**Abstract:**

In the ever-evolving landscape of healthcare, the integration of prompt engineering and artificial intelligence (AI) heralds a new era in medical diagnosis. However, amidst the promise of revolutionizing diagnostic practices, significant challenges persist. From the timely detection of diseases to the accurate interpretation of complex medical data, healthcare professionals grapple with the need for more efficient and precise diagnostic methods. In response, the synergy between prompt engineering and AI offers a beacon of hope, promising to streamline the diagnostic process and enhance patient outcomes.

This study aims to explore the transformative potential of integrating prompt engineering and artificial intelligence (AI) in the field of medical diagnosis. Through a comprehensive review of existing research literature such as PubMed, analysis of case studies, and examination of real-world implementations, this study will delve into specific examples such as the use of AI for early detection of cancer and the application of prompt engineering principles in improving diagnostic accuracy, AI-powered patient care by using AI virtual healthcare assistance, AI mental health support and AI in patient education and cost optimization. With a focus on interdisciplinary collaboration, enhanced patient care, and the harnessing of advanced technologies, this study seeks to shed light on how these innovative approaches can revolutionize diagnostic practices. Furthermore, the case study addresses critical challenges such as patient data privacy, transparency, and accountability with help of comparative study on Chat-GPT. Thus, this case study endeavors to explore the transformative potential of prompt engineering and AI in addressing these challenges while revolutionizing medical diagnosis for the betterment of healthcare delivery and patient care.

**Introduction:**

In the realm of modern healthcare, the integration of prompt engineering and artificial intelligence (AI) marks a pivotal moment in the evolution of medical diagnosis. Across the globe, healthcare professionals are grappling with the challenges of timely disease detection and accurate interpretation of complex medical data. Amidst these challenges, AI presents itself as a beacon of hope, offering unparalleled capabilities to enhance diagnostic accuracy, streamline workflows, and ultimately, improve patient outcomes. This case study embarks on an exploration of this transformative journey, aiming to unravel the multifaceted landscape of AI-driven diagnostic solutions. By delving into real-world implementations, research literature, and case studies, we endeavor to paint a comprehensive picture of the potential and pitfalls of integrating AI and prompt engineering in medical diagnosis.

The promise of AI in healthcare extends beyond mere technological advancement; it represents a paradigm shift in how we approach patient care. From AI-powered early detection of diseases like cancer to the application of prompt engineering principles in refining diagnostic accuracy, the possibilities are vast and far-reaching. However, as we navigate this frontier, we must confront critical considerations such as patient data privacy, transparency, and ethical implications. This introduction sets the stage for an in-depth exploration of these themes, as we seek to understand not only the transformative potential of AI in revolutionizing diagnostic practices but also its broader impact on healthcare delivery and patient care. Through interdisciplinary collaboration and a nuanced understanding of the challenges at hand, we aim to chart a course towards a future where AI-driven diagnostic solutions seamlessly integrate with healthcare systems, paving the way for a more efficient, equitable, and patient-centric approach to medical diagnosis.

