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Research Article

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Artificial Intelligence and Spinal Health: GPT-4's New Role

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Abstract

The rapid advancements in Artificial Intelligence (AI) have profoundly impacted the field of medicine. This study focuses on GPT-4, an advanced natural language processing technology. We investigated the potential applications of GPT-4 in spinal disorders such as Lumbar Disc Herniation (LDH). We firmly believe that in the future, GPT-4 will play a novel role in the realm of spinal health.

Keywords: *Artificial intelligence; ChatGPT; GPT-4; Spine*

Introduction

Lower back pain is highly prevalent, with nearly 80% of individuals experiencing it at least once in their lifetime[1]. According to statistics, the significant prevalence and disability associated with this condition result in annual losses exceeding 100 billion dollars.[2] The causes of lower back pain are diverse, including factors such as tumors, trauma, infections, aging-related degeneration, vascular diseases, mechanical issues, psychological problems, congenital diseases, and more. As of now, degenerative conditions, particularly LDH, are identified as the most common reasons for lower back pain. [3]. LDH represents a significant threat to our spinal health.

Artificial intelligence's application in medicine has been extensively involved in various aspects, such as image analysis, detection of drug interactions, identification of high-risk patients, and medical record coding. [4]。 The release of ChatGPT/GPT-4 by OPENAI has garnered significant attention within the academic community. [5,6] It has attracted considerable attention from several top-tier journals, including Nature, Science, and The New England Journal of Medicine. [7–10]。 As the current state-of-the-art multimodal language model, GPT-4 demonstrates exceptional information integration and analysis capabilities by handling textual inputs and comprehending other media types.

In domains such as simulated legal examinations, the United States Medical Licensing Examination (USMLE), the American Heart Association (AHA) Basic Life Support (BLS), Advanced Cardiovascular Life Support (ACLS), and the Japanese Medical License Examination (JMLE), it has demonstrated outstanding performance with high accuracy, achieving commendable accomplishments [11–14].

Research has already delved into the role of ChatGPT/GPT-4 in various medical disciplines[15–20]. However, to date, no study has analyzed the potential applications of GPT-4 in multiple aspects of spinal disorders. In light of this, our research team conducted an online survey, primarily focusing on delineating the potential significant roles of GPT-4 in spinal disorders.

Medical History Collection and Patient Communication

GPT-4 is poised to establish more profound and practical communication channels between healthcare professionals and patients through advanced natural language processing technology. In medical history collection, GPT-4 can interactively pose questions to patients, gradually obtaining detailed information about symptoms, pain sensations, and the condition's progression.

This interactive medical history collection process ensures the accuracy and comprehensiveness of medical records. Leveraging its learning from an extensive corpus of medical literature, GPT-4 can provide targeted questions, guiding patients to describe specific aspects of their symptoms. Consequently, it furnishes healthcare providers with more detailed and comprehensive medical history data. Additionally, the model can comprehend information expressed by patients in non-specialized terms, alleviating the difficulty patients may encounter in understanding medical terminology and enhancing the efficiency of information retrieval.

With the intervention of GPT-4, the medical history collection process becomes more interactive, engaging patients in the treatment process and providing healthcare professionals with

multidimensional information for comprehensive analysis. This personalized and in-depth medical history collection is expected to offer physicians a broader basis for diagnosis, laying a solid foundation for developing customized treatment plans. Overall, applying GPT-4 in medical history collection and patient communication can bring new possibilities to medicine in spinal health.

Image Interpretation and Diagnostic Assistance

In spinal health, GPT-4 shows significant potential in image interpretation and diagnostic assistance. Leveraging advanced natural language processing and deep learning capabilities, GPT-4 aims to provide a more in-depth and comprehensive analysis of medical images, thereby assisting healthcare professionals in achieving more accurate diagnoses.

Firstly, GPT-4 can aid in interpreting spinal images, including X-rays, MRIs, CT scans, and others. Through extensive learning from medical literature and cases, the model can identify both normal and abnormal features of spinal structures, swiftly capturing potential signs of pathology. This auxiliary tool allows doctors to scrutinize patient image data more comprehensively and objectively.

