Current Status of ChatGPT Utilization in Medical Education: Potentials, Challenges and Strategies

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Abstract

ChatGPT, a Generative Pre-trained Transformer, has garnered global attention and sparked discussions since its introduction in early 2023. However, it has stirred controversy within the realms of medical education and scientific research. This paper focuses on exploring the potentials, challenges, and corresponding strategies associated with ChatGPT. ChatGPT offers personalized learning support to medical students through its robust natural language generation capabilities, enabling it to furnish answers. Moreover, it has demonstrated significant utility in simulating clinical scenarios, facilitating teaching and learning processes, and revitalizing medical education. Nevertheless, a myriad of challenges accompany these advancements. In the realm of education, it is imperative to prevent excessive reliance on ChatGPT and combat academic plagiarism. Similarly, in the medical domain, ensuring the timeliness, accuracy, and credibility of ChatGPT-generated content is crucial. Concurrently, ethical challenges and concerns regarding information security arise. In light of these challenges, this paper proposes targeted strategies. Firstly, mitigate the risk of over-reliance on ChatGPT and academic plagiarism through ideological education, fostering comprehensive competencies, and implementing diverse evaluation criteria. Embracing modern educational approaches alongside ChatGPT enhances the overall quality of medical education. Enhance the professionalism and reliability of the generated content by implementing measures such as optimizing ChatGPT's training data professionally and enhancing the transparency of the generation process. This ensures that the generated content aligns with the most recent standards of medical practice. Furthermore, enhancing value alignment and establishing relevant laws or codes of practice address ethical concerns, including algorithmic discrimination, medical responsibility allocation, privacy, and security. In conclusion, while ChatGPT presents significant potential in medical education, it also encounters various challenges. Through comprehensive research and the implementation of suitable strategies, it is anticipated that ChatGPT's positive impact on medical education will be harnessed, laying the groundwork for advancing the discipline and fostering the development of high-caliber medical professionals.

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Keywords Chat Generative Pre-trained Transformer; ChatGPT Medical Education

1 Introduction

Artificial intelligence (AI) refers to the emulation of human cognitive abilities through computer programs, enabling machines to mimic human thinking and behavior[1]. AI Generation involves the automated creation of diverse content types, including text, images, video, and audio, leveraging AI technologies. This process utilizes language, imagery, and multimodal macro models to produce content[2]. Among these technologies, ChatGPT stands out as a sophisticated, large-scale language model developed by OpenAI, reaching stage 4.0, the latest iteration in OpenAI's system. Trained on extensive textual data, ChatGPT is optimized to engage in conversational interactions with users, responding contextually to their prompts[3]. Notably, ChatGPT exhibits robust capabilities in natural language processing, logical reasoning, task execution, information retrieval, image analysis, content generation, and more[4]. Moreover, ChatGPT offers a diverse array of services accessible through global registration, facilitating its integration across various domains.

In the realm of education, ChatGPT has garnered significant attention and sparked extensive discussions. Its remarkable generative capabilities offer novel opportunities for augmented learning, teaching enhancement, academic inquiry, and knowledge dissemination[5]. The integration of ChatGPT into medical education, aiming to synergize the advancement of both education and medicine, has emerged as a prominent focal point. This paper seeks to scrutinize the potential and challenges inherent in ChatGPT to facilitate an informed evaluation of its incorporation into medical education. Additionally, strategies are proposed to advocate for a seamless convergence of medicine

and technology.

2 Potentials

In this study, we searched the Web of Science (WOS) database using specific terms related to ChatGPT and education or medical science within the timeframe of January 2022 to December 2024. We utilized CiteSpace v6.1R6 (64-bit) Basic to analyze the posted keywords[6]. The basic parameters employed in CiteSpace were configured as follows: the time partition ranged from January 2022 to December 2024, with a one-time slice; the node selection criterion was set to k=25 for the g-index in each time slice, while the remaining parameters were kept at default settings. The top seven keywords, ranked by frequency in the keyword network (Figure 1), were identified as follows: natural language processing, impact, academic integrity, artificial intelligence in medicine, writing, health literacy, and healthcare professionals.