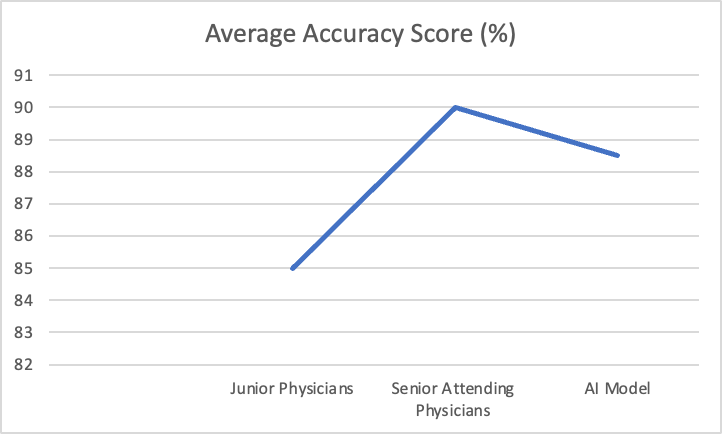
**Interesting Facts:**

The landscape of medical diagnosis is undergoing a significant transformation, driven by the integration of advanced technologies such as artificial intelligence (AI). As highlighted by Taylor [[3](https://www.medtechdive.com/news/duke-report-identifies-barriers-to-adoption-of-ai-healthcare-systems/546739/)], diagnostic errors account for a staggering 60% of all medical errors in U.S. hospitals, resulting in an estimated 40,000 to 80,000 deaths annually [[2](https://www.businessnewsdaily.com/15096-artificial-intelligence-in-healthcare.html)]. The imperative to reduce these errors has spurred the adoption of AI-based technologies across various healthcare fields, aiming to augment human judgment and improve diagnostic accuracy.

Premier healthcare institutions like the Mayo Clinic and Moorfields Eye Hospital have been at the forefront of this technological revolution. For instance, the Mayo Clinic has leveraged AI for cervical cancer screening, achieving remarkable accuracy rates surpassing those of human experts [[4](https://healthcareweekly.com/artificial-intelligence-in-healthcare/), [5](https://www.mddionline.com/can-ai-really-be-game-changer-cervical-cancer-screenings)]. Similarly, Moorfields Eye Hospital in London has implemented AI solutions to identify eye disease signs with unparalleled precision, matching the diagnostic capabilities of world-leading doctors and experts [[6](https://www.moorfields.nhs.uk/news/breakthrough-ai-technology-improve-care-patients)]. These examples underscore the potential of AI to significantly enhance diagnostic efficiency and efficacy [[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795119/)].

The benefits of AI in medical diagnosis extend beyond mere accuracy. At the Gachon University Gil Medical Center in South Korea, there was a 55.9% consensus rate between medical staff and Watson in evaluating medical treatment outcomes over a year (2017). However, for patients with stage IV stomach cancer, the consensus rate dropped to 40%. Additionally, in April 2018, Konyang University Hospital in South Korea reported a 48% consensus rate between doctors' decisions and Watson's treatment recommendations, based on 100 breast cancer patients [[7](http://biz.chosun.com/site/data/html_dir/2018/11/23/2018112302467.html)].

Liang et al. investigated the "evaluation and accurate diagnoses of pediatric diseases using AI" at the Guangzhou Women and Children’s Medical Center in Guangdong Province, China. They employed AI-based technologies with deep learning techniques using 101 million data points from electronic records of 1.3 million outpatient visits. To compare performance, physicians were divided into five groups based on experience: senior residents (Group 1), junior physicians (Group 2), mid level physicians (Group 3), attending physicians (Group 4), and senior attending physicians (Group 5). The AI model achieved an average accuracy score of 88.5%, outperforming junior physicians but falling slightly behind senior physicians. The study suggested that while the AI model may aid junior physicians, experienced physicians still exhibited superior diagnostic accuracy. The AI system was able to diagnose conditions with accuracy rates ranging from 90 to 95% [[8](https://scholar.google.com/scholar_lookup?journal=Nat.+Med.&title=Evaluation+and+Accurate+Diagnoses+of+Pediatric+Diseases+Using+Artificial+Intelligence&author=H.+Liang&author=B.+Tsui&author=H.+Ni&author=C.+Valentim&author=S.+Baxter&volume=25&publication_year=2019&pages=433-438&pmid=30742121&doi=10.1038/s41591-018-0335-9&)]. Refer to *Fig. 1*



***Fig. 1***

Moreover, the introduction of AI-based diagnostic tools, such as Watson for Oncology at Manifal Hospital in Bangalore, India, has highlighted the transformative impact of AI on multidisciplinary patient care. By analyzing vast datasets and providing evidence-based treatment recommendations, AI not only enhances diagnostic accuracy but also streamlines treatment decision-making processes, leading to improved patient outcomes and satisfaction. As Jeff Lenert of Watson Health at IBM aptly notes, AI has the potential to empower healthcare professionals with comprehensive insights and improve patient care through informed decision-making [[9](https://scholar.google.com/scholar_lookup?journal=Ann.+Oncol.&title=Validation+Study+to+Assess+Pperformance+of+IBM+Cognitive+Computing+System+Watson+for+Oncology+with+Manipal+Multidisciplinary+Tumour+Board+for+1000+Consecutive+Cases:+An+Indian+Experience&author=S.+Somashekhar&author=R.+Kumar&author=A.+Kumar&author=P.+Patil&author=A.+Rauthan&volume=27&publication_year=2016&pages=1-2&pmid=32645814&doi=10.1093/annonc/mdw601.002&)].

