Review

Applications of ChatGPT/GPT4 in Biological Studies, Medical and Dental Care

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Abstract: Chat generative pre-trained transformer (ChatGPT) is a developed language model and a subgroup of artificial intelligence (AI) which has demonstrated noticeable innovation in interactions between computer models and human studies. The release of ChatGPT in November 2022 attracted over 100 million users in a short time. It has unlimited applications in different fields of studies such as technology and science. ChatGPT utilizes deep learning and internet text to produce responses that resemble human language, although their accuracy is not always guaranteed. ChatGPT and GPT-4 can make a huge revolution in biology, medical, dental research, and health care. However, it's important to acknowledge the limitations of ChatGPT such as limitation in accessing the latest data. ChatGPT has generated both excitement and concern regarding its potential misuse. Its utilization in scientific publications has sparked debates and prompted the development of policies to govern the use of it. Although ChatGPT has certain limitations, it could impact on many different fields of study. There are challenges associated with using ChatGPT in the field of laboratory medicine and biology, particularly in the interpretation of test results. In this article, we review some of the applications of ChatGPT and GPT-4 in biology, dental and medical studies, and concerns about ChatGPT. Despite ChatGPT's conversational abilities are impressive, there are important considerations regarding its use in different fields of research and academic public.

Keywords: ChatGPT; GPT-4; artificial intelligence; biology; medicine; dentistry

Introduction

ChatGPT, have significantly advanced natural language processing and is developed to create human-like responses to conversation and questions from users and has been designed based on GPT (Generative Pre-trained Transformer) especially GPT-3.5 which is an advanced language model. It provides a chat-based interaction to improve efficiency and facilitate the usage of ChatGPT [1,2].

The growing interest in artificial intelligence (AI) has sparked significant research in various fields of science and technology [3, 4]. As AI advancements continue to progress, it is crucial for specialists' communities in different fields to embrace the potential of ChatGPT and GPT-4 and other AI technologies, while remaining mindful of the associated ethical challenges . It is impossible to replace physicians entirely due to limitations in understanding context by ChatGPT. Instead, AI can enhance physician effectiveness by optimizing workloads and performance [6]. Plebani highlights ethical considerations and acknowledges the limitations of ChatGPT when compared to well-trained physicians and emphasizes the need to reevaluate laboratory testing, address ethical concerns, and enhance the interpretation of test results, underscoring the necessity for further research in these areas. ChatGPT may have appropriate applications in self-testing and direct-to-consumer laboratory testing if patients utilize the results responsibly [7]. Kim has reported that ethical implications of ChatGPT in scientific articles are currently being discussed and raises concerns within scientific journals. Despite these concerns, ChatGPT is a widely recognized AI chatbot that is freely available to users and has demonstrated its value in editing English grammar and speed up writing the articles especially for non-native English-speaking authors, so it can be a beneficial tool in the publication process. If ChatGPT is used for language editing purposes, it can be deemed acceptable in the article preparation process. However, any novel ideas generated by ChatGPT must be validated through

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real experiments and verified by human researchers [8]. ChatGPT has demonstrated proficiency in various scientific tasks, such as writing essays, scholarly manuscripts, and statistical analyses [6].

Recently, there are some studies to compare GPT-4 with ChatGPT. In fact, GPT-4 is the newest type of GPT series which has shown the advancements in architecture, training data, model size, and fine-tuning techniques to improve the performance of language understanding and generation of relevant and appropriate responses.

It has been reported that GPT-4 performance is better than GPT-3.5 on the United States Medical Licensing Exams (USMLE). Therefore, the efficiency of GPT-4 in learning medical education and biomedical knowledge is excellent and better than ChatGPT [9,10].

