¹

CHATGPT'S ADVANTAGES AND LIMITATIONS IN FINAL EDITING OF MEDICAL ARTICLES

While ChatGPT can be highly effective in final editing tasks, it's important to note that it is still an AI language model and not a human editor.²⁸ While it may be faster and more efficient than a human editor in certain aspects of final editing, it may lack the contextual understanding, creativity, and subjectivity that a human editor possesses, making it difficult to say definitively that ChatGPT is better than a human editor at final editing. A combination of both may be the most effective approach for achieving the highest quality of written work.²⁸

ChatGPT's capabilities in final editing stem from its advanced natural language processing (NLP) algorithms, which allow it to analyze text at a deep semantic level.^{6,30} This means that it can not only identify errors in grammar, syntax, and spelling, but also understand the meaning behind sentences and paragraphs.³⁰ This enables ChatGPT to provide more nuanced and accurate editing suggestions than a traditional spell-check or grammar-check tool. Moreover, ChatGPT can learn from examples of well-written text, and use this

knowledge to suggest improvements to other pieces of writing. This means that the more it is used, the better it becomes at identifying and correcting errors, and providing helpful feedback to users.

In addition to its technical capabilities, ChatGPT's responsiveness and efficiency make it an ideal tool for final editing. It can efficiently correct grammatical errors and suggest more concise language (Figure 5). It can quickly process large volumes of text, enabling authors to make last-minute adjustments or revisions before submitting their work. This can help to ensure that the final product is polished, professional, and free of errors.

CHATGPT'S POTENTIAL ASSISTANCE ON SUBMISSION PROCESSES FOR MEDICAL ARTICLES

ChatGPT can assist in the submission process by helping authors create templates for documents required by a journal's author instructions (Figure 6). By analyzing the specific requirements for the document, including formatting, content, and layout, ChatGPT can create a template that includes all of the necessary elements and formatting, making it easier for authors to create the required document and ensuring that it meets the journal's guidelines.³¹

You

Can you correct grammatical errors and suggest more concise language. Please bold the changes u have made "ADA's mision is to prevent and cure diabtes, a chronc illness that requires continous medical care, and the release of ADA's Standrds of Care is a critical part of that mission," said Chuck Henderson, chief executive officer for the ADA. "This year's annual report provides necessary guidance that considers the role health inequites play in the development of diabetes, particularly for vulnerable communities and communities of color disproportionately impacted by the disease. This guidance will ensure health care teams, clinicians and researchers treat the whole person."

ChatGPT

Here's the revised and more concise version of the quote with grammatical corrections, and I've bolded the changes for clarity:

"The ADA's mission is to prevent and cure diabetes, a chronic illness that requires continuous medical care, and the release of the ADA's Standards of Care is a critical part of that mission," said Chuck Henderson, chief executive officer for the ADA. **"This year's annual report provides necessary guidance, considering the impact of health inequities on diabetes development, particularly in vulnerable and disproportionately affected communities of color.** This guidance will ensure health care teams, clinicians, and researchers **treat individuals holistically.**"

The original quote highlighted the ADA's commitment to addressing diabetes, with a focus on the importance of their annual report and the Standards of Care in considering the broader social and health inequities that affect the management and treatment of diabetes. The revised version maintains this emphasis while improving clarity and conciseness.

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Figure 5. ChatGPT's language refinement capabilities

