



How Can AI-Powered Solutions Improve Communication in Healthcare?

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Received: December 19, 2023
Accepted: February 7, 2024
Published: May 28, 2024

Keywords:

Artificial intelligence;
Communication;
Healthcare



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Abstract: *AI, as an integral part of various applications and devices in mHealth, can help establish reliable communication in healthcare. AI Chatbots can understand and respond to patients' language, providing instant answers to common questions. They can conduct initial assessments of patients' physical or mental conditions, assist patients through diverse healthcare processes, and offer support to individuals experiencing adverse health conditions. Additionally, wearables and smartphones can collect vast amounts of information that can be further analyzed using AI and machine learning technologies and used to identify risk factors and potential health patterns that may not be immediately apparent, thus enabling personalized healthcare interventions. This paper aims to point out that Chatbots, being user-friendly and highly accessible, are facilitating online healthcare services and helping patients to self-manage their conditions. Therefore, AI-powered solutions can be an efficient tool for improving communication with patients and easing the pressures faced by healthcare professionals.*

1. INTRODUCTION

The field of mobile health has experienced rapid growth, demonstrating the potential to support and assist patients in the diagnosis, treatment, and prediction of health-related events. This rise has undeniably been contributed to by the implementation of AI tools. The synergy of AI and wearable technologies serves as a notable example of AI's contribution to mobile health: wearables generate patient data related to health, and AI tools process this information, leading to conclusions that aid healthcare professionals in making decisions about patient health. Effective communication between patients and doctors is a vital aspect of the healthcare system. The evolution of technologies in mobile health has opened up new possibilities for exchanging health-related messages and providing timely information and alerts in real-time, as observed in the COVID-19 pandemic, through various electronic communication media, such as SMS text messaging (Jelić et al., 2022). In situations where a patient, for any reason, is hesitant to seek assistance from a doctor, chatbots and virtual assistants emerge as a means to bridge the communication gap – anywhere and anytime.

ChatGPT, an AI chatbot developed by OpenAI San Francisco, CA, USA, was launched in November 2022. While currently free to use, OpenAI plans to monetize ChatGPT in the future. Being highly accessible to the public, it has already garnered millions of interactions. When given a query, ChatGPT autonomously generates responses based on information from thousands of internet sources. This functionality underscores the increasing need for strict AI author guidelines particularly in scholarly publishing due to ethical concerns related to copyright, attribution, plagiarism,

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and authorship when AI is involved in producing academic text. Despite its popularity, there are apprehensions about the potential harm caused by generating misleading or inaccurate content, raising concerns about scholarly misinformation. The widespread use of ChatGPT emphasizes the urgency of addressing these issues, prompting questions about the authenticity of the content and the involvement of human authors in what is being read (Liebrenz et al., 2023).

In his study on the current popularity of using Generative AI in healthcare, Pohrebniyak (2023) provides some interesting insights into the statistics based on the survey. According to this article, ChatGPT is ranked highest among healthcare professionals for patient inquiries, while the results of the survey show that more than 10% of healthcare workers currently use this technology, and half are planning to adopt it. Undeniably, Generative AI has many benefits for both patients and healthcare providers, such as speed drug discovery, cost-effectiveness, regulatory compliance, risk mitigation, resource allocation, and enhanced customer experience.

The widespread use of AI-powered conversational chatbots in the healthcare industry has been justified due to their versatile applications. The article titled “Benefits of Chatbots in Healthcare: 9 Use Cases of Healthcare Chatbots” (2023) provides facts stating that “an extensive study by Verified Market Research showed that the healthcare chatbot’s market size is currently valued at USD 194.85 million in 2021 and is projected to reach USD 943.64 million by 2023, growing at a CAGR of 19.16% from 2022 to 2023. It is worth noting that in the age of personalized medicine, AI tools facilitate tailored health solutions and recommendations based on individual patient medical data. In this context, personalized chatbots offer immediate health advice, help in scheduling appointments, and send reminders to patients for their medication. However, despite the undoubtedly numerous advantages such as 24/7 availability, rapid information access, cost savings, shorter wait times, anonymity, and improved patient satisfaction, as stated in the article, chatbots raise some ethical and security concerns, particularly regarding data protection, as well as issues like report validity, the inability to address posed questions, and other related considerations.