Undoubtedly, the development of ChatGPT and GPT-4 has the potential to bring about a transformative shift in medical practice, particularly within the different fields of surgeries. It can assist in diagnosis of different kinds of disease such as cancer, treatment planning and robot-assisted surgeries [11]. ChatGPT and GPT-4 can assist with tasks like summarization, question answering, and personalized recommendations. These can help in management and providing the bills and scheduling and facilitate the services to patients. On the other hand, ChatGPT has some limitations and risks in medicine. Fijačko et al. showed that ChatGPT did not achieve a passing score in the life support exam. However, when faced with scenario-based questions, ChatGPT not only provided answers but also furnished insightful explanations to support its responses. Compared to other AI-based systems, ChatGPT's answers are accurate and exhibit greater alignment with resuscitation guidelines [12]. Wang et al. showed that ChatGPT and GPT4 facilitate the biomedical research and healthcare applications for faster progress and implementation [13].

Although the references provided by ChatGPT tend to be broad, the answers are frequently more comprehensive. Liu et al. reported a growing interest in researching ChatGPT and GPT-4 and their potential applications in various fields. It provides insights into the capabilities and ethical concerns associated with these models, as well as suggestions for future advancements. Ethical concerns surrounding biased or harmful content, privacy violations, and misuse of the technology are identified and should be responsibly addressed. On the other hand, the reliance of ChatGPT on existing text raises ethical concerns in academic publishing, as it calls into question the originality and accuracy of its outputs [14], while ChatGPT generally gives well-formed answers with minimal errors, there were also weaknesses observed. The model's training data is not regularly updated, with the assessed model only incorporating data up to 2021. This lack of up-to-date information should be considered by users who expect the latest data, especially researchers. Additionally, the model cannot cite sources or fully understand user queries, which could lead to potential misleading responses [15].

Overall, this review has emphasized the potential capacities of ChatGPT and GPT-4 to facilitate training, global collaboration, knowledge exchange, education and improving patient care and increasing the research speed.

Discussion

ChatGPT and GPT-4 in biology:

In recent years, genomics, proteomics, and epigenetics have attracted the attention of researchers and a lot of studies investigated gene expression, protein changes and signaling pathways in animal and human studies in different diseases [16-19]. Meanwhile, a huge progress of artificial intelligence-based technologies has brought a significant innovation on the bioinformatics [20]. Multiple studies have shown that ChatGPT is a highly valuable and complementary tool for professionals in the field of science and programming. It can be particularly useful in the fields of bioinformatics and computational biology [21]. Although the utilization of these technologies can enhance productivity and expedite scientific discoveries, it is important to avoid relying on them excessively. ChatGPT increases the efficiency of research by speeding up the writing and publishing of the articles, but it needs the edition by authors to avoid plagiarism. In fact, researchers can spend time on interpreting and collecting the results instead of focusing on literature reviews [22].

Agathokleous et al. reported that ChatGPT plays a significant role in biology, ecology, and environmental science by impacting various aspects such as supporting research, scientific

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communication, risk assessment and outreach activities. However, while ChatGPT offers numerous advantages, they also come with limitations and uncertainties. Despite the unknowns, it can anticipate remarkable advancements in biology and environmental science [23].

Researchers are excited about the potential applications of ChatGPT. It answered accurately the questions related to the role of computational biology in analysis of the large amount of data and identification of the trends and behavior of stem cell in biological research. However, collecting large amounts of data can be challenging especially in a huge group of cells [24].

GPT-4 may assist in predicting tissue growth, vascularization, and integration of engineered tissues with the host, analyzing genomics and proteomics datasets by understanding the scientific literature. It may aid in identifying genetic variations and predicting protein interactions and suggest therapeutic targets. Additionally, it could assist in optimizing gene editing techniques and predicting the behavior of engineered cells. It can help in designing advanced scaffolds, biomimetic materials, and tissue culture techniques [24-26].

ChatGPT in Biomedical engineering:

Biomedical engineering is based on biology, medicine, and engineering. Research in this field plays a major role in improving healthcare and dental care. Artificial intelligence-based technologies have significantly improved biomedical engineering field [26].