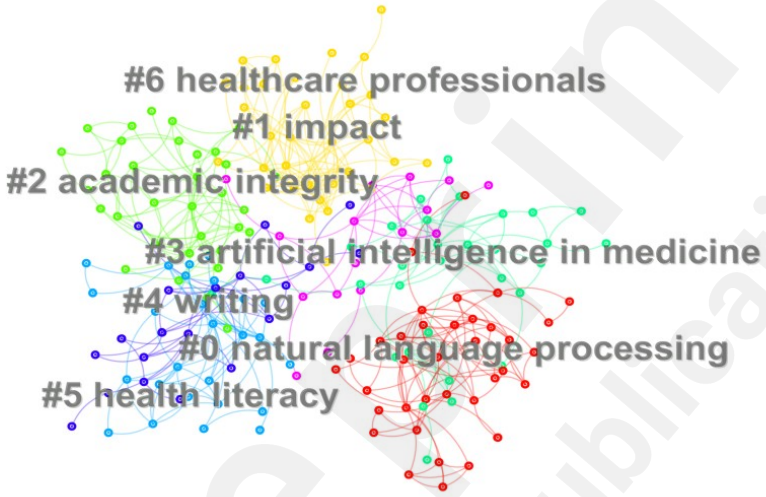

Figure 1. Keywords of ChatGPT in the medicine and education

2.1 Education Support

2.1.1 Academic Assistance

ChatGPT excels in both understanding language and generating content with remarkable competency. Leveraging semantic comprehension and reasoning, it adeptly discerns user intent through interactive dialogues. Furthermore, employing deep learning techniques, ChatGPT efficiently retrieves information from diverse sources to furnish users with accurate responses. Hence, ChatGPT emerges as a valuable resource for medical students, primarily facilitating their comprehension of intricate concepts[7]. By furnishing examples and conducting text analyses, ChatGPT enhances clarity and conciseness in content understanding. Moreover, ChatGPT plays a pivotal role in addressing academic uncertainties among medical students[8]. With its proficiency in question generation and answering, as well as aiding in revision tasks, ChatGPT can provide guidance to medical students in completing coursework, assess the quality of their coursework, and aid in reinforcing the learned concepts[9]. Serving as a personalized tutor, ChatGPT devises tailored learning plans and time management strategies by considering individual interests and learning preferences[10]. Additionally, renowned for its prowess in research and writing, ChatGPT contributes significantly to academic endeavors[11]. On one hand, it assists students in comprehensively exploring research literature, gaining a preliminary understanding of current research trends. On the other hand, ChatGPT aids in structuring thesis frameworks and generating writing prompts, while also offering grammar and spelling checks to enhance writing proficiency and quality.

2.1.2 Scenario Simulation

ChatGPT boasts excellent interactive features, enabling it to simulate clinical scenarios for

medical students through situational simulation and role-playing[12]. This functionality aids in facilitating the transition of medical students from a theoretical understanding to a clinical mindset. Additionally, ChatGPT has the capability to replicate clinical scenarios authentically, dynamically responding to changes in patients' conditions. This functionality enables students to accumulate practical experience in managing unforeseen medical situations within simulated environments, ultimately bolstering their preparedness and psychological fortitude.

2.1.3 Educational Curriculum Development

In the realm of educational curriculum development, ChatGPT plays a pivotal role in assisting teachers with their logical reasoning abilities and task performance capabilities[13]. It supports teachers in designing lesson plan, crafting course handouts, and generating content for lesson plans, thus streamlining the curriculum creation process. Furthermore, ChatGPT contributes to innovation in teaching methodologies by facilitating scenario-based learning, role-plays, and the integration of multiple educational resources. Recognizing the importance of ongoing pedagogical innovation, teachers are encouraged to blend the capabilities of artificial intelligence, such as ChatGPT, with traditional teaching methods[14]. This integration enables continuous improvement in teaching methodologies, thereby enhancing the effectiveness of teaching practices and fulfilling educators' instructional responsibilities more efficiently.