2. AI LANGUAGE PROCESSING MODEL – A POWERFUL TOOL FOR VARIOUS APPLICATIONS

The use of large datasets and predictive models that enable machine learning is highly significant for doctors as assistance in diagnosing and treating patients (Handelman et al., 2018). These services are facilitated through the use of artificial intelligence tools and natural language processing (NLP). The development of human language has been a goal for AI researchers since the 1950s. This field includes applications such as speech recognition, text analysis, translation, and language-related tasks such as negation detection, context determination, hedging, word tokenization, lemmatization, and various others (Moradi & Samwald, 2022). In healthcare, prominent usages of NLP involve creating, understanding, and categorizing clinical documentation and published research. NLP systems can analyze unstructured clinical notes about patients, generate reports (e.g., on radiological examinations), transcribe interactions with patients, and participate in AI-driven conversations. Harrison and Sidey-Gibbons (2021) pointed out the importance of sentiment analysis (or opinion mining), as one of the common NLP techniques, which is a process of assigning subjective meaning to text units. Recognizing that different forms of text data represent a rich source for clinical research, Kreimeyer et al. (2017) conducted a literature review to identify existing clinical NLP systems capable of converting unstructured texts into interpretable datasets for statistical and machine-learning models.

According to [Patel and Lam \(2023\)](#), ChatGPT could find valuable applications in the creation of discharge summaries. Generating comprehensive discharge summaries can be time-consuming, which can lead to delays in patient discharges or the production of insufficient summaries. The use of ChatGPT could alleviate the burden of writing discharge summaries, and contribute to more efficient and thorough discharge processes. However, even though ChatGPT can serve as an initial step in the writing process, manual verification by a doctor is necessary before finalization. Doctors can utilize ChatGPT by providing specific information, concepts to elaborate on, and guidance for explanation. In return, the system rapidly generates a formal discharge summary. The suitability of this technology for discharge summaries is evident due to the standardized format typically used. The authors further consider the potential consequences of technology failure stating that while asking trivial questions to a home chatbot may have minimal impact, providing incorrect or insufficient information regarding medication changes or follow-up can significantly affect patient care.

[Li et al. \(2023\)](#) investigated radiology reports, highlighting the ability of ChatGPT to simplify complex texts into easily comprehensible summaries, one aspect of ChatGPT that has been somewhat overlooked. The authors also state that to produce high-quality language predictions, resembling human language, the LLM-based chatbot – ChatGPT has been trained on vast text datasets, LLM (Large Language Models) being derived from NLP.

Taking into consideration how extensively medical imaging techniques have been used worldwide for diagnosing illnesses and monitoring patients' progress, [Alfarghaly et al. \(2021\)](#) researched deep learning models capable of automating the report writing process. The aim of their study is twofold: to help radiologists generate confident and accurate reports, as well as to reduce the considerable time it takes for radiologists to draft full-text reports. Automated analysis of medical images would facilitate the composing of a comprehensive textual report describing the findings, and hopefully, avoid uncertain information that might prompt additional tests for patients, or require advanced imaging methods.

However, there are some concerns about using AI chatbots in healthcare. In their recent study on ChatGPT's capabilities in diagnosis and managing patients with new shoulder and elbow complaints, [Daher et al., \(2023\)](#) conclude that although ChatGPT presents a formidable counterpart, its existing form is insufficient to substitute a specialist in the diagnosis and treatment of patients. This limitation arises from factors like potential misdiagnosis, inadequate management, a lack of empathy and direct patient interactions, reliance on magnetic resonance imaging reports, and a deficiency in incorporating new knowledge.

3. CASE STUDY

This paper aims to investigate how online communication in the healthcare sector can be improved, focusing on both semantic and linguistic aspects, through the utilization of AI and machine learning technologies, as opposed to online consultations with a doctor via a web portal. To facilitate this analysis and comparison, a query sent by a patient from Macedonia to the www.stetoskop.info web portal seeking a dermatologist, whose work she had been following for a while, has been chosen:

*Original query: Dear!!! I am Kate, your follower and admirer, thank you so much for the phenomena content! I forgot to ask you * Firstly, for a dear friend, she bites her nails, a*

bad habit... Can you recommend a solution for me? Please!!! Secondly, when our nails are breaking, what should we do? Should we take some vitamins? And also, for vaginal itching, some cream to use? For me, gynecological swabs are negative, but I occasionally experience unpleasant itching.. Thank you in advance for everything!!! Soon we are going to Nis, for an examination with a vascular specialist, and... Let's meet somewhere for coffee/ice cream, whatever you prefer!! Kiss!!!

(Stetoskop, 2023)

The patient seizes the opportunity to ask three questions: firstly, seeking a solution for a friend who bites her nails; secondly, looking for a recommendation for vitamins to reduce nail breakage; and finally, inquiring about which cream to use for vaginal itching, which persists despite negative gynecological swabs. On the www.stetoskop.info web portal, the dermatologist ignores the questions about nails and, in a very concise epistolary form, provides a brief answer recommending PRP treatment for vaginal issues.