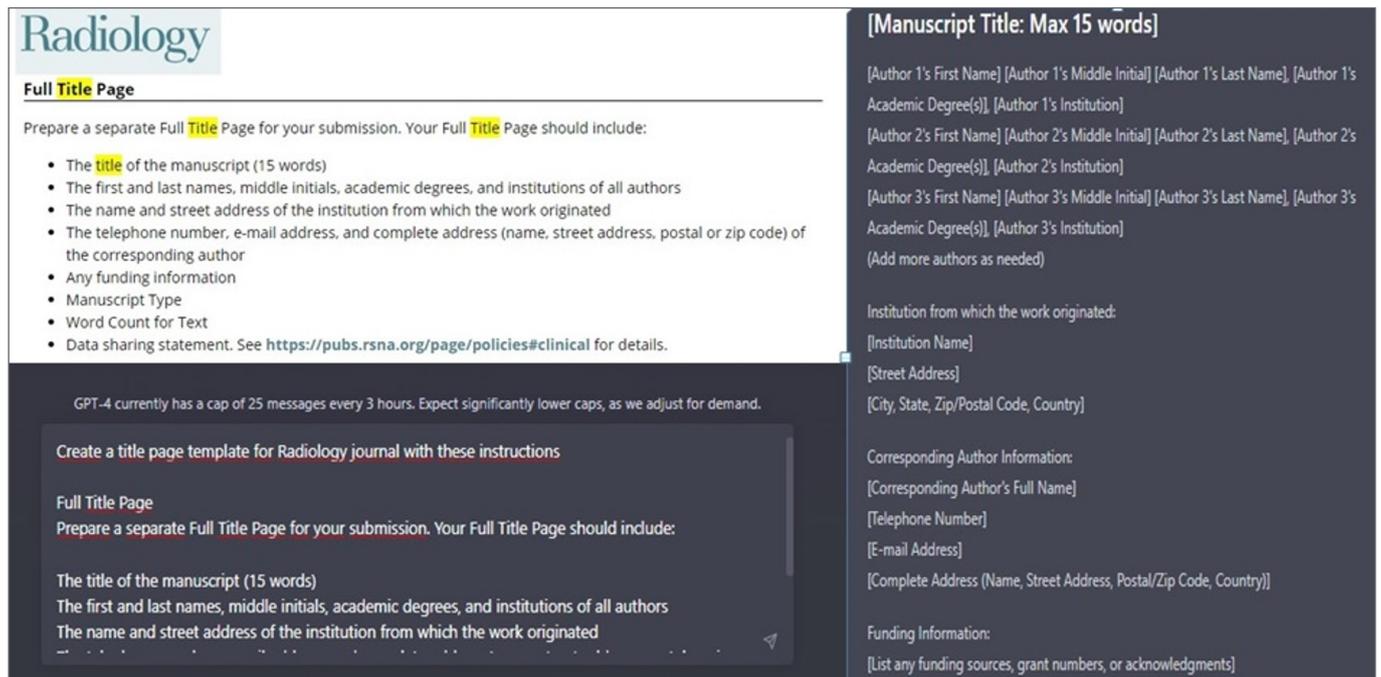


Figure 6. Creating a title page template in accordance with the journal's guidelines for authors

ChatGPT can also be used to create abstracts for journal articles and research papers by analyzing the content, summarizing key themes and topics, providing context, and refining the abstract to match the requirements of the publication.³¹ By analyzing the text and identifying the main findings or research, ChatGPT can create a concise and clear summary that meets the guidelines for abstract length and format.

Additionally, ChatGPT can assist with keyword optimization, helping writers to identify relevant keywords and ensure that they are used appropriately throughout the article. This can improve the article's search engine optimization and increase its chances of being discovered by potential readers.

ETHICAL IMPLICATIONS

The ethical implications of using ChatGPT include concerns about biased and inaccurate outputs, as the tool is trained on a mix of sources, some of which may contain biases. This can result in outputs that reflect these biases or are factually incorrect.³² The lack of clarity about the tool's training sources and decision-making process also poses a challenge. Privacy is another significant concern. Since ChatGPT stores user interactions for training purposes, there's a risk of personal or sensitive information being inadvertently used in future model training. Users should be cautious about the information they input. In academic settings, there's a risk of using ChatGPT for plagiarism or cheating.³² This could involve using AI-generated content as one's own work or paraphrasing existing

content without proper attribution. Such actions are against academic integrity principles. ChatGPT might also produce outputs that inadvertently infringe on copyright, as it is trained on various sources, including copyrighted material. Users are responsible for any copyright issues that arise from their use of the outputs. Ethically using ChatGPT involves adhering to institutional guidelines, being transparent about the use of the tool, critically evaluating its outputs, and using it as a guide rather than as a complete substitute for original work.³²

CONCLUSION

While ChatGPT offers numerous benefits and can assist in various stages of the medical article writing process, it is important to recognize its limitations and the continued importance of human expertise. A combination of both human researchers and AI tools like ChatGPT can lead to the creation of high-quality medical articles that are well-researched, engaging, and adhere to ethical guidelines.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version

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