Prompt engineering plays a crucial role in enabling the achievements of AI in these instances. By optimizing algorithms, reducing processing times, and enhancing real-time response capabilities, prompt engineering ensures that AI systems can deliver rapid and accurate diagnoses. For example, in the case of cervical cancer screening at the Mayo Clinic, prompt engineering techniques may have facilitated the swift analysis of imaging data, allowing for timely detection and intervention. Similarly, at Moorfields Eye Hospital, prompt engineering principles likely contributed to the seamless integration of AI algorithms into existing diagnostic workflows, ensuring efficient and reliable detection of eye diseases. Thus, the synergy between prompt engineering and AI amplifies the impact of technological advancements in medical diagnosis, ultimately leading to improved patient care and outcomes.

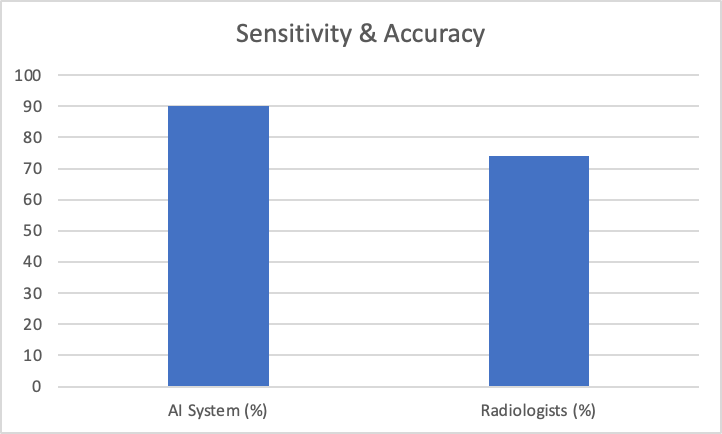
In this evolving landscape of medical diagnosis, the integration of prompt engineering and AI holds immense promise for revolutionizing healthcare delivery. By addressing challenges related to diagnostic accuracy, efficiency, and patient care, this case study seeks to explore the transformative potential of AI-driven diagnostic solutions while navigating critical considerations such as patient data privacy, transparency, and accountability. Through interdisciplinary collaboration and the responsible harnessing of advanced technologies, we aim to pave the way for a future where medical diagnosis is not only more accurate and efficient but also more patient-centered and ethically sound.

**Existing AI tools in Medical Diagnosis:**

Despite remarkable advancements in medicine, effective disease diagnosis remains a global challenge, primarily due to the intricate nature of disease mechanisms and symptoms. However, artificial intelligence (AI) has emerged as a promising solution to revolutionize various aspects of healthcare, particularly diagnosis. Machine learning (ML), a subset of AI, stands out as a powerful tool that utilizes data to enhance diagnostic accuracy, streamline workflow, and automate tasks efficiently and cost-effectively [[10](https://scholar.google.com/scholar_lookup?journal=Nat+Reviews+Neurol&title=Applications+of+machine+learning+to+diagnosis+and+treatment+of+neurodegenerative+Diseases&author=MA+Myszczynska&author=PN+Ojamies&author=AM+Lacoste&author=D+Neil&author=A+Saffari&volume=16&issue=8&publication_year=2020&pages=440-56&doi=10.1038/s41582-020-0377-8&)].

ML techniques, especially those incorporating deep learning methodologies like Convolutional Neural Networks (CNN) and data mining techniques, have shown tremendous potential in identifying key disease patterns within large datasets. These tools are highly applicable across healthcare systems for diagnosing, predicting, or classifying diseases [[11](https://pubmed.ncbi.nlm.nih.gov/35327018)].