*Dear,
For your vaginal issues, I recommend PRP treatment.
Warm regards,
[name and surname of the doctor known to the authors]*

(Stetoskop, 2023)

The same content query was entered into ChatGPT. The introductory and concluding parts of the response, i.e., the greeting and farewell, will be analyzed first.

Introduction: First of all, thank you for your kind words! Now let's talk about your questions:

[Body of the response]

Conclusion: And finally, happy examination with the vascular specialist in Nis! I hope you enjoy your time with coffee and ice cream. If you have any additional questions, I am at your disposal. Kiss and all the best! 🌹

(OpenAI, 2023)

Upon initial observation, there is a distinct difference in the communicative style of the latter response compared to the online consultation with the doctor. ChatGPT adeptly recognizes and mirrors the tone used by the patient. An informal communicative style is established with a speech act expressing gratitude (Searle, 1969) (*First of all, thank you for your kind words*) and the utilization of the “inclusive we” to self-mention, exemplifying the interactive dimension of metadiscourse (Hyland, 2005) (*Now we will talk about...*). The response concludes in the same amiable tone, extending best wishes for the patient's ongoing treatment, a delightful time with coffee and ice cream, and an invitation to reach out again for any additional questions, concluding with a warm farewell. This example showcases a high level of personalization in human-machine communication. Following the initial greeting, ChatGPT addresses all the questions posed by the patient.

To enhance comprehension of how the formulation of a question influences the scope, style, and content of ChatGPT's responses, the same query will be entered as specific, precise questions but in two different ways:

Test query 1: How can one address nail biting, nail breakage, and vaginal itching?

Test query 2: I have an issue with nail-biting, nail breakage, and vaginal itching. How can these issues be cured?

Due to the scope of this paper, only responses to the question about nail biting will be analyzed. In Table 1, responses to the Original query posed by the patient, Test Query 1, and Test Query 2 are presented for comparison.

Table 1. Comparison of responses provided by ChatGPT regarding nail biting

Response to the Original query	Response to Test Query 1	Response to Test Query 2
For nail biting: <ul style="list-style-type: none"> • You could use some bitter nail preparations available in pharmacies. • Consider taking vitamins and minerals that can support nail health, such as biotin and zinc. 	Nail biting: <ul style="list-style-type: none"> • Application of bitter coatings: Use special coatings with a bitter taste and apply them to the nails. This can deter nail biting. • Always keep nails neat: Maintain nails regularly groomed and shaped. People often bite their nails less if they are beautiful and neat. 	Nail biting: <ul style="list-style-type: none"> • Psychotherapy: If nail biting is a result of stress, anxiety, or other emotional factors, psychotherapy (such as cognitive-behavioral therapy) may be helpful. • Application of bitter coatings: Use medications with a bitter taste on the nails to break the habit of nail biting. • Holistic approach: Identify triggers leading to nail biting and work on changing those behavior patterns.

Source: Own research

As seen in Table 1, responses to all three differently phrased questions are presented in bullet-lists. In the response to the Original query, ChatGPT maintains a less formal communicative style using appropriate language tools, such as the use of potentials (*You could use...*), as well as hedging while giving advice, achieved through the use of verbs like *consider* and the modal verb *might/may* (*Consider taking vitamins and minerals that may support nail health...*). The response to Test Query 1, presented as a simple, specific question without elaboration, starts without any introduction. It is evident that language tools have been altered, adopting a direct approach by using imperative verbs (*Use special coating...apply them...; Maintain nails regularly groomed...*). The impact of how a question is formulated on the response is best illustrated in the answer to Test Query 2, wherein the key term 'issue' is used. This term triggered a new approach to seeking answers, offering psychotherapy and a holistic approach to addressing the health problem. Unlike the previous two responses, the phrase 'to have an issue' connected nail biting with stress, anxiety, or other emotional states, as reflected in the use of new lexis, shifting the linguistic register to the fields of psychology.

The small-scale investigation outlined in this paper as a case study implies several key findings. Alongside the significance of the accuracy of input data in ChatGPT and the algorithms processing that data, it is equally crucial how users frame queries directed to ChatGPT. Most importantly, both patients and doctors need to adopt a critical approach to the information they receive.

