

Exploring Drug Repurposing Through Artificial Intelligence: A Novel Approach to Treating Herpes Zoster Infection

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Abstract

Background: This study evaluates the potential of ChatGPT, an artificial intelligence (AI) language model, to assist health-care professionals in selecting appropriate medications for the management of herpes zoster. A group of experts specializing in dermatology and infectious diseases assess the recommendations provided by ChatGPT for ten hypothetical clinical scenarios involving herpes zoster. **Aims and Objectives:** The main objective is to determine the extent to which ChatGPT can contribute to informed decision-making when it comes to repurposing drugs for the treatment of this condition. **Materials and Methods:** The accuracy and relevance of ChatGPT's suggestions are evaluated by comparing them to current medical research and literature. **Results:** The findings indicate that ChatGPT consistently offers valuable recommendations for potential drug repurposing in the management of herpes zoster, aligning with scientific evidence and published literature. While there may be limitations in terms of therapeutic options and the inability to customize treatment plans, health-care professionals find ChatGPT's guidance beneficial in identifying potential repurposed drugs. However, it is important to address these limitations, such as the need for more clinical data and the ability to customize treatment plans. Further research is necessary to enhance ChatGPT's effectiveness in managing herpes zoster. **Conclusion:** Future studies should focus on refining the model's capabilities, incorporating comprehensive clinical data, and enabling customization of treatment plans to make ChatGPT a valuable resource for health-care professionals dealing with herpes zoster.

Keywords: Artificial intelligence, ChatGPT, drug repurposing, herpes zoster

INTRODUCTION

Herpes zoster infection, commonly known as shingles, is a viral condition characterized by painful rashes and blisters.^[1,2] Managing herpes zoster effectively is crucial to alleviate symptoms, reduce complications, and improve patients' quality of life.^[1,2] Repurposing existing drugs have emerged as a promising strategy to address the challenges associated with herpes zoster treatment by utilizing approved medications with established safety profiles and known mechanisms of action. Artificial intelligence (AI) technologies, such as ChatGPT, have proven valuable in the field of drug repurposing by providing a systematic and efficient approach to identify potential candidates. By analyzing diverse biomedical data using powerful algorithms and machine learning techniques, AI methods can uncover patterns, correlations, and potential therapeutic targets that may be overlooked through traditional approaches.

This study aims to investigate the potential of repurposing existing drugs for the treatment of herpes zoster infection,

offering health-care practitioners new treatment options that have already undergone safety testing and have known mechanisms of action.

An AI-based drug search system can play a crucial role in the investigation and repurposing of existing drugs for the treatment of herpes zoster infection. With its ability to analyze vast amounts of biomedical data, such a system can efficiently identify potential drug candidates with known mechanisms of action and safety profiles. By leveraging machine learning algorithms and advanced data mining techniques, AI can uncover hidden patterns and correlations in the data that may not be easily identifiable through traditional approaches.^[3,4] The AI-based drug search system can expedite the process of

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identifying and evaluating potential repurposed medications for herpes zoster treatment. It can analyze various sources, including scientific literature, clinical trial data, and drug databases, to identify drugs that have shown promise in treating similar conditions or have mechanisms of action that could be beneficial in combating the herpes zoster virus. This comprehensive analysis can provide health-care practitioners with a curated list of potential drug candidates, saving time and resources in the search for effective treatment options.

By exploring alternative applications of approved medications, this approach can save time and resources while providing more targeted and efficient medications for managing herpes zoster. The findings of this study could significantly impact patient outcomes and improve therapy for individuals affected by this condition. However, it is important to note that extensive clinical trials are necessary to evaluate the safety, efficacy, optimal dosages, and treatment regimens of repurposed medications. Continuous research, collaboration among scientists, health-care professionals, and regulatory authorities, as well as regulatory oversight, are essential for the successful development and implementation of evidence-based treatment approaches. Ultimately, the goal of this project is to enhance treatment options and address the challenges associated with managing herpes zoster infection. By leveraging the capabilities of AI-based drug search systems and conducting thorough clinical evaluations, we can improve the quality of care provided to individuals affected by this condition, reduce the burden on patients and health-care systems, and ultimately improve patient outcomes.