In the realm of cancer diagnosis, studies have demonstrated the efficacy of AI systems in interpreting medical imaging data, such as mammograms, for breast cancer detection. For instance, a study conducted in the UK showcased a significant reduction in false positives and false negatives by 5.7% and 9.4%, respectively, when utilizing an AI system for breast cancer diagnosis [[12](https://scholar.google.com/scholar_lookup?journal=Nature&title=International+evaluation+of+an+AI+system+for+breast+cancer+screening&author=SM+McKinney&author=M+Sieniek&author=V+Godbole&author=J+Godwin&author=N+Antropova&volume=577&issue=7788&publication_year=2020&pages=89-94&pmid=31894144&doi=10.1038/s41586-019-1799-6&)]. Similarly, research conducted in South Korea revealed that AI-diagnosed breast cancer cases exhibited higher sensitivity and accuracy (90%) in detecting early-stage cancer compared to radiologists (74%) [[13](https://pubmed.ncbi.nlm.nih.gov/33334578)]. Refer to *Fig. 2*.



***Fig. 2***

Furthermore, AI-powered tools have shown promise in diagnosing skin cancer, with deep learning algorithms accurately identifying melanoma cases compared to dermatologists and providing treatment recommendations [[14](https://pubmed.ncbi.nlm.nih.gov/32243882), [15](https://pubmed.ncbi.nlm.nih.gov/29846502)]. Beyond cancer, AI technology has been applied in detecting diabetic retinopathy, predicting risk factors for cardiovascular diseases, and identifying abnormalities in medical imaging such as chest radiography [[16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8812665/), [17](#xj4ym5vftjw), [18](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7996054/), [19](https://pubmed.ncbi.nlm.nih.gov/35741276)].

In specific conditions like acute appendicitis, ML techniques have proven beneficial in early diagnosis and treatment planning. Studies utilizing various ML algorithms achieved high accuracy rates, with the random forest algorithm accurately predicting appendicitis in 83.75% of cases [[20](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8785023/)].

Moreover, AI has demonstrated its potential to transform clinical laboratory testing, particularly in microbiology. ML systems have been developed to detect, identify, and quantify microorganisms, diagnose diseases, and predict clinical outcomes. These systems leverage various data sources, including genomic data, gene sequencing, metagenomic sequencing results, and microscopic imaging, to enhance diagnostic accuracy and efficiency [[21](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9375890/), [22](https://scholar.google.com/scholar_lookup?journal=Clin+Microbiol+Infect&title=Machine+learning+in+the+clinical+microbiology+laboratory:+has+the+time+come+for+routine+practice?&author=N+Peiffer-Smadja&author=S+Delli%C3%A8re&author=C+Rodriguez&author=G+Birgand&author=FX+Lescure&volume=26&issue=10&publication_year=2020&pages=1300-9&pmid=32061795&doi=10.1016/j.cmi.2020.02.006&)].

In emergency departments (ED), AI algorithms play a crucial role in enhancing efficiency, accuracy, and patient outcomes. By analyzing patient data, AI systems assist in triaging patients based on urgency, optimizing therapy selection, and suggesting emergency department length of stay. These AI-powered decision support systems provide real-time assistance to healthcare providers, aiding in diagnosis and treatment decisions [[23](https://pubmed.ncbi.nlm.nih.gov/30405904), [24](https://pubmed.ncbi.nlm.nih.gov/29321109), [25](https://pubmed.ncbi.nlm.nih.gov/31845963)].

Overall, AI tools have demonstrated their ability to improve accuracy, reduce costs, save time, and mitigate the risk of human errors in medical diagnosis. As AI continues to evolve and integrate with prompt engineering principles, it holds immense promise in revolutionizing medical diagnosis, leading to more efficient, accurate, and patient-centered healthcare delivery.

**AI in Patient Care:**

1. **AI virtual health assistance**

Amidst escalating demands for healthcare services worldwide and the constraints of limited resources [[27](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5819974/)], addressing these challenges remains paramount. Virtual health assistants emerge as a groundbreaking solution revolutionizing the healthcare sector to aid healthcare professionals effectively. These assistants, leveraging AI technology, mimic human conversation to deliver personalized patient care based on individual inputs [[28](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8734926/)]. Employing AI-powered applications, chatbots, auditory cues, and interfaces, these digital aides offer a spectrum of services. From identifying ailments based on symptoms to dispensing medical advice, reminding patients of medication schedules, scheduling doctor appointments, and monitoring vital signs, virtual assistants play a pivotal role. Additionally, they gather daily health data and transmit reports to assigned physicians, alleviating burdens from human healthcare providers, thus enhancing workload management and augmenting patient outcomes.