The incorporation of ChatGPT into the field of biomedical engineering offers great potential as well as notable difficulties about privacy, leading to contentious discussions. GPT-4 makes revolutionary changes in the field of biomedical engineering by optimizing the design of medical devices and improving the accuracy of diagnosis. Recent studies focused on assessing the potential of GPT-4 across domains of biomedical engineering. Cheng et al. has shown that utilization of GPT-4 could open novel ways for advancements in biomedical engineering such as biomaterials, tissue engineering, and bioinformatics [26].

ChatGPT in medicine and dentistry:

Applications of ChatGPT and GPT-4 in diabetes

According to the study conducted by Nakhleh et al., ChatGPT demonstrated not only the ability to accurately respond to all questions in the diabetes knowledge questionnaire, but also provided satisfactory explanations. The researchers concluded that ChatGPT has the potential to be a valuable resource in generating educational materials for diabetes patients. It is imperative for researchers and healthcare professionals to work together to develop artificial intelligence programs to meet the specific requirements of individuals living with diabetes [27]. It has the potential to generate conversational text for various manuscript contents in the field of Sport & Exercise Medicine (SEM) [28]. However, despite the great potential of GPT-4, applications of GPT-4 or ChatGPT in clinical medicine and dentistry have privacy and cybersecurity concerns [27]. Yeo et al. showed that the accuracy of ChatGPT in providing responses to frequently asked questions related to the treatment of patients with cirrhosis and hepatocellular carcinoma (HCC) is good, but it should be noted that many of these correct responses were insufficient. However, as the model continues to improve its accuracy, ChatGPT has the potential to serve as a valuable supplementary tool for patients [29].

Applications of ChatGPT and GPT-4 in intensive care medicine (ICM)

Intensive medical care such as care provided in ICU is very important because it should supply a quick response to emergencies situation. ICU provides specialized care for patients who are critically sick or have done major surgeries and complex procedures and need advanced monitoring devices for recording the vital signs. ICU is designed to minimize the risk of infections because the immunity system of patients is weak [30]. Lu et al. reported the possible applications of ChatGPT and GPT-4 in the field of intensive care medicine (ICM). These applications include managing devices, enhancing knowledge, aiding clinical decision-making, establishing early warning systems, and creating an intensive care unit (ICU) database. As artificial intelligence tools like ChatGPT/GPT-4 progress, it becomes crucial for intensivists to comprehend and utilize these tools in conjunction with

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their clinical expertise. This integration can lead to improved patient outcomes, streamlined processes, and readiness for future crises involving critically ill individuals. The COVID-19 pandemic resulted in a substantial increase in requests for intensive care unit (ICU) services. Additionally, it has created unique prospects for advancements and progress in this field that have not been seen before [31].

Applications of ChatGPT and GPT-4 in medical and dental surgery

GPT-4 can assist surgeons specialized in joint arthroplasty by diagnosis the disease and treatment procedure including preoperative assessment, intraoperative guidance, and postoperative care. In this way, GPT-4 increases the patient's satisfaction by improving therapeutic effects of joint replacement [32].

Li et al. explored the potential roles and applications of GPT-4 in diverse aspects of neurosurgery. GPT-4 could contribute to development of brain-computer interfaces and predicting the behavior of neural circuits. It may help in understanding and designing therapies for neurological disorders [33].

In another study, He et al. emphasized that ChatGPT and GPT-4 can be valuable tools for spinal surgeons. In this way, continuous development of ChatGPT is expected to facilitate surgical planning and enhance communication with patients. However, it is important to note that the effective use of ChatGPT and GPT-4 as a guiding resource for spinal surgeons relies on appropriate utilization and reasonable supervision. Although it can solve different clinical problems, it lacks clinical experience from a human doctor. Therefore, it's dependent on physician detection, but it has an excellent ability of large datasets processing, so it can be an indispensable scientific assistant [34].