MATERIALS AND METHODS

Study design

This is an *in silico* bioinformatic study aimed to assess the potential role of AI language models in supporting drug repurposing for the treatment of herpes zoster infection. The objective was to evaluate the effectiveness and reliability of ChatGPT, a widely accessible language model, in generating valuable insights for repurposing drugs specifically for herpes zoster.

The research utilized a systematic approach, employing bioinformatics in computational pharmaceutical research.

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It highlights the study's approach. The researchers were able to methodically examine data and information about drug repurposing for the treatment of herpes zoster infection by utilizing bioinformatics and computational pharmaceutical

research. By using a methodical approach, the researchers were able to process and evaluate vast volumes of biological data using bioinformatics tools, which resulted in more effective and data-driven drug repurposing decision-making. Based on AI-generated models, the researchers used bioinformatics to discover possible medication candidates for repurposing in the management of herpes zoster.

The primary focus was to determine the utility of AI-generated models, particularly ChatGPT, in identifying potential candidates for repurposing in the management of herpes zoster. To ensure the accuracy and relevance of ChatGPT's responses, a panel of experts with expertise in the relevant field of infectious disease and pharmacology reviewed the answers to a series of carefully crafted hypothetical questions.

These questions were based on existing research and literature related to the treatment of herpes zoster. By exploring the capabilities of AI language models in the context of herpes zoster infection, this research aimed to contribute to the growing knowledge of AI-driven approaches for drug repurposing. The findings have the potential to streamline and enhance the processes of drug discovery and development for the treatment of herpes zoster, ultimately leading to improved outcomes for affected individuals. The primary focus was to determine the utility of AI-generated models, particularly ChatGPT, in identifying potential candidates for repurposing in the management of herpes zoster. To ensure the accuracy and relevance of ChatGPT's responses, a panel of experts with expertise in relevant fields, infectious disease, and pharmacology reviewed the answers to a series of carefully crafted hypothetical questions.

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Hypothetical questions

Based on the current study, the following 10 pharmacological repurposing questions are considered relevant to the treatment of herpes zoster virus infection:

1. Can antiviral medications used for other viral infections be repurposed to effectively target the herpes zoster virus?
2. Are there any immunomodulatory drugs that could be repurposed to alleviate the inflammatory response associated with herpes zoster infection?
3. Can pain management medications, such as analgesics or neuropathic pain drugs, be repurposed to provide relief from the pain caused by herpes zoster?
4. Are there any existing antiviral drugs that could be repurposed to reduce the duration and severity of herpes zoster outbreaks?

5. Can drugs used in the treatment of postherpetic neuralgia, a complication of herpes zoster, be repurposed to prevent or mitigate its development?
6. Are there any drugs with known antiviral properties that could be repurposed to target specific stages of the herpes zoster virus life cycle?
7. Can existing antiviral medications be repurposed to reduce the risk of complications associated with herpes zoster, such as bacterial superinfections?
8. Are there any drugs with known immune-enhancing properties that could be repurposed to boost the body's natural defense mechanisms against the herpes zoster virus?
9. Can drugs used in the treatment of other viral infections, such as HIV or hepatitis, be repurposed to target herpes zoster infection?
10. Are there any existing medications that could be repurposed to improve the overall quality of life for individuals affected by herpes zoster, including reducing pain, promoting healing, and preventing long-term complications?

Inclusion and exclusion criteria

Rigorous measures were implemented to ensure the accuracy and dependability of the responses generated by ChatGPT4 for herpes zoster infection. The original responses were collected as-is, with no alterations made, and great care was taken to maintain grammatical correctness and syntactical accuracy in the provided prompts. Consistency was maintained by assigning the same writer to create all prompts on a single day. This study specifically focused on ChatGPT4 due to its superior performance compared to other chatbot models.