2.2 Clinical Support

ChatGPT plays a crucial role in clinical support by standardizing procedures, aiding in disease diagnosis, and delivering health education. In terms of literature search and operational procedures, ChatGPT is capable of accessing the latest literature and clinical guidelines[15]. This capability enables the provision of evidence-based best practices to healthcare professionals, facilitating the identification of current operational procedures and the enhancement of operational protocols. Regarding disease diagnosis, ChatGPT can analyze patient data and test results, assisting doctors in diagnosing conditions and offering treatment recommendations[16]. Additionally, it supports healthcare professionals in telemedicine by engaging in real-time communication with patients and providing remote diagnosis and treatment suggestions[17]. Moreover, ChatGPT serves as a valuable tool for patient health education[18]. It can translate health education materials into multiple languages and deliver personalized health education using straightforward language, thereby aiding patients in understanding condition guidance and adopting healthier lifestyles.

Overall, ChatGPT enhances medical education by integrating essential functionalities into clinical support through standardized processes, aiding in disease diagnosis, and delivering health education. This not only empowers healthcare professionals to provide medical services more efficiently but also provides students with a comprehensive and enriching learning experience, fostering the growth of medical professionals with practical skills and professional competence.

2.3 Disciplinary Development

The integration of artificial intelligence (AI) and medicine represents a future frontier, characterized by the convergence of technological innovation and advancements in medical care[19]. This cross-disciplinary collaboration not only fosters technological progress but also propels medical care toward greater intelligence and efficiency. Moreover, it catalyzes the nurturing of well-rounded talents in academic institutions, capable of navigating the intersection of medicine and technology. Looking ahead, collaborative efforts between medical and technological domains are poised to accelerate technological innovation and propel the field of medicine forward. This synergy promises to usher in a new era of healthcare characterized by innovation and efficiency, effectively addressing society's evolving health needs. ChatGPT contributes to the advancement of medical education by facilitating interdisciplinary collaboration and fostering innovation at the intersection of medicine and technology.

3 Challenges

3.1 Learning Dependency and Uneven Education

While ChatGPT can serve as a valuable learning aid by providing answers, assisting in understanding complex concepts, and offering personalized tutoring, excessive reliance on it can yield detrimental consequences in the long term[9]. Overdependence on ChatGPT may result in the erosion of critical thinking skills, creativity, and self-directed learning capabilities. The ease of obtaining answers quickly through ChatGPT may foster complacency among students, discouraging them from engaging in reflective problem-solving[20]. To mitigate this issue, students should proactively disclose which parts of their work were aided by ChatGPT, allowing teachers to assess the overall quality of assignments more accurately[9]. Failure to do so may lead to the perpetuation of an "information cocoon," wherein students are only exposed to solutions that align with their existing preferences, hindering the exploration of diverse perspectives. Additionally, while ChatGPT can facilitate learning, excessive reliance on it may diminish students' ability to engage in dialectical thinking and creative problem-solving, limiting their capacity for independent learning and innovation. Furthermore, the widespread adoption of ChatGPT may exacerbate educational inequalities[21]. Developing and underdeveloped countries may lack the necessary technological infrastructure and resources to fully leverage ChatGPT, widening the educational gap between these regions and more developed countries. Hence, it is crucial to address these challenges to ensure equitable access to educational resources and opportunities worldwide.

3.2 Copying and Plagiarism

When tackling assignments or final papers, students often seek to leverage technology to address challenges, enhance content, and elevate the overall quality of their work. ChatGPT, with its exceptional interactive capabilities and vast knowledge base, offers students the opportunity to obtain answers, prepare for exams, outline papers, and even complete them through interactive dialogue[21]. However, such practices are commonly perceived as copying answers and plagiarism, thereby contravening the fundamental principles of scientific research and academic integrity [22]. Moreover, ChatGPT encounters issues related to the fabrication of reference citations, as it may generate citations without verifiable sources, making it difficult for users to locate the original literature on academic platforms[23]. This inability to access and verify the sources provided by ChatGPT poses significant obstacles to maintaining academic integrity and conducting rigorous scholarly research.[24].

