



Original Article

<http://wjpn.ssu.ac.ir>**Applications of Artificial Intelligence Chatbots in Congenital Diplopodia: A Real-World Perspective on a Rare Case of Duplicated Lower Limb**Ali Masoudi¹, Amirhossein Omid¹, Seyedeh Elham Shams^{*2}, Maryam Yeganegi³, Mahsa Danaei⁴, Amirmasoud Shiri⁵, Maryam Aghasipour⁶, Kazem Aghili⁷, Hossein Neamatzadeh⁸¹ Student Research Committee, Shahid Sadoughi University of Medical Sciences, Yazd, Iran² Department of Pediatrics, Hamadan University of Medical Sciences, Hamadan, Iran³ Department of Obstetrics and Gynecology, Iranshahr University of Medical Sciences, Iranshahr, Iran⁴ Department of Obstetrics and Gynecology, Iran University of Medical Sciences, Tehran, Iran⁵ Student Research Committee, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran⁶ Department of Cancer Biology, College of Medicine, University of Cincinnati, Ohio, USA⁷ Department of Radiology, Shahid Rahnamoun Hospital, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran⁸ Mother and Newborn Health Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

Received: 03 August 2024

Revised: 23 October 2024

Accepted: 20 November 2024

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Keywords:Congenital diplopodia,
Artificial intelligence,
ChatBot,
Duplicated lower limb**ABSTRACT****Background:** This study examines the effectiveness of AI chatbot technology in assisting patients with congenital diplopia, focusing on a case study of a 16-month-old boy with duplicated lower limbs.**Methods:** We assessed the performance of two AI chatbots—Sider Fusion AI and Perplexity AI—by analyzing their discharge summaries against a previously published clinical scenario. An orthopedic specialist, geneticist, and neonatologist evaluated the summaries for competence, accuracy, relevance, informativeness, support capabilities, and overall communication effectiveness.**Results:** Both chatbots produced organized summaries that accurately reflected the diagnosis and surgical procedure outlined by Dr. Kitta. However, Sider Fusion AI surpassed Perplexity AI in organization and detail, offering structured summaries with clear headings and bullet points. It included comprehensive information on patient care, dietary advice, genetic testing, family support, follow-up instructions, pain management, and Ankle-Foot Orthosis (AFO) guidelines. In contrast, Perplexity AI's summary, while accurate, was less specific and clear, conflating care instructions with vague mobility information.**Conclusion:** The findings suggest that while AI chatbots can aid in clinical documentation, their effectiveness varies significantly, with Sider Fusion AI providing a more structured and practical resource for families and practitioners dealing with congenital orthopedic disorders.

Introduction

Congenital diplopodia, characterized by duplicated lower limbs and extra toes or fingers, poses unique challenges for clinicians and caregivers.¹ This condition significantly impacts the psychosocial and physical well-being of those affected, requiring a comprehensive approach to assessment and management. The genetic foundation of this condition can involve various elements, including mutations in key genes crucial for limb development, such as SHH (Sonic Hedgehog), GLI3, and ZRS (Zinc Finger Regulatory Sequence).^{2,4} Congenital diplopodia can be influenced by genetic factors, including chromosomal abnormalities such as duplications or translocations.^{1,5} These structural changes in chromosomes may play a significant role in the manifestation of diplopodia.³ Hereditary patterns are also crucial, as the condition can be inherited through autosomal dominant or recessive pathways. In autosomal dominant cases, a single mutated gene from one parent can lead to the condition, while autosomal recessive inheritance requires mutations in both gene copies.⁶⁻⁸ Additionally, congenital diplopodia may be associated with syndromes that present multiple congenital anomalies, each with distinct genetic origins.^{1,9,10} Ongoing research aims to unravel the specific genetic factors associated with congenital diplopodia, which can exhibit considerable variability in presentation.¹¹ Genetic counseling is recommended for affected individuals and their families to navigate the implications of the condition and understand recurrence risks.

Recent advancements in artificial intelligence (AI) have significantly transformed various aspects of healthcare, leading to the creation of sophisticated chatbot applications designed to enhance healthcare delivery. These AI-driven tools improve patient communication by offering timely and personalized responses to inquiries, which is especially beneficial for individuals with rare conditions like congenital diplopodia.