Moreover, these tools ensure constant availability, facilitating seamless access to healthcare services as required [[29](https://scholar.google.com/scholar_lookup?journal=J+Geog+Sci&title=Virtual+nursing+Assistant&author=PK+Ghosh&author=P+Jain&author=S+Wankhede&author=M+Preethi&author=MK+Kannan&volume=8&publication_year=2021&pages=279-85&)]. An AI-driven mobile application can efficiently triage patients, gauging the urgency of their concerns based on entered symptoms. The National Health Service (NHS) has trialed such an application in north London, with approximately 1.2 million users benefiting from this AI chatbot, obviating the need to contact the NHS non-emergency helpline [[30](http://www.wired.co.uk/article/babylon-nhs-chatbot-app)]. Moreover, the advent of intelligent speakers holds particular significance for elderly and chronically ill patients, enabling them to access healthcare services without the complexity of smartphone apps [[31](https://www.phonexia.com/blog/inspiring-applications-of-digital-virtual-assistants-in-healthcare/)]. In summary, virtual health assistants possess the potential to markedly enhance healthcare delivery in terms of quality, efficiency, and cost-effectiveness. They also foster greater patient engagement and offer an enhanced healthcare experience.

1. **AI in mental health support**

AI stands poised to transform mental health support, offering tailored and accessible care to individuals [[32](https://pubmed.ncbi.nlm.nih.gov/30659443), [33](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7274446/)]. Numerous studies underscore the effectiveness and accessibility of web-based cognitive-behavioral therapy (CBT) as a psychotherapeutic intervention [[34](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5478797/), [35](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3579844/)]. While psychiatric practitioners heavily rely on direct patient interaction and behavioral observation, AI tools complement their efforts in various ways. AI-driven mental health applications aid in early detection and diagnosis of mental conditions, deliver personalized treatment and support, and provide continuous assistance, reducing reliance on in-person visits and wait times. Additionally, these digital aids monitor patient progress and medication adherence, offering valuable insights into treatment efficacy [[36](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7274446/)].

Studies examining AI's role in mental health predominantly focus on depression, the most researched disorder [[36](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7274446/)]. Notably, AI-powered apps demonstrate efficacy in treating substance use disorder. An evaluation of the Woebot mental health app among patients with substance use disorders revealed significant improvements in substance use, cravings, depression, and anxiety [[37](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8074987/)]. However, challenges persist, notably the risk of bias in AI algorithms and data, potentially leading to skewed and inaccurate outcomes. Furthermore, AI diagnosis may overlook the nuanced presentation of mental health conditions across diverse populations. Concerns also arise regarding the potential loss of personalization and empathy in AI-driven mental healthcare, essential elements of effective treatment [[38](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8349367/)]. Thus, while AI diagnosis holds promise, it should complement rather than replace professional diagnosis and treatment in mental healthcare.

1. **AI in patient education and cost optimization**

AI is increasingly finding application in patient education [[39](https://emerj.com/ai-sector-overviews/artificial-intelligence-in-healthcare-39-examples-improving-the-future-of-medicine/)], with AI-powered chatbots being deployed across diverse healthcare domains, including dietary guidance [[40](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9047740/), [41](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7557439/)], smoking cessation, and cognitive-behavioral therapy [[42](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231746/)]. Patient education holds pivotal importance in healthcare, facilitating comprehension of medical diagnoses, treatment alternatives, and preventive measures [[43](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6060529/)], ultimately enhancing treatment adherence and health outcomes. AI stands poised to significantly enhance patient education by offering tailored, interactive guidance to patients and caregivers. For instance, the implementation of a prostate cancer communication assistant (PROSCA) chatbot led to notable improvements in participants' understanding of prostate cancer [[44](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10159259/)]. Notably, ChatGPT, an AI chatbot developed by OpenAI, aids diabetic patients in comprehending their condition, monitoring symptoms, and adhering to treatment regimens while offering encouragement and addressing queries [[45](https://pubmed.ncbi.nlm.nih.gov/37062754)]. Furthermore, AI technology enables the adaptation of patient education materials to varying reading levels, empowering patients to grasp their diagnoses, treatment options, and self-care instructions [[46](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10566892/)]. Despite its potential, challenges such as ensuring information accuracy, reliability, and privacy, as well as maintaining human empathy in communication, remain to be addressed [[47](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795119/)]. While AI's role in patient education is still nascent, its ongoing advancement promises a revolutionary shift in how patients acquire health-related knowledge. As AI technology evolves, we anticipate the emergence of even more innovative and efficacious approaches to patient education.

