

Generative artificial intelligence and ChatGPT as a chatbot for chronic oedema information

Digital health assists in healthcare by allowing for more convenient and accessible patient access to information. ChatGPT is an application of artificial intelligence, known as generative artificial intelligence, which can contribute to the ongoing development of digital health solutions by utilising natural language processing and machine learning algorithms to generate healthcare communication. This paper introduces concepts of digital health, including generative artificial intelligence, discusses natural language processing, and demonstrates the use of ChatGPT using a scenario of a patient using the chatbot to understand a complex clinical presentation of lymphorrhea with an eczematous ulcerated lesion.

Digital health encompasses a vast array of electronic technologies and methods for improving healthcare delivery and outcomes.

Some common forms of digital health communication are as follows.

Electronic health records (EHRs), which are digital versions of patients' medical records, including their medical history, diagnoses, medications, and test results. They can be used for large, population-based studies to better understand chronic oedemas (Yen et al, 2015).

Telemedicine and telehealth refer to the use of digital technologies, such as video conferencing, to provide remote medical and health consultations and care. Telehealth can improve access to care, particularly for patients in rural or underserved areas, and can reduce costs associated with in-person visits (Naumann et al, 2023).

Mobile health (mHealth) refers to the use of mobile devices, such as smartphones and tablets, to support healthcare (Chan, 2021).

Health information websites or databases that provide information on health topics and conditions (Küçükakkaş and Ince, 2022).

Virtual doctors are where generative artificial intelligence is used to create patient communication. Ayers et al (2023) compared physician and chatbot responses to patient questions posed on a public social media forum. The quality and empathy ratings of chatbot responses were significantly higher than those of physician responses.

Social media platforms, such as Instagram, can be used for health communication and education, providing opportunities to share information, resources, and support for health issues (Tuğral et al, 2021).

Natural language processing

Natural language processing (NLP) is a subfield of computer science and artificial intelligence (AI) that focuses on enabling computers to understand, interpret, and generate human language. Leeson et al (2019) state: "NLP uses algorithmic approaches rooted in statistical techniques to ascertain semantic meaning from textual data". NLP involves developing algorithms and models that allow computers to process, analyse, and generate natural language data, such as text or speech.

In healthcare, NLP can be used to analyse electronic health records, assist in medical diagnosis, and provide automated communication and support to patients.

Hao et al (2021) provide further applications of NLP to health research and delivery including:

- NLP models for medical or social web data (e.g. literature, EHRs, clinical trials and social media about healthcare processing).
- Health information retrieval and extraction.
- NLP techniques for medicine personalisation.
- Novel tools for medical, clinical or social web data interpretation and visualisation.
- Innovative NLP systems for mobile environments for healthcare applications.
- NLP for clinical decision support and informatics.
- Question-answering technologies for health applications.

Generative artificial intelligence and ChatGPT

ChatGPT is an application of question-answering technologies (Open AI, 2023a; 2023b). The program can be considered a type of electronic health technology (also known as eHealth) that falls under the categories of digital health communication and generative

Andrea Mangion

Cancer and Lymphoedema
Physiotherapist, Educator
and PhD Candidate
in the Lymphoedema
Clinical Research Unit,
Flinders University,
Adelaide, Australia

Neil Piller

Director of the
Lymphoedema
Clinical Research Unit,
Flinders University,
Adelaide, Australia

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- Digital health communication
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artificial intelligence (Pavlik, 2023). Specifically, ChatGPT can be used as a chatbot or virtual assistant to provide health-related information, support, and advice to users.

ChatGPT (OpenAI; San Francisco, CA/ Version 3.0) is a NLP model based on generative pre-trained transformer (GPT) architecture. GPT refers to a series of pre-trained language models (PLM; Zhu and Luo, 2022). ChatGPT can generate human-like responses to natural language input by predicting the most likely next word in a sequence of text. The model has been trained on a large amount of text data from the internet, including books, articles and websites, allowing it to understand and generate responses in a wide range of topics and styles. It can also perform a variety of language-related tasks, such as summarising, translation and answering questions.

Demonstration of ChatGPT for questions pertaining to lymphorrhea with an eczematous ulcerated lesion

In the context of chronic oedema management, ChatGPT could be used to develop a conversational agent or chatbot that can help patients manage their condition by providing information, answering questions, and offering support.