Furthermore, chatbots can educate patients about their conditions, treatment options, and self-management strategies, promoting a deeper understanding of their health.¹² By streamlining patient interactions and increasing access to healthcare resources, these technologies enhance overall patient experiences and outcomes.¹³ The role of AI chatbots in healthcare is becoming increasingly important, as they provide essential information and support to patients, caregivers, and healthcare professionals.¹⁴

This study conducts a critical analysis of a real-world case to investigate the transformative role of AI chatbots in enhancing information dissemination, boosting patient engagement, and improving decision-making processes within the context of congenital anomalies.¹⁵ By focusing on congenital diplopodia, a rare condition characterized by duplicated lower limbs, the research highlights the potential applications of AI technology in diagnosing, treating, and managing this complex issue. The analysis demonstrates how AI chatbots can elevate patient care, facilitate communication between patients and healthcare providers, and enhance patient education by providing relevant and personalized information.¹⁶ Furthermore, the study evaluates the effectiveness of these chatbots in addressing patient inquiries and delivering tailored recommendations. Ultimately, the research aims to establish a framework for integrating AI tools into clinical practice for congenital limb abnormalities, identifying best practices that can be applied in similar medical contexts to improve overall patient outcomes.

Materials and Methods

This study evaluated two AI chatbots, Sider Fusion AI and Perplexity AI, using a clinical case scenario by Muhammad Ihsan Kitta et al.¹ from 2021, published in the International Journal of Surgery Case Reports. The scenario involved a patient with congenital diplopodia, a rare condition marked by duplicated lower limbs. A panel of an orthopedic specialist, a

geneticist, and a neonatologist assessed the chatbots for competence, accuracy, relevance, informativeness, support capabilities, and overall communication effectiveness. The primary aim was to investigate the current functionalities of AI chatbots and their potential role in assisting healthcare practitioners and patients with congenital orthopedic disorders.

Reasons for choosing chatbots and the scenario

The selection of Sider Fusion AI and Perplexity AI is based on their unique strengths and methodologies in text generation. Sider Fusion AI is particularly effective in medical and clinical contexts, as it excels at generating contextually accurate and relevant content tailored for healthcare settings. In contrast, Perplexity AI is renowned for its versatile language processing capabilities, allowing it to adeptly handle a diverse range of prompts. This evaluation focuses on a rare clinical case involving congenital diplopodia, necessitating a comprehensive analysis by healthcare professionals. The patient's duplicated foot and accompanying anatomical variations provide a crucial context for assessing how well the chatbots can produce clinically relevant summaries and recommendations. The researchers aimed to gauge the efficacy of both chatbots in managing complex pediatric orthopedic disorders, encompassing aspects like surgical interventions, post-operative care, and genetic testing. By analyzing their performance in this specific scenario, the researchers can highlight each chatbot's strengths and weaknesses, showcasing their potential to support practitioners facing similar challenges. The combined capabilities of Sider Fusion AI and Perplexity AI enhance the understanding of AI's role in the healthcare domain.

Scenario

"Create a discharge summary that includes instructions, dietary recommendations, genetic testing options, family and patient support, required surgeries, and return precautions for A 16-month-old boy who was brought to our private hospital by his mother due to a

duplicated foot on his right leg. His obstetric history was unremarkable, with a spontaneous vaginal delivery at 39 weeks and a birth weight of 3000 g. He was the fourth child, with no teratogenic exposure or family history of diplopodia. Physical examination revealed a normal left lower extremity and a well-formed duplicate foot on the posterior-lateral aspect of the mid-lower right leg, featuring four toes and an attachment resembling an Achilles tendon. The dorsalis pedis pulse was strong, but no active movement was noted in the duplicated foot. The native right leg exhibited normal joint mobility, while the left leg showed intact pulses and sensations, with a 4 cm leg length discrepancy on the right. Radiographic studies revealed the duplicated foot articulating with four metatarsals and two ossified tarsals: the calcaneus and talus. CT scans indicated nearly complete mirror image duplication of the right foot, including its talus and calcaneum, while both limbs had single tibia and fibula of equal size. The right popliteal artery was enlarged with an aberrant course, bifurcating into two branches at the popliteal fossa, with the anterior branch dividing into the right anterior/posterior tibial arteries and peroneal artery. The abnormal posterior branch generated anteromedial and posterolateral tributaries proximal to the native calcaneum. The surgical procedure was performed by pediatric orthopedic consultant Dr. Muh. Ihsan Kitta, M. Kes, Sp. OT(K), who has five years of experience. The patient was placed in a prone position, and a zigzag approach was utilized. The neurovascular bundle at the duplicated foot was identified and dissected before the foot was surgically excised. Normal musculotendinous anatomy and perfusion were observed in the native right leg, but the duplicated foot contained no muscle structure aside from an aberrant gastrocnemius. Post-surgery, the patient had uneventful wound healing and began walking with an Ankle-Foot Orthosis, reporting no significant issues. Follow-up at three months is illustrated in the accompanying figure."