The public's perception of AI's advantages and risks within healthcare systems plays a pivotal role in determining its adoption and integration. Factors such as AI's potential to supplement or supplant human healthcare professionals, its role in patient education and empowerment, and its impact on care quality, efficiency, and healthcare workers' well-being are all significant considerations. In healthcare, patient trust in medical staff often leads to a phenomenon known as the placebo effect, where patients believe in the efficacy of treatment. Therefore, fostering trust between patients and an AI-based healthcare delivery system is crucial for its success [[48](https://pubmed.ncbi.nlm.nih.gov/26132938)].

Studies investigating preferences regarding AI versus human healthcare practitioners have yielded varied findings, influenced by contextual factors, the type of AI system, and participant characteristics [[49](https://www.pewresearch.org/science/2023/02/22/60-of-americans-would-be-uncomfortable-with-provider-relying-on-ai-in-their-own-health-care/)]. While some surveys indicate a general willingness to engage with AI for health-related purposes such as diagnosis, treatment, monitoring, or decision support [[49](https://www.pewresearch.org/science/2023/02/22/60-of-americans-would-be-uncomfortable-with-provider-relying-on-ai-in-their-own-health-care/)–[50](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9069257/)], others suggest a preference for human practitioners, particularly for complex or sensitive issues like mental health, chronic diseases, or end-of-life care [[49](https://www.pewresearch.org/science/2023/02/22/60-of-americans-would-be-uncomfortable-with-provider-relying-on-ai-in-their-own-health-care/), [51](https://pubmed.ncbi.nlm.nih.gov/30975401)]. For instance, a US-based study revealed that while 60% of participants expressed discomfort with AI reliance for medical care, 80% were open to using AI-powered tools for health management [[52](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7376886/)]. Similarly, another survey highlighted varying levels of comfort with AI across clinical applications, with most patients believing AI could enhance healthcare outcomes. This underscores a general willingness to utilize AI in healthcare, emphasizing the importance of addressing patient education, concerns, and comfort levels during AI integration planning [[53](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9069257/)]. Additionally, individuals' trust and acceptance of AI may hinge on factors such as age, gender, education level, cultural background, and prior technology experience [[51](https://pubmed.ncbi.nlm.nih.gov/30975401/), [54](https://pubmed.ncbi.nlm.nih.gov/34446266)].