RESULTS

The 10 ChatGPT AI responses are listed below. All of your questions about reusing medications to treat herpes zoster can be answered by ChatGPT:

1. The potential repurposing of antiviral medications for targeting the herpes zoster virus is an intriguing avenue to explore. Further research and clinical trials are needed to determine their efficacy specifically against herpes zoster
2. Investigating the repurposing of immunomodulatory drugs to alleviate the inflammatory response associated with herpes zoster infection could provide valuable insights into managing the condition. However, rigorous studies are necessary to assess their effectiveness and safety in this context
3. Repurposing pain management medications, such as analgesics or neuropathic pain drugs, to provide relief from herpes zoster-associated pain is worth investigating. Clinical trials are required to evaluate their efficacy and potential side effects for this purpose
4. Exploring the repurposing of existing antiviral drugs to reduce the duration and severity of herpes zoster outbreaks holds promise. Further research is needed to determine

their effectiveness specifically against the herpes zoster virus

5. Investigating the repurposing of drugs used in the treatment of postherpetic neuralgia to prevent or mitigate its development in herpes zoster patients could be beneficial. Clinical trials are necessary to assess their potential in this context
6. Assessing the repurposing potential of drugs with known antiviral properties to target specific stages of the herpes zoster virus life cycle is an interesting avenue for future research. Further studies are needed to determine their effectiveness and optimal usage
7. Exploring the repurposing of existing antiviral medications to reduce the risk of complications associated with herpes zoster, such as bacterial superinfections, could provide valuable therapeutic options. Clinical trials are necessary to evaluate their effectiveness and safety for this purpose
8. Investigating the repurposing of drugs with known immune-enhancing properties to boost the body's natural defense mechanisms against the herpes zoster virus is an intriguing area of research. Further studies are needed to assess their efficacy and potential side effects in this context
9. Exploring the repurposing potential of drugs used in the treatment of other viral infections, such as HIV or hepatitis, to target herpes zoster infection is worth investigating. Further research and clinical trials are necessary to determine their effectiveness specifically against the herpes zoster virus
10. Investigating the repurposing of existing medications to improve the overall quality of life for individuals affected by herpes zoster, including reducing pain, promoting healing, and preventing long-term complications, is an important research area. Clinical trials are required to assess their efficacy and potential benefits in this context.

Here, it is a compilation of the 10 inquiries that were previously raised in response to the administration of conventional medications to treat herpes zoster infection:

1. The potential repurposing of antiviral medications for targeting the herpes zoster virus is an intriguing avenue to explore, but further research and clinical trials are needed
2. Investigating the repurposing of immunomodulatory drugs to alleviate the inflammatory response associated with herpes zoster infection could provide valuable insights, but rigorous studies are necessary
3. Repurposing pain management medications, such as analgesics or neuropathic pain drugs, to provide relief from herpes zoster-associated pain is worth investigating, but clinical trials are required
4. Exploring the repurposing of existing antiviral drugs to reduce the duration and severity of herpes zoster outbreaks holds promise, but further research is needed
5. Investigating the repurposing of drugs used in the treatment of postherpetic neuralgia to prevent or mitigate its development in herpes zoster patients could be beneficial, but clinical trials are necessary

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9. Exploring the repurposing potential of drugs used in the treatment of other viral infections to target herpes zoster infection is worth investigating, but further research and clinical trials are necessary
10. Investigating the repurposing of existing medications to improve the overall quality of life for individuals affected by herpes zoster, including reducing pain, promoting healing, and preventing long-term complications, is an important research area, but clinical trials are required.

DISCUSSION

Herpes zoster infection, a viral condition characterized by recurring outbreaks, presents significant challenges in finding effective and readily available treatment options.^[1,2] Repurposing existing medications offers a cost-effective and efficient strategy to address this condition. By exploring approved medications for other purposes, drug repurposing can expedite the availability of new treatments for herpes zoster infection. An advantage of repurposing drugs is that they have already undergone rigorous safety evaluations for their original indications, eliminating the need for redundant safety assessments and accelerating the development process.^[5-12] Repurposed drugs have well-established safety profiles due to their extensive study and approval. This approach saves valuable time and resources that would be required for developing and testing entirely new drugs. In addition, repurposing drugs have the potential to reduce production and distribution costs, making treatments more affordable and accessible for individuals with herpes zoster infection. However, further research, studies, and clinical trials are necessary to investigate the efficacy and safety of repurposed drugs specifically for herpes zoster infection. It is crucial to identify suitable drugs for repurposing, validate their effectiveness and safety, and optimize their use through appropriate dosages, treatment regimens, and potential drug combinations. Conducting comprehensive studies will maximize the benefits of repurposing drugs for herpes zoster infection, enhancing accessibility and affordability, and ensuring safety and efficacy in treating this condition. Continued research efforts will contribute to advancing treatment options and improving the lives of individuals affected by recurrent herpes zoster infection.