Notably, Som Biswas, a radiologist in the United States, has authored 16 papers with ChatGPT, resulting in the publication of six articles across four journals[25-30]. However, peer review has uncovered significant inaccuracies in the content, with all references found to be fictitious[31]. Editors at Nature have stated that while ChatGPT cannot be held accountable for the content and integrity of scientific papers, its contributions can be acknowledged[32]. Similarly, editors of scientific journals have indicated that using text generated by ChatGPT without proper citations may be construed as plagiarism, although acknowledgments of contributions to ChatGPT can be made in the acknowledgments section[32]. Therefore, there is a pressing need to establish clearer criteria to distinguish between legitimate use and plagiarism when employing ChatGPT assistance in academic research.

3.3 Insufficient Factualness, Timeliness, and Interpretability

ChatGPT's credibility is not absolute, as it grapples with issues such as illusion, poor timeliness,

and interpretability, akin to other large language models[33]. Despite its impressive performance, ChatGPT has been known to generate convincing yet erroneous information, undermining its reliability, particularly in the healthcare domain. Moreover, its conclusions may not always reflect the most current information, as its training data is sourced up to January 2022, necessitating continuous updating and expansion[11]. Furthermore, ChatGPT lacks specialized medical expertise and may struggle to comprehend complex disease interactions[34]. Its algorithms operate as a black box, offering results without transparently disclosing the underlying process, leading to uncertainty surrounding its suitability for healthcare applications. While doctors may leverage ChatGPT for disease diagnosis to enhance clinical accuracy, the absence of evidence supporting diagnosis and treatment may leave patients questioning the reliability of the results.

3.4 Ethical Issues

While ChatGPT holds immense potential in medical education, it also ignites numerous ethical controversies. Addressing issues such as algorithmic discrimination, allocation of responsibility for medical malpractice involving ChatGPT, and safeguarding data privacy and security are imperative considerations[35, 36].

ChatGPT exhibits algorithmic biases, including gender stereotypes, racial discrimination, and cultural insensitivity[37]. These biases not only compromise the model's accuracy, fairness, and credibility but also perpetuate inequalities within clinical healthcare[21]. Moreover, the shortcomings of ChatGPT, including poor timeliness, interpretability, and accuracy, pose risks of inaccurate clinical diagnoses, treatment protocols, and dissemination of erroneous information, thereby jeopardizing patient care[38]. Furthermore, safeguarding patient privacy is paramount in the clinical setting, necessitating stringent measures to protect sensitive patient data. Given that ChatGPT can potentially share information, there is a risk of privacy breaches, with patient data temporarily stored on OpenAI's servers[39]. This raises concerns about the potential leakage of patients' private information, including personal details, medical conditions, and examination reports, when utilizing ChatGPT for assisted diagnosis, treatment, and health education[40]. Hence, there is an urgent need to establish practical ethical norms to harness the value of ChatGPT while ensuring alignment with scientific and technological advancements and societal development goals. These norms should address concerns related to algorithmic biases, data privacy, accuracy, and accountability to foster responsible and ethical utilization of ChatGPT in healthcare and other domains.

3.5 Undermining Communication and Trust

The doctor-patient relationship has long been a focal point of attention, with effective communication serving as a cornerstone for patients to comprehend their condition and grasp health concepts. While ChatGPT functions as a patient's health manager, delivering information more understandably, its reliance on impersonal interaction and communication may undermine patients' trust in healthcare providers[40]. Furthermore, it's essential to recognize that ChatGPT lacks emotional intelligence, as it can only provide responses rationally, devoid of perception and empathy[41]. Consequently, it falls short of delivering humanistic care. Hence, there arises a pressing need for a novel doctor-patient relationship paradigm that accommodates ChatGPT intervention. This entails proactively integrating emotional value into patient interactions, fostering a more holistic approach to care that combines the rationality of AI with the empathetic touch of healthcare providers. By striking a balance between technological assistance and human compassion,

healthcare professionals can cultivate a patient-centric environment that addresses both medical needs and emotional well-being.

4 Strategies

4.1 Prevention of Over-dependence

Firstly, it is imperative to delineate the relationship between individuals and ChatGPT[42]. Humans remain the primary agents in social activities, with ChatGPT serving as a useful tool to aid them. While students may utilize the answers and suggestions provided by ChatGPT, it is crucial that they engage in critical thinking and judgment to arrive at their conclusions.