Results

The discharge summary emphasizes key insights from an orthopedic specialist, geneticist, and neonatologist, assessing the chatbots in detail, comprehensiveness, medication and diet recommendations, and family support, as detailed below:

Comparison of discharge summaries from Sider and Perplexity AI:

1. Structure and Organization:

- Sider Fusion AI: The summary features clear headings and bullet points, systematically detailing patient information, diagnosis, surgical procedure, postoperative recovery, care instructions, dietary guidelines, genetic testing options, family support, follow-up, and return precautions. This layout enhances readability and comprehension.

- Perplexity AI: This summary also uses headings and bullet points but has a simpler outline with some sections combined, resulting in less detail than Sider. The "Medications" section merges with home care instructions and lacks the specific over-the-counter pain management advice in Sider's summary.

2. Content:

- Diagnosis: Both summaries correctly identify the diagnosis (duplication of the right foot/diplopodia) and describe the surgical procedure, including the surgeon's information.

- Post-Operative Course: Sider notes that the patient began ambulating with an Ankle-Foot Orthosis (AFO) without significant issues, whereas Perplexity states recovery was uneventful, mentioning ambulation less specifically.

3. Care Instructions:

- Wound Care: Both emphasize keeping the surgical site clean and dry, watching for infection, and changing dressings. Sider is more specific about monitoring increased discharge as a sign of infection.

- Mobility and Physical Activity: Sider provides detailed instructions on AFO usage and supervision to prevent falls, while

Perplexity discusses gentle movement and weight-bearing, lacking explicit mention of the AFO.

- Pain Management: Sider offers comprehensive guidance on over-the-counter pain relief, whereas Perplexity combines pain management with medication instructions but lacks specificity.

- Dietary Recommendations: Both highlight the importance of a balanced diet for healing. Sider emphasizes hydration and regular meal times, while Perplexity includes hydration and suggests potential supplementation consultation.

- Genetic Testing Options: Both recommend genetic counseling; however, Sider adds specific recommendations for further evaluation, enriching the discussion.

- Family and Patient Support: Sider includes family support resource connections, which Perplexity omits.

- Return Precautions: Both summaries detail signs for seeking medical attention, but Sider provides more specific concerns regarding the leg and overall health.

4. Tone and Language:

- Sider Fusion AI: The tone is professional and detailed, ensuring comprehensive home care instructions, with an emphasis on clear directives.

- Perplexity AI: The tone is similarly professional but more concise, which may aid quick reading but could omit important specifics.

Summarizes the similarities and differences between Sider and Perplexity AI:

Similarities:

1. Header and Patient Information: Both begin with essential patient details, including name, age, gender, and dates of admission and discharge.

2. Diagnosis: Each confirms the primary diagnosis — duplication of the right foot (diplopodia).

3. Surgical Procedure: Both describe the procedure undertaken by Dr. Muh. Ihsan Kitta,

detailing the technique used (zigzag approach) and the excision.

4. Post-Operative Recovery: Both conclude that the recovery was uneventful, mentioning wound healing and the use of an Ankle-Foot Orthosis (AFO).

5. Wound Care Instructions: Both provide thorough instructions for wound care, emphasizing cleanliness, dryness, and infection monitoring.

Differences:

1. Structure and Format:

- Sider uses a segmented format with bullet points, clearly outlining care instructions and follow-up needs.

- Perplexity employs a more narrative approach in the “Summary of Hospital Stay,” transitioning to bullet points for home care instructions.

2. Additional Care Instructions:

- Sider places greater emphasis on mobility, providing specific supervision instructions for AFO use.

- Perplexity integrates medication management in home care instructions, covering prescribed pain relief and side effect monitoring.

3. Dietary Recommendations:

- Sider offers a comprehensive nutritional guide focusing on food groups and regular meal importance.

- Perplexity highlights a balanced diet and hydration, suggesting potential supplementation for broader nutritional considerations.