Chronic oedema affects millions of people around the world and, if left untreated, can have severe health consequences. One such consequence, as discussed by Karnasula (2012) is ulceration, which is more common in venous disease, but can also occur in severe cases of lymphoedema, such as in association with lymphorrhea.

Lymphorrhea, the weeping of lymph through the skin, is a complication of chronic oedemas (Renshaw, 2007). As MacLaren (2001) explains, lymphorrhea typically manifests as beads of fluid trickling down the swollen limb. This can lead to maceration of the surrounding skin, soaked clothing, fluid pooled in footwear, and extreme coldness and discomfort for the patient.

Below is a hypothetical case study of a patient with ulceration and lymphorrhea who uses ChatGPT to understand their health condition. The patient understands that they have a chronic ulcer on their left leg, which is leaking clear fluid. The patient has already seen two healthcare providers, but the wound has failed to heal.

The first question posed to the AI was: "I have a big leaky ulcer on my leg. It won't heal. What should I do?" The first AI-generated response [Figure 1] involved:

- Acknowledgement of their condition: "I'm sorry to hear about your ulcer."
- Recommendation to seek medical help: "It's

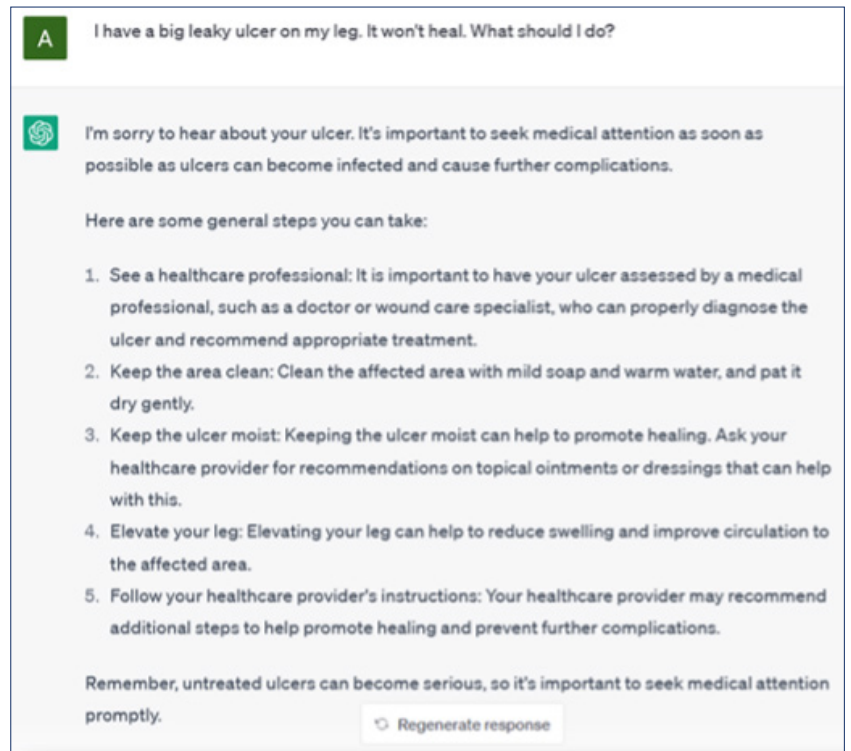


Figure 1. Initial question and ChatGPT response.