Secondly, it is essential to apprise students of the limitations inherent in ChatGPT[22]. Despite students' optimism towards ChatGPT[43], educators must underscore that it is not a panacea. Students should adopt an objective and cautious stance toward its capabilities. Teachers can focus on nurturing students' independent thinking, creative problem-solving abilities, and information literacy skills. This includes cultivating habits of reading and lifelong learning, fostering critical thinking and effective communication, and enhancing independent problem-solving skills. The ultimate goal is to empower students to transition from mere questioners to creators and decision-makers.

Furthermore, in curriculum design, educators can optimize both the format and content of courses[44]. This can involve implementing a teacher-student-machine interaction model for teaching, offering courses on artificial intelligence, and exploring innovative assignment formats and evaluation methods. For instance, educators may replace traditional writing tasks with presentation reports, oral debates, group discussions, and peer reviews[13]. Encouraging students to maintain transcripts of their interactions with ChatGPT can also be beneficial[23]. Emphasizing the demonstration of knowledge and competence rather than reliance on ChatGPT for direct answers encourages deeper engagement and critical thinking among students. And, highlighting the symbiotic relationship between humans and ChatGPT while acknowledging its limitations enables educators to steer students towards a balanced utilization of this tool. Emphasizing the development of independent thinking, creativity, and the transformation of students into proactive decision-makers serves as a pivotal strategy in mitigating over-reliance on ChatGPT and ensuring its responsible and effective integration into the learning process. By guiding students to utilize ChatGPT wisely and leverage its positive impacts, educators can foster a learning environment that maximizes the benefits of this technology while nurturing essential critical thinking and problem-solving skills.

4.2 Academic Integrity

ChatGPT possesses unique advantages, and it is essential not to prohibit students from using it entirely but rather to guide them in its proper utilization. Therefore, fostering the quality of student learning is paramount. In terms of educational orientation, teachers should steer students towards establishing correct values regarding science and technology. Prioritizing education on academic integrity is crucial, with a focus on reiterating the basic principles and ethical boundaries of scientific research, enhancing awareness of academic ethics and integrity, and deepening reverence for science.

Furthermore, educators should elucidate the consequences and repercussions of breaching research integrity to students. Subsequently, the content generated by ChatGPT should undergo evaluation and review to ensure academic accuracy and integrity[45]. It is imperative to approach the answers with reasonable skepticism and verify their accuracy to ascertain their correctness. Clearly

indicating which portions were derived from ChatGPT is also necessary. Additionally, employing plagiarism detection software enables students to verify that the content generated by ChatGPT does not infringe upon others' academic work, thereby mitigating the risk of plagiarism and ensuring the accuracy and authenticity of cited references.[46]. Ultimately, the development of guidelines and establishment of regulatory mechanisms are indispensable for the proper utilization of ChatGPT[47]. Stakeholders can collaborate to formulate appropriate guidelines supporting the standardized application of ChatGPT. Furthermore, organizations and institutions can conduct seminars on academic integrity, educating individuals on the ethical application of ChatGPT[44]. Simultaneously, implementing a corresponding management mechanism can enhance the management approach through training, education, evaluation, review, feedback, and improvement processes to ensure the ethical use of ChatGPT.

4.3 Model Enhancement

While ChatGPT boasts significant power, its susceptibility to hallucination poses a challenge to its credibility. However, effective mitigation of this issue and refinement of its specialization could unlock limitless potential in the medical domain. Future advancements should focus on enhancing training methodologies and tailoring the model to better grasp medical concepts[48]. Incorporating the latest medical literature promptly into the training data system is crucial to continuously augmenting the quality of the dataset, enabling ChatGPT to furnish more precise and current information. Collecting feedback on ChatGPT responses allows for iterative adjustments and enhancements to the model's accuracy. Timely updates of data, especially for time-sensitive matters, facilitate a more accurate understanding of queries and the generation of relevant answers. For instance, regular updates on clinical data, research findings, expert consensus, and medical guidelines can effectively inform clinical practice.

Furthermore, transparency in the generation process is paramount for enhancing interpretability[49]. Increased transparency fosters trust between humans and machines. Not only does it enable medical personnel to comprehend the model's decision-making process, but it also enables better evaluation and interpretation of generated results, thereby reducing the likelihood of medical errors. Incorporating transparency measures is therefore crucial for optimizing ChatGPT's utility in medical settings.