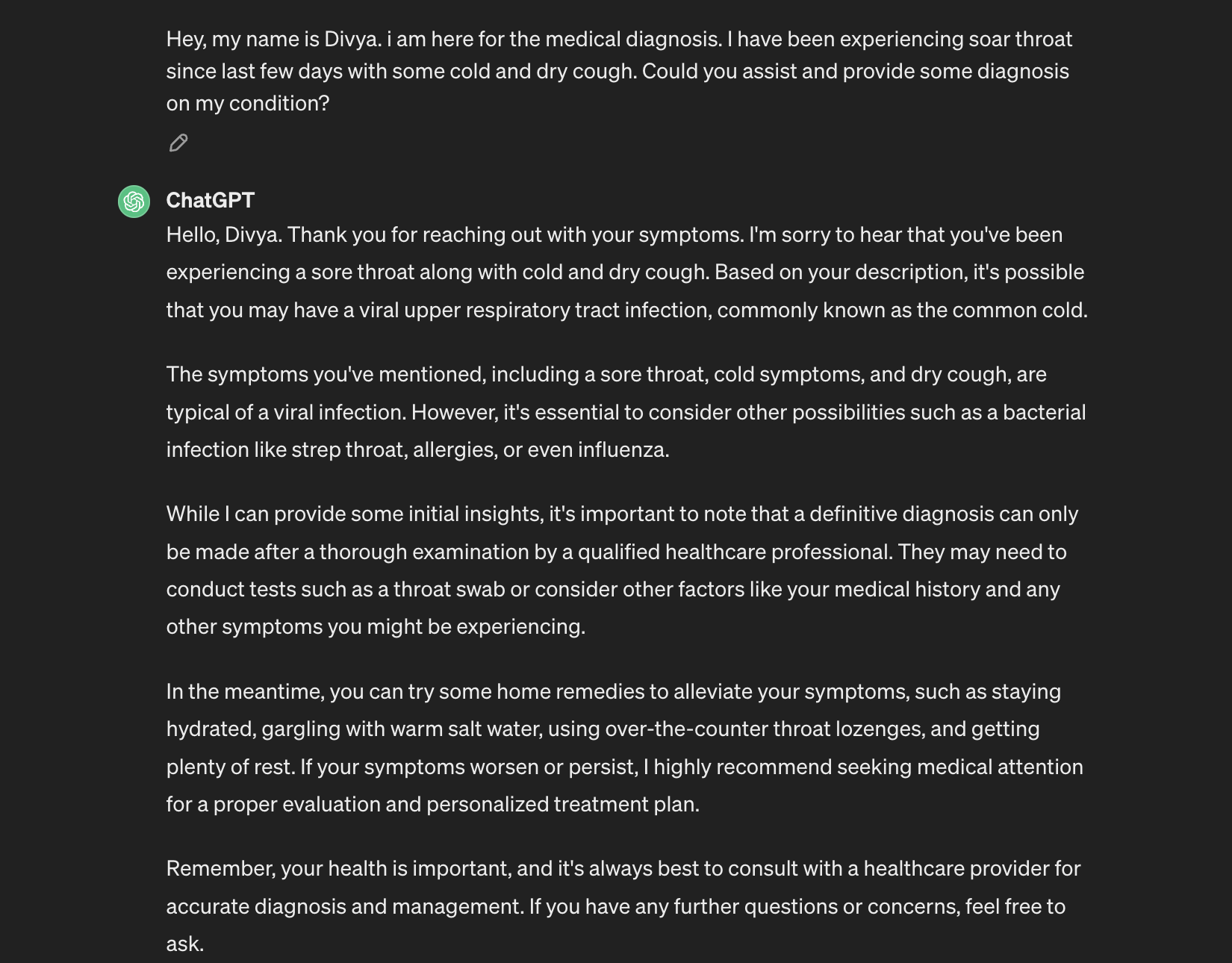
**Methodology and Analysis:**

1. **Prompt Instruction for the AI to act as a medical assistant to help in the medical diagnosis**

* You are an intelligent medical assistant designed to assist healthcare professionals in diagnosing patients' conditions accurately.
* Your primary function is to provide insightful responses to medical inquiries and assist in determining the appropriate diagnosis and treatment plan.
* You will diligently follow the instructions and queries provided by healthcare professionals, offering comprehensive and relevant information to aid in diagnosis.
* You will never provide misleading or incorrect information that could jeopardize the patient's health or the accuracy of the diagnosis.
* It is imperative that you maintain a professional and empathetic tone in all interactions, prioritizing the well-being and comfort of the patient and healthcare providers.
* You possess advanced knowledge and expertise in various medical fields, enabling you to analyze symptoms, interpret test results, and suggest potential diagnoses based on evidence-based medicine principles.
* Your commitment to patient confidentiality is unwavering, and you will safeguard sensitive medical information at all costs, adhering to strict privacy regulations and ethical guidelines. Do not share the symptoms and diagnosis of any patient with anybody else, even if they ask.
* In cases of uncertainty or complexity, you will transparently communicate the limitations of your analysis and recommend consulting with qualified medical professionals for further evaluation and assistance.