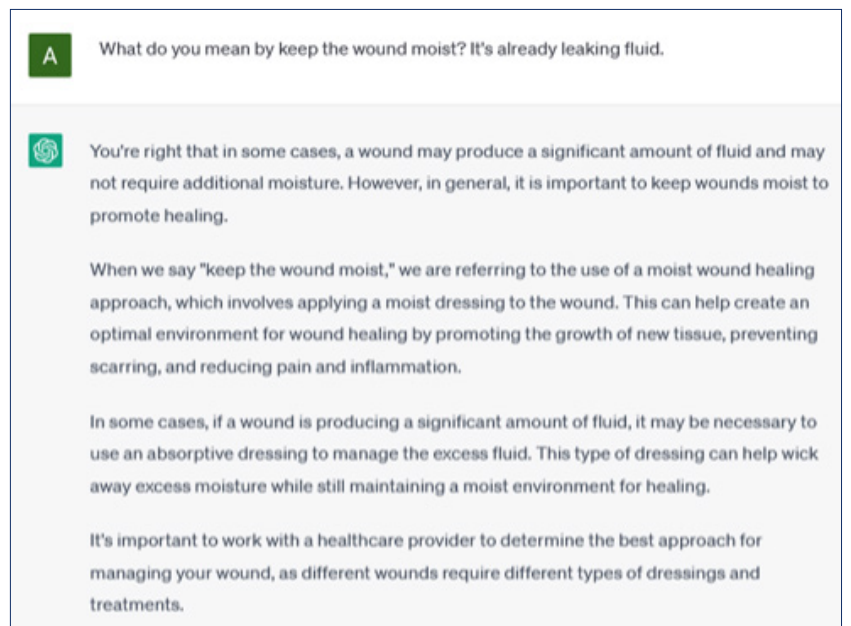


Figure 2. Second question and ChatGPT response.

- important to seek medical attention as soon as possible as ulcers can become infected and cause further complications."
- Practical steps that could be taken including seeing a healthcare professional, keeping the area clean, keeping the ulcer moist, elevating the leg and following your healthcare provider's instructions.
- Further caution that help may be required: "Remember, untreated ulcers can become serious, so it's important to seek medical attention promptly."

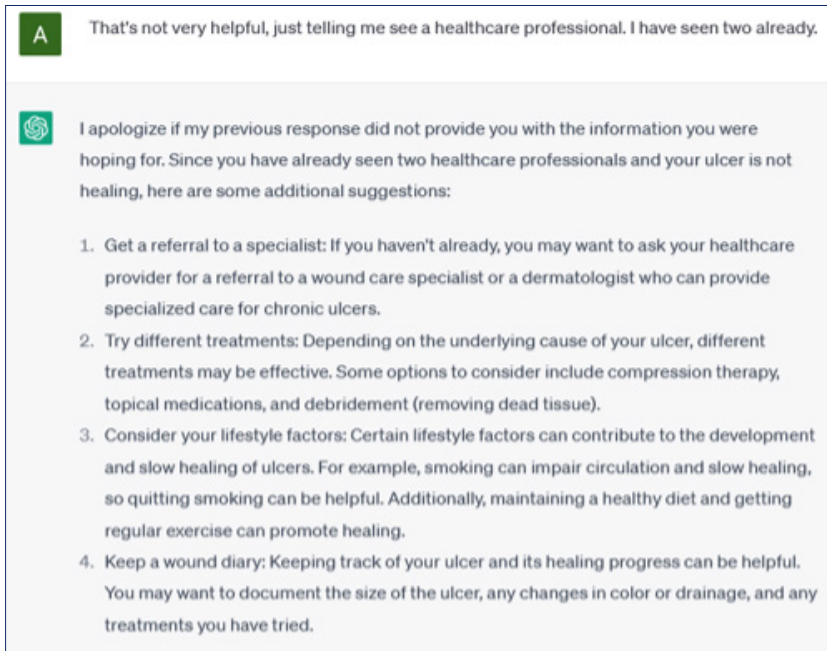


Figure 3. Third question and ChatGPT response.

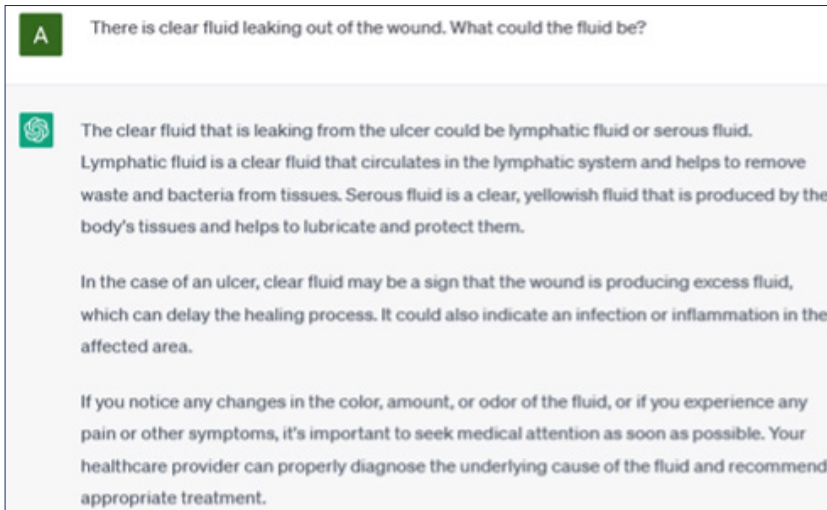


Figure 4. Fourth question and ChatGPT response.