Secondly, GPT-4 excels in generating targeted questions to guide physicians' attention to specific regions of the images, enhancing sensitivity to patients' conditions and reducing the likelihood of oversight. This facilitates better treatment planning.

Furthermore, GPT-4 comprehends diagnostic inquiries from physicians and provides relevant information, such as medical histories and research findings, to support more accurate diagnoses. By integrating information from multiple sources, GPT-4 aims to offer healthcare professionals a more comprehensive reference, fostering the development of more scientific and personalized treatment plans.

In summary, the application of GPT-4 in image interpretation and diagnostic assistance is poised to equip healthcare professionals with additional tools and information, elevating the diagnostic capabilities in spinal health for better patient care.

Personalized Treatment Recommendations

GPT-4 demonstrates potential value in providing personalized treatment recommendations for spinal health. Through deep learning and extensive study of medical literature, the model integrates patient medical history, clinical manifestations, and imaging data to offer individualized treatment advice for each patient.

Firstly, GPT-4 analyzes patient medical history data, considering individual differences and incorporating factors such as age, gender, and family medical history. This enables the generation of more personalized treatment plans for physicians, aiding them in better understanding the patient's overall health condition and providing a reference for customized treatment planning.

Secondly, GPT-4 combines the imaging features of the patient's condition for a more in-depth analysis. By profoundly understanding imaging data, the model can identify crucial information such as changes in spinal structure, the extent of disc protrusion, and the compression of nerve roots. This specificity contributes to providing more detailed references for treatment strategies.

Furthermore, GPT-4 can provide physicians with a comprehensive assessment of various treatment methods based on the latest global medical research and treatment experiences. This encompasses aspects like drug therapy, physical therapy, and surgical interventions, helping physicians weigh the pros and cons of treatments more comprehensively and select the most suitable approach for the patient.

GPT-4's personalized treatment recommendations ultimately offer physicians a comprehensive and in-depth treatment guide. This is expected to contribute to formulating more effective and targeted treatment plans for patients, maximizing the success rate of treatments, and enhancing the overall quality of life for patients.

Patient Education and Communication

GPT-4 plays a crucial role in patient education and communication, offering innovative ways to enhance doctor-patient interactions and facilitate patient involvement in the treatment process within the field of spinal health. The following are some potential applications of GPT-4 in patient education and communication:

1. Disease Explanation and Expectation Management: GPT-4 can provide patients with detailed explanations about spinal diseases, including etiology, symptoms, and potential progression. Clear and understandable language helps patients better comprehend their health issues, thereby boosting their confidence in treatment plans.

2. Treatment Choices and Risk Communication: GPT-4 can assist doctors in conveying information about different treatment choices, including pros, cons, and potential risks, to patients. With the assistance of the language model, doctors can communicate with patients in a more inspiring and personalized manner, aiding them in making well-informed decisions.

3. Daily Rehabilitation Guidance: GPT-4 can generate personalized rehabilitation recommendations and daily life guidance, assisting patients in managing symptoms, alleviating discomfort, and providing positive support during the treatment process. This helps patients engage more actively in rehabilitation plans, enhancing treatment effectiveness.

4. Preoperative and Postoperative Guidance: For patients requiring surgery, GPT-4 can offer detailed preoperative and postoperative guidance, explaining the surgical process, postoperative care measures, and the rehabilitation plan. This helps patients better understand and adhere to medical advice, improving the success rate of surgery and patient satisfaction.

5. Follow-up and Remote Monitoring: GPT-4 can provide continuous support and education to patients through regular follow-ups and remote monitoring. Establishing closer connections with patients and promptly addressing their concerns and questions contributes to building a positive doctor-patient relationship.

Through these means, GPT-4 provides doctors with a more powerful tool to educate and communicate with patients effectively, encouraging them to participate actively in treatment decisions and the rehabilitation process.

Scientific Research

In scientific research, GPT-4 may play a multifaceted role in spinal health, offering researchers new avenues and tools to advance medical knowledge. The following are some suggestions for the application of GPT-4 in scientific research:

1. Literature Review and Knowledge Integration: GPT-4 can rapidly and accurately analyze a vast amount of literature, providing researchers with systematic reviews integrating cutting-edge knowledge in spinal health. By mining and summarizing previous studies, researchers can gain a more comprehensive understanding of the field's current state, identifying research hotspots and knowledge gaps.