4. CHALLENGES AND OPPORTUNITIES FOR FUTURE DEVELOPMENT

AI-powered chatbots have been increasingly implemented into various healthcare practices, showing a huge potential to empower healthcare professionals in making predictions and becoming a diagnostic tool and a useful consultation resource for physicians. However, there are also challenges to consider. Exploring the benefits and drawbacks of using ChatGPT for medical imaging diagnosis, [Srivastav et al. \(2023\)](#) highlight significantly improved accuracy and efficiency of AI-supported radiological diagnoses but also emphasize that some challenges, including the necessity for high-quality training data, ethical consideration, and the need for further research and development, should be constantly addressed in future. Radiology is pivotal in treating various medical conditions, offering physicians detailed images of the body's internal structures to assist in diagnosis and treatment planning. Since the interpretation of medical images is intricate, time-consuming, and requires specialized expertise, AI has opened up new possibilities for improving accuracy and patient outcomes. The authors draw further attention to addressing the ethical implications of making healthcare more accessible, in other words, inaccessible and underserved regions and populations should be able to receive adequate attention and medical support, which would significantly reduce health disparities. Furthermore, while improving accessibility, it is crucial to remain committed to protecting patient privacy and confidentiality.

In addition to privacy issues, instances have been documented where AI apps provide risky and detrimental guidance to professionals involved in making decisions in clinical care. It has been noticed that ChatGPT cannot comprehend some complex conditions and subtle distinctions. This can have severe consequences, particularly in fields like mental health. Artificial intelligence systems will unquestionably make mistakes in diagnosis, which can lead to e.g., the misinterpretation of results from medical tests or radiological images, or inappropriate advice for further treatment. Additionally, machine learning systems may be susceptible to algorithmic bias, perhaps predicting a higher likelihood of a disease based on gender or race, when they are not causal factors. All of this raises questions of establishing accountability, transparency, safety, and privacy, regarding who is more responsible: AI developers or the healthcare professionals using it. Moreover, it is crucial for healthcare institutions, as well as government and regulatory bodies, to establish structures for monitoring key issues, to act responsibly, and to establish management mechanisms to limit negative implications. Future work on improving AI systems should focus on ensuring the input of accurate and unbiased data upon which AI-generated predictions and recommendations can be comprehensive to both patients and clinicians.

A paper in the Journal of the American College of Radiology aiming to investigate the potential use of LLMs in radiology identifies the positive and negative aspects of using ChatGPT ("[The Pros and Cons of Using ChatGPT in Clinical Radiology: an Open Discussion](#)", 2023). ChatGPT exhibits versatile applications within the healthcare domain, contributing to the improvement of patient care and medical processes. It can simplify complex medical reports for patients, fostering a more patient-centered approach. Additionally, it aids individuals preparing for radiologic-guided procedures by providing information, assessing readiness, and offering support. Moreover, ChatGPT serves as an effective educational tool for radiologists, enhancing their training experience. However, concerns surround its accuracy and reliability, particularly in addressing the hallucination ([Hallucination, 2023](#)) problem. The transparency of ChatGPT's operations poses a challenge, raising questions about how it generates outputs. Privacy apprehensions also emerge regarding the safeguarding of patient data. Notably, there is a consensus that AI systems, including ChatGPT, should complement rather than replace human expertise and judgment. Additionally, ethical considerations arise regarding the implications of AI-generated content in research and publications.

5. CONCLUSION

The implementation of AI presents a notable challenge in the field of communication in healthcare, involving the creation of sound theories and models and providing an opportunity for detailed testing of health communication theories and models that are still unverified. As Galetsi et al. (2023) conclude once individual health data is converted into digital format and handed over to healthcare professionals and app developers who maintain health information systems, inquiries emerge regarding the utilization and safeguarding of this information. In other words, certain concerns have been raised about the potential harm these applications might pose to public privacy, data ownership rights, and the permissible sale or storage of such data by app companies.

This paper aims to illustrate the advantages of using an AI chatbot to alleviate the workload of physicians by reducing the necessity for patients to schedule appointments in clinics, thus easing the strain on the healthcare system. Even online portals, which can assist in facilitating doctor-patient communication, demand additional effort and time from doctors to effectively address patient inquiries. The paper also emphasizes the significance of carefully formulating questions, as large language models can discern the style and tone of a question, and much depends on this in determining the direction in which they generate a response. Analyzing communication skills through the use of email, SMS text messaging, web portals, and social networks, Mamula Tartalja et al. (2023) underline the importance of increasing eHealth literacy. This encompasses the ability to search for, find, understand, and evaluate health information, along with applying it to treatment and the improvement of one's well-being. To increase the prospects for better health outcomes, the authors assert that a specific level of health literacy is necessary for internet users to approach information critically and determine its accuracy.

While acknowledging the immense potential of this technology, it is crucial to steer the future development of AI systems in healthcare towards enhancing the capabilities of healthcare professionals rather than replacing them. The advancement of machine learning should empower doctors to augment their cognitive and reflective abilities, ultimately resulting in improved healthcare outcomes.

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