4. Genetic Testing Options:

- Sider recommends genetic evaluation referral if there's a family history of limb malformations and discusses genetic counseling for inheritance.

- Perplexity emphasizes genetic testing options, such as chromosomal microarray analysis, while not addressing family history.

5. Follow-Up and Precautions:

- Sider provides specific follow-up appointment details and conditions for seeking immediate medical attention.

- Perplexity offers general follow-up guidelines but lacks a structured list of return precautions

Discussion

The comparison between the summaries provided by Sider Fusion AI and Perplexity AI reveals notable similarities and differences in how they present information, particularly regarding the discharge instructions for a 16-month-old male patient post-surgery for duplication of the right foot (diplopodia). Structurally, both summaries commence with essential patient information, setting a clear context before delving into the specifics of diagnosis and treatment. This foundational format is crucial in medical documentation as it shapes the reader's understanding and engagement with the information presented. In terms of content, both summaries successfully identify the primary diagnosis and detail the surgical procedure performed, ensuring consistency in conveying crucial medical information. The mention of Dr. Muh. Ihsan Kitta adds credibility and a personal touch to the medical narrative, highlighting the expertise involved in the procedure. However, the nuances in the post-operative course differentiate the two summaries significantly. Sider's account provides a more detailed narrative of the patient's ambulation with Ankle-Foot Orthosis (AFO), while Perplexity's summary is less descriptive, potentially leaving out important information that could aid caregivers in understanding the expected recovery trajectory.

Care instructions also exhibit stark differences. Sider's emphasis on explicit wound care, mobility, and pain management instructions demonstrates an understanding of the potential complexities caregivers face. Its specificity regarding monitoring for infection, proper use of the AFO, and detailed pain management strategies allow for a

comprehensive grasp of home care. Conversely, Perplexity's combined sections on medications and home care risk omitting critical over-the-counter pain relief recommendations, which could be essential for the patient's comfort. Dietary recommendations similarly reflect Sider's more thorough approach, stressing hydration and structured meal times, while Perplexity's implication for nutritional supplementation can lack clarity. The depth of information regarding genetic counseling is another area where Sider excels. By providing specific recommendations for further evaluation, it underscores the importance of genetic considerations that may impact the patient and family. Support for family members is a vital aspect of pediatric care. Sider's inclusion of resources for family support and connection to advocacy groups acknowledges the broader implications of the patient's condition on family dynamics. The absence of this in Perplexity's summary suggests a missed opportunity to address holistic care. Return precautions are another area where Sider demonstrates a commitment to comprehensive care. Its more detailed signposting regarding specific concerns related to the leg and overall health reflects an understanding of the anxiety caregivers may experience post-surgery. Tone and language are also pivotal in effective communication. Sider Fusion AI adopts a professional and detailed tone, ensuring clarity in directives for home care. This approach is beneficial for caregivers who may need reassurance and exhaustive guidance. On the other hand, Perplexity's more concise presentation caters to quick-reading preferences but risks the omission of essential details necessary for effective post-operative management.

Research on the effectiveness of AI chatbots in clinical documentation aligns with numerous studies regarding AI's impact on healthcare. The use of AI-powered chatbots has significantly improved response times and patient engagement. Abreu et al. demonstrated the potential of AI chatbots to enhance patient-provider communication by improving the

readability of patient-facing content, ultimately streamlining documentation processes.¹⁷ Liao et al. highlighted the role of ChatGPT-4 in analyzing Electronic Patient-Reported Outcomes (ePROs) for cancer patients, showcasing AI's ability to process data accurately and provide improvement suggestions that aid in clinical decision-making and reduce caregiver stress.¹⁸ A study by Sharma et al. emphasized the transformative impact of chatbots in healthcare, particularly in optimizing clinical workflows and enhancing patient engagement. Which aligns with the efficiency gains observed in preliminary evaluations of AI healthcare chatbots.¹⁹ A comprehensive analysis evaluated the impact of AI tools in orthopedics. The study found that while these advancements improved administrative functions and communication among healthcare professionals and patients, their overall effectiveness was inconsistent.²⁰ The results highlighted the importance of a systematic approach, similar to the strategy of Sider Fusion AI, to fully leverage AI's potential in clinical settings. Previous research indicates that AI chatbots can significantly enhance clinical record-keeping, though their effectiveness depends on various factors, including design, application, and the specific healthcare context. Exploring congenital orthopedic conditions through Sider Fusion AI showcases the benefits of specialized AI platforms. By utilizing AI-driven chatbots, healthcare institutions can streamline documentation, improving operational efficiency, information accessibility, and the quality of patient care. Overall, these findings emphasize the transformative potential of AI technologies, particularly chatbots, in enhancing communication between patients and providers and revolutionizing healthcare delivery.