Patients attempting to heal their “leaking legs” may not be familiar with the concept of moist wound healing, which is well-known to experienced wound practitioners. Therefore, a follow-up question was posed: “What do you mean by keep the wound moist? It’s already leaking fluid”. The second AI-generated response [Figure 2] involved:

- Clarification of the point: “You’re right that in some cases, a wound may produce a significant amount of fluid and may not require additional moisture. However, in general, it is important to keep wounds moist to promote healing. When we say ‘keep the wound moist,’ we are referring to the use of a moist wound healing approach, which involves applying a moist dressing to the wound. This can help create an optimal environment for wound healing by promoting the growth of new tissue,

preventing scarring, and reducing pain and inflammation.”

- Information on the solution: “In some cases, if a wound is producing a significant amount of fluid, it may be necessary to use an absorptive dressing to manage the excess fluid. This type of dressing can help wick away excess moisture while still maintaining a moist environment for healing.”
- Recommendations to seek medical help: “It’s important to work with a healthcare provider to determine the best approach for managing your wound, as different wounds require different types of dressings and treatments.”

In this hypothetical scenario, even after being bandaged by community nurses, the clear fluid continued to leak down the leg and into the patient’s shoe. They expressed their frustration towards the AI, writing: “That’s not very helpful, just telling me to see a healthcare professional. I have seen two already”.

The third AI-generated response [Figure 3] involved:

- Acknowledgement of their disappointment: “I apologise if my previous response did not provide you with the information you were hoping for.”
- Recommendations to seek medical help: “Remember, chronic ulcers can be complex and difficult to treat. It may take time to find the right treatment approach for your specific situation. It’s important to continue working with your healthcare provider and following their recommendations to promote healing and prevent further complications.”
- Practical steps that could be taken, including seeing a wound care specialist or a dermatologist, trying different treatments such as compression therapy, topical medications, and debridement (removing dead tissue), considering lifestyle factors and keeping a wound diary.

Then the patient tried to seek further understanding of what the fluid leaking from their leg was. They wrote, “There is clear fluid leaking out of the wound. What could the fluid be?” The AI generated response [Figure 4] noted that the clear fluid could be lymphatic fluid or serous fluid with valid definitions of the type of fluid being provided. A reminder to seek medical help was again provided.

The patient questioned further: “The fluid leaks out of my leg into my shoe, even after I have been bandaged by the community nurses. What is this called?” The AI responded that the fluid must be wound exudate [Figure 5].

The patient questioned further [Figure 6]. “Are you sure it is wound exudate? It drips

down my leg. I think there is something else wrong with my leg". The AI responded with an acknowledgement: "It's possible that there may be a more serious underlying issue beyond wound exudate." A valid response was provided including that the reason could possibly involve a range of conditions such as lymphoedema, venous insufficiency or an infection.

Limitations

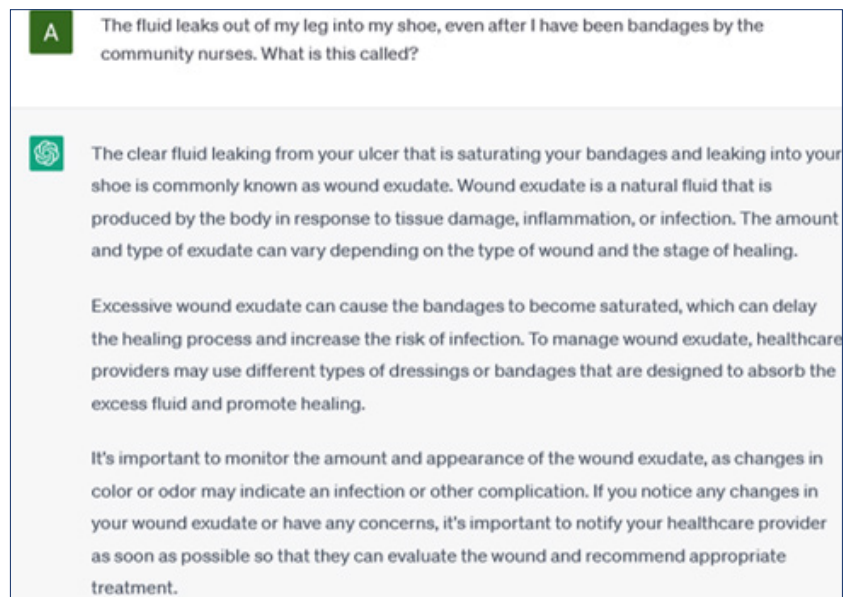
An experienced lymphoedema practitioner composed the questions posed to the chatbot in an effort to elucidate a diagnosis of lymphorrhoea. Poorly worded questions, misspellings and the reliability of responses necessitate additional research.