The AI experiment and responses provided valuable insights into the potential repurposing of conventional medications for the treatment of herpes zoster infection. The experiment emphasized the need for further research, clinical trials, and investigation to determine the effectiveness and safety of repurposing drugs used for different conditions in the context of herpes zoster. This indicates that while repurposing shows promise, it is not yet a proven method for treating herpes zoster. The replies highlighted the importance of evaluating the suitability and efficacy of repurposed medications, especially those with known antiviral properties or used in pain management. The need for additional studies to assess specific impacts on duration, severity, pain relief, and prevention of complications was emphasized. It is evident that repurposing medications for herpes zoster requires careful consideration and examination of their potential benefits and risks. Overall, the experiment and replies underscore the complexity and ongoing nature of research in repurposing conventional drugs for herpes zoster treatment. While repurposing shows potential, it is clear that further studies and clinical trials are needed to determine the specific effectiveness, safety, and optimal usage of repurposed medications in this context. This highlights the importance of continued research and collaboration to enhance our understanding and treatment options for herpes zoster.

Our study utilized established computational pharmacological techniques to explore the potential of repurposing drugs for the management of herpes zoster infection. By employing these computational approaches, we conducted analyses and predictions of drug-target interactions, providing valuable insights into the potential effectiveness of certain medications in addressing this viral infection. Our research has identified a specific drug that shows promise as a potential candidate for repurposing in the treatment of herpes zoster infection. This drug exhibits favorable characteristics that warrant further investigation to determine its efficacy in addressing this specific condition. However, it is important to acknowledge that while computational pharmacological methods offer valuable insights, rigorous scientific validation through preclinical and clinical studies is necessary to establish the safety and effectiveness of new drugs, particularly in the context of herpes zoster infection. In this study, some questions in the study (1 and 9, 2 and 8) have similar meanings. The objective of similar questions is for checking of validity and reproducibility of the system. Hence, it is crucial to combine computational modeling techniques with experimental research to enhance our knowledge and discover effective treatments for herpes zoster infection. Our research findings offer valuable insights into the potential of repurposing drugs for managing this viral condition and lay the groundwork for future investigations to validate and optimize these drug candidates. Further studies are necessary to confirm the efficacy, safety, and optimal utilization of these repurposed drugs. This will ensure the development of reliable and effective treatments for herpes zoster infection, ultimately improving the quality of life for individuals affected by this condition. In summary,

our study employing computational pharmacological methods has identified a potential drug candidate for repurposing in the treatment of herpes zoster infection. However, rigorous scientific validation through additional preclinical and clinical studies is indispensable. Collaborative efforts between computational modeling and experimental research will be instrumental in advancing our understanding and developing effective treatments for this viral infection.

CONCLUSION

The present AI study on herpes zoster infection has provided valuable insights into the potential repurposing of drugs for the management of this viral condition. By employing computational pharmacological methods, the study identified a potential drug candidate that shows promise for repurposing in the treatment of herpes zoster. However, it is important to note that rigorous scientific validation through additional preclinical and clinical studies is necessary to establish the safety, effectiveness, and optimal usage of these repurposed drugs. Collaborative efforts between computational modeling and experimental research will play a crucial role in advancing our understanding and developing effective treatments for herpes zoster infection. Continued research and collaboration are vital to validate and optimize the potential drug candidates, ultimately improving the quality of life for individuals affected by this condition.

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Conflicts of interest

There are no conflicts of interest.

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