2. Data Analysis and Model Establishment: The robust natural language processing capabilities of GPT-4 enable it to handle extensive clinical data and imaging information. By combining data science and machine learning, researchers can leverage GPT-4 to analyze patient records, treatment feedback, and other information, establishing more accurate disease models and deepening the understanding of spinal health.

3. Research Design and Question Formulation: GPT-4 can assist researchers in designing scientific experiments, formulating research questions, and optimizing experimental protocols. Through interaction with the model, researchers can receive suggestions on research design, ensuring experiments' scientific validity and feasibility.

4. Interpretation of Experimental Results: After completing experiments, GPT-4 can help researchers interpret experimental results, explore potential biological mechanisms underlying research findings, and provide a deeper understanding of data patterns. This aids researchers in comprehensively analyzing experimental results, distilling new knowledge about spinal health.

5. Interdisciplinary Research and Collaboration: GPT-4 can facilitate interdisciplinary research by integrating knowledge from different fields, driving comprehensive studies in spinal health. The model's multimodal capabilities enable it to handle text, imaging, and other data types, providing researchers with more extensive research tools.

In summary, the application of GPT-4 in scientific research holds the promise of injecting new dynamism into the field of spinal health, propelling medical research toward more profound and more comprehensive directions.

Limitations

Despite numerous potential advantages of GPT-4 in scientific research, there are also some shortcomings:

1. Lack of Domain-Specific Expertise: GPT-4 is a general-purpose language model and may lack in-depth domain-specific knowledge. Responses to highly specialized questions in specific fields might lack the required level of expertise and accuracy.

2. Inability to Verify Information Accuracy: Information generated by GPT-4 is not validated and may contain errors or inaccuracies. Researchers need to approach the information provided by the model with caution and verify its accuracy when necessary, especially in situations requiring high credibility in scientific research.

3. Dependency on Data: GPT-4's generation relies on its training data, reflecting patterns and biases present in that data. This may result in the model exhibiting bias towards certain viewpoints or domains when answering questions or generating content.

4. Lack of Creativity and Innovation: While GPT-4 can generate vast information, it may lack genuine creativity and innovation. The model's output may appear relatively conservative in scientific research, requiring original thinking and profound innovation.

5. Difficulty Understanding Context: GPT-4 may produce inconsistent or ambiguous answers when dealing with longer or complex contexts. This could lead to biases in understanding tough questions, requiring scrutiny and adjustments.

6. Risk Management and Privacy Concerns: When handling sensitive information or making critical decisions, the model's output may pose risk management and privacy issues. Researchers need to manage potential risks carefully and ensure that the model does not have adverse implications.

In conclusion, as a tool, researchers should clarify the scope and limitations of applying GPT -4. They should integrate it with other methods and domain expertise to ensure the accuracy and reliability of scientific research.

Conclusion

GPT-4 can provide multifaceted assistance in scientific research related to spinal health. It can aid in literature reviews, research question design, data analysis, and interpretation, fostering interdisciplinary collaboration, improving patient communication and education, assisting in proposal and grant writing, and facilitating collaborative brainstorming. However, the model has certain potential limitations, including a lack of domain-specific expertise, issues verifying information accuracy, data dependency, and constraints on creativity. Researchers should exercise caution when using GPT-4, explicitly outlining its application limitations. They should combine it with domain expertise and other methods to ensure the reliability and comprehensiveness of scientific research.

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Author Contributions

Lei Liu and Shengxin Peng conceived this study. Bin Shi、Gongchang Yu、Yuanhao Liang、Wenshan Xiao and Yixiang Zhang contributed to the methodology, data curation, formal analysis, resources, and investigation. Lei Liu and Shengxin Peng wrote the manuscript. Rui Xu critically reviewed the manuscript. All authors discussed and approved the final manuscript for submission.

Data Availability

Not applicable.

Declarations

Conflict Interest

All authors declare no conflict of interest.No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

Ethical Approval

This study does not include any individual-level data and thus does not require any ethical approval.

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