Conclusion

Forms of digital health communication, such as generative AI, are rapidly expanding. In this paper the use of ChatGPT elucidated valid responses for questions pertaining to a hypothetical case of lymphorrhoea. As AI technology continues to advance, there may be further integration of AI language models into virtual doctors and other digital healthcare services. Further research of AI specifically on patients with chronic oedema is required. ●

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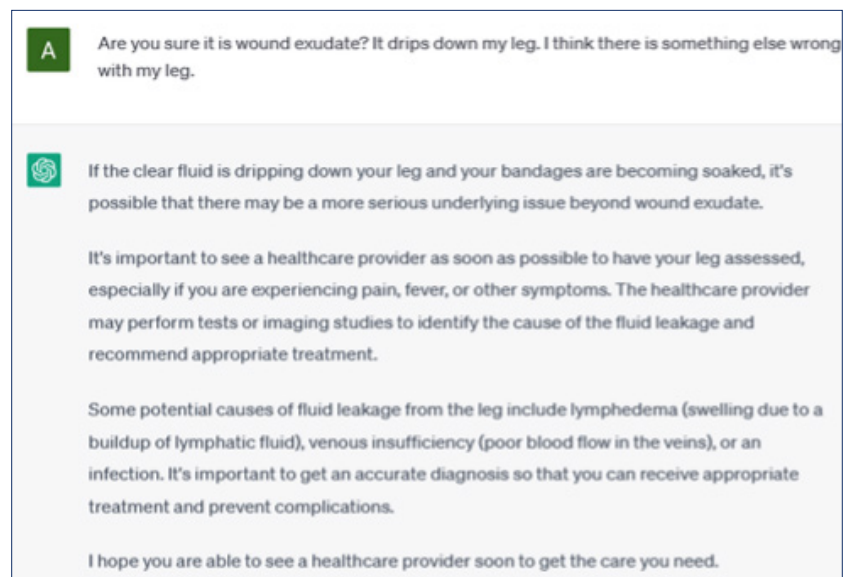
A The fluid leaks out of my leg into my shoe, even after I have been bandaged by the community nurses. What is this called?

G The clear fluid leaking from your ulcer that is saturating your bandages and leaking into your shoe is commonly known as wound exudate. Wound exudate is a natural fluid that is produced by the body in response to tissue damage, inflammation, or infection. The amount and type of exudate can vary depending on the type of wound and the stage of healing.

Excessive wound exudate can cause the bandages to become saturated, which can delay the healing process and increase the risk of infection. To manage wound exudate, healthcare providers may use different types of dressings or bandages that are designed to absorb the excess fluid and promote healing.

It's important to monitor the amount and appearance of the wound exudate, as changes in color or odor may indicate an infection or other complication. If you notice any changes in your wound exudate or have any concerns, it's important to notify your healthcare provider as soon as possible so that they can evaluate the wound and recommend appropriate treatment.

Figure 5. Fifth question and ChatGPT response.



A Are you sure it is wound exudate? It drips down my leg. I think there is something else wrong with my leg.

G If the clear fluid is dripping down your leg and your bandages are becoming soaked, it's possible that there may be a more serious underlying issue beyond wound exudate.

It's important to see a healthcare provider as soon as possible to have your leg assessed, especially if you are experiencing pain, fever, or other symptoms. The healthcare provider may perform tests or imaging studies to identify the cause of the fluid leakage and recommend appropriate treatment.

Some potential causes of fluid leakage from the leg include lymphedema (swelling due to a buildup of lymphatic fluid), venous insufficiency (poor blood flow in the veins), or an infection. It's important to get an accurate diagnosis so that you can receive appropriate treatment and prevent complications.

I hope you are able to see a healthcare provider soon to get the care you need.

Figure 6. Sixth question and ChatGPT response.

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