4.4 Emphasizing Ethical Issues

Value alignment is a contentious issue in ChatGPT, focusing on harmonizing its capabilities and behaviors with human intentions, ethical principles, and values to foster safety and trust in human-ChatGPT collaborations. The top three ethical concerns surrounding ChatGPT are algorithmic discrimination, medical liability allocation, and privacy and security issues[40].

To address algorithmic discrimination, efforts must be made to mitigate biases in ChatGPT-trained models by incorporating diverse, representative, and balanced training samples. Continuous review and improvement of data are essential to minimize gender and racial discrimination, particularly in healthcare, where equitable outcomes are paramount[35]. Education in AI ethics is crucial to fostering an understanding of the ethical responsibilities stemming from scientific and technological advancements. Healthcare professionals utilizing ChatGPT for decision support should actively engage in its decision-making process and critically assess its recommendations.

Collaboration between healthcare professionals and ChatGPT can enhance decision-making accuracy[50]. Patients' right to information should be upheld, with transparency regarding the acceptance of ChatGPT-generated content by medical staff. Organizations and institutions must ensure ChatGPT's responsible participation in treatment and adherence to ethical standards.

Protecting personal privacy and information data is imperative to prevent financial losses and safeguard societal security. Measures such as analogously asking ChatGPT questions to conceal original motives and implementing manual review mechanisms for uploaded information can mitigate privacy risks. Compliance with privacy laws and regulations is essential to secure patient privacy and medical information, ensuring data handling and storage integrity. Establishing clear guidelines, ethical frameworks, and institutional norms for data collection, storage, and use is crucial[48].

4.5 Irreplaceability of Medical Personnel and Educators

While ChatGPT holds promise in expanding access to primary healthcare in underdeveloped regions and streamlining repetitive tasks for medical staff, it cannot supplant healthcare professionals in any capacity. ChatGPT lacks independent consciousness, ethical standards, emotional empathy, and the ability to anticipate unforeseen circumstances. Face-to-face communication between healthcare professionals and patients, along with the human touch in providing emotional support and humanistic care, cannot be replicated by ChatGPT[51]. Additionally, medical staff bring invaluable empirical assistance and support to patients based on their clinical experience, which enhances the quality of clinical services—capabilities that ChatGPT does not possess[51]. Therefore, ChatGPT should be positioned as a valuable tool for assisting medical personnel in clinical work rather than as a replacement for human healthcare providers.

Similarly, ChatGPT cannot replace teachers in the realm of education. Education serves the purpose of fostering individual growth, societal progress, and the continuity of human civilization. While ChatGPT has undoubtedly facilitated the advancement of education by equalizing and enriching educational resources, it remains merely a tool for teachers rather than a substitute. Teachers possess unique abilities that ChatGPT lacks. They can cultivate students' moral qualities and abilities, such as ideals, beliefs, values, critical thinking, emotional intelligence, and creativity. Moreover, humans are inherently social beings who require interpersonal communication for growth experiences and spiritual fulfillment.

In conclusion, despite the conveniences offered by ChatGPT, it cannot replace humans in healthcare and education. Our distinct qualities and capabilities enable us to retain social value in an era characterized by rapid advancements in artificial intelligence.

5 Conclusion

ChatGPT has showcased significant potential in medical education, yet it has also brought forth a host of thought-provoking challenges. It is imperative that we approach ChatGPT with caution and subject it to critical evaluation, weighing its benefits against its drawbacks. This paper engages in a dialectical examination of the current state of ChatGPT's application in medical education, conducting a deep analysis of its advantages and the dilemmas it presents. Additionally, targeted strategies are proposed to address these challenges effectively. The ultimate aim is to standardize and rationalize ChatGPT's maximum potential in the future, paving the way for innovative approaches in

medical education and contributing to the advancement of medicine.

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Supplementary Files

Figures

The figure shows the top seven keywords in the realm of ChatGPT and medical education , ranked by frequency in the keyword network, were identified as follows: natural language processing, impact, academic integrity, artificial intelligence in medicine, writing, health literacy, and healthcare professionals.