Nori et al. conducted a qualitative analysis to examine the behavior of GPT-4 and reported the possibility of errors and the difficulties in evaluating performance. Therefore, appropriate use of technological innovations and optimize the benefits and decrease the risks associated with implementing GPT-4 in practical applications is important [9].

Numerous articles have highlighted several potential uses of GPT-4 in clinical medicine. These applications include creating virtual assistants in different kinds of surgery such as bariatric surgery, oral and maxillofacial surgery and colorectal surgery or converting unstructured radiology reports into structured formats [35-38].

Balel reported that ChatGPT is a great tool for providing patient information in the field of oral and maxillofacial surgery. However, using ChatGPT in training should be limited because of safety concerns. The medical field is expected to witness an increased adoption of ChatGPT, but it is important for surgeons to use it as a supplementary tool alongside their own clinical knowledge and experience in oral and maxillofacial surgery [39].

Ferres et al. has reported that ChatGPT combines different data types such as text, images, video, and speech. This integration has the potential to transform radiology by allowing models to incorporate images, text, notes, and medical records. The ability to generate grammatically correct text is a notable achievement in AI development which can process like report generation for radiologists. The researcher's use of ChatGPT to address common questions from radiologists is noteworthy. Despite the limitations and real examples of mistakes ChatGPT in the field of radiology, it demonstrates the valuable contribution and potential to revolutionize healthcare practices [40].

Cheng et al. and Hassam et al. have conducted the study that shows GPT-4 can be helpful in developing virtual assistant based on artificial intelligence for spinal surgeons and joint arthroplasty [32, 41].

Rao et al. has demonstrated that ChatGPT is useful for making radiologic decisions and assisting the clinical services [42]. ChatGPT in dentistry can provide accurate information about hygienic services and dental health for patients [43,44].

ChatGPT in medical and dental education and biology knowledge:

ChatGPT can be helpful in a wide range of applications. It can be used as a tool for education and improving teaching facilities and research in health care studies. ChatGPT represents an exciting opportunity for teachers to facilitate the learning process and produce high-quality teaching in

different fields of studies [45,47]. Parsa et al. has reported that ChatGPT in medical education has improved health literacy, patient education, and clinical workflows. It can help in tasks such as generating reliable responses, composing medical notes, scheduling patients, and facilitating treatment planning. Medical educators can use ChatGPT's capabilities for activities like preparing lectures, crafting syllabi, and fostering creative thinking. However, the use of ChatGPT in medicine gives rise to concerns surrounding limited access to up-to-date information, cultural biases, and privacy implications [48].

There is a growing public interest in CPR (Cardiopulmonary Resuscitation) information. In the past, this information was mainly available through guidelines and articles, which were not easily accessible to the public and often required professional education to understand. However, ChatGPT can provide CPR information in a more accessible and understandable manner for the public. So, it is valuable to explore different possibilities for utilizing this technology in the provision of resuscitation information and CPR education [49]. Gilson et al. has reported that ChatGPT makes a significant improvement the same as a third-year medical student in answering logically to most medical questions [50].

Conclusion

In conclusion, the applications of ChatGPT and GPT-4 in molecular biology, biomedical engineering, medical and dental research have the potential to increase research, development, and innovation in various subfields. However, it's important to note that these are speculative possibilities, and the actual impact of ChatGPT and GPT-4 would depend on its specific capabilities and the integration of language models with other technologies in the field. However, despite certain limitations, ChatGPT exhibits a valuable resource and self-learning tool. Totally, ChatGPT and GPT-4 are technologies that are likely to continue advancing. Banning or disregarding their use is not the solution, as they offer significant benefits by improving efficiency. However, their implementation should be approached mindfully, and open discussions about the associated risks and benefits are necessary. It is crucial to consider the proper utilization of ChatGPT and GPT-4 in medicine, dentistry, and science.

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