Novelties, Advantages, and Limitations of this study

The study on the comparative analysis of AI chatbots, specifically Sider Fusion AI and Perplexity AI, offers a novel evaluation in the context of generating simulated clinical

discharge summaries, analyzing their responses to a unique medical case scenario involving congenital diplopodia. This rare condition, with limited existing literature on AI assistance in medical communication, highlights the potential of AI chatbots to address specialized medical topics in pediatric orthopedics effectively. A unique aspect of this study is the expert evaluation methodology, which involves a panel of orthopedic experts and a neonatologist assessing the AI-generated summaries. This expert involvement enhances the credibility of the analysis, ensuring that the assessments are backed by clinical expertise.

The study provides several advantages, such as enhancing the understanding of AI capabilities in medical contexts and illustrating the role these chatbots can play in assisting healthcare practitioners with complex conditions. The structured evaluation criteria employed—focusing on competence, accuracy, relevance, informativeness, support capabilities, and communication effectiveness—offer a systematic approach that can serve as a model for future studies and clinical applications. Moreover, the detailed insights into discharge instructions emphasize the significance of thorough post-operative guidance for caregivers, ultimately enhancing patient safety and health outcomes. Additionally, by addressing holistic patient care aspects like dietary recommendations, genetic counseling options, and family support resources, the study underscores how AI can contribute to comprehensive patient management in pediatrics.

However, the study also has limitations. The focus on a single clinical case scenario restricts the generalizability of the findings, as the performance of AI chatbots may vary across different medical conditions. Furthermore, evaluator bias may arise from the expert panel, whose individual preferences regarding communication style and information presentation can influence the assessment of AI outputs. Additionally, the rapid evolution of AI technology poses a challenge, making the study's findings time-

sensitive, as advancements in AI capabilities could significantly alter the effectiveness of these chatbots. Lastly, a notable shortcoming is the lack of a patient-centric perspective; However, the study highlights AI functionality in generating discharge summaries, but it fails to consider patient experiences and perspectives on the quality of information provided. Including feedback from patients and caregivers would give a more comprehensive understanding of the utility of AI in real-world medical settings.

Conclusion

In summary, while Sider and Perplexity AI effectively deliver structured discharge summaries, Sider provides a more comprehensive and detail-oriented account, addressing a wider range of concerns pertinent to the patient's post-operative care. Care instructions, dietary suggestions, genetic testing options, and family support resources are more thoroughly addressed, enhancing the completeness and utility of the information provided. Perplexity's solid summary, while effective for brevity, could benefit from the inclusion of the specificities found in Sider's narrative to better support caregivers in navigating the post-surgical landscape.

Conflict of Interest

The authors declare no conflicts of interest regarding the study, and neither Sider Fusion AI Bot nor Perplexity AI has financial ties that could affect result interpretation. The evaluation was conducted independently to ensure an unbiased assessment of the chatbots' performance in a clinical context.

Acknowledgments

We sincerely thank all the developers and researchers in artificial intelligence for their dedicated efforts in creating and refining chatbot applications. Your commitment to advancing AI technology has enabled its application in healthcare settings.

Funding

This work was not supported by any specific funding.

Ethical Considerations

Ethics declarations are not considered necessary for this evaluation.

Author's Contribution

Conceptualization, A. M., A. O., and S.E.S.; methodology, A. M., A. O., and S.E.S.; conducting the data collection and performing the analyses, M. Y., M. D., and A. S.; assisting in interpreting the results and reviewing the literature, M. A., K. A., and H. N.; providing critical revisions and oversight throughout the study, H. N.; reviewing and approving the final manuscript, A. O and A. S.

How to Cite: Masoudi A, Omidi A, Shams SE, et al. Applications of Artificial Intelligence Chatbots in Congenital Diplopodia: A Real-World Perspective on a Rare Case of Duplicated Lower Limb. *World J Peri & Neonatol* 2024; 7(1): 7-15. DOI: 10.18502/wjpn.v7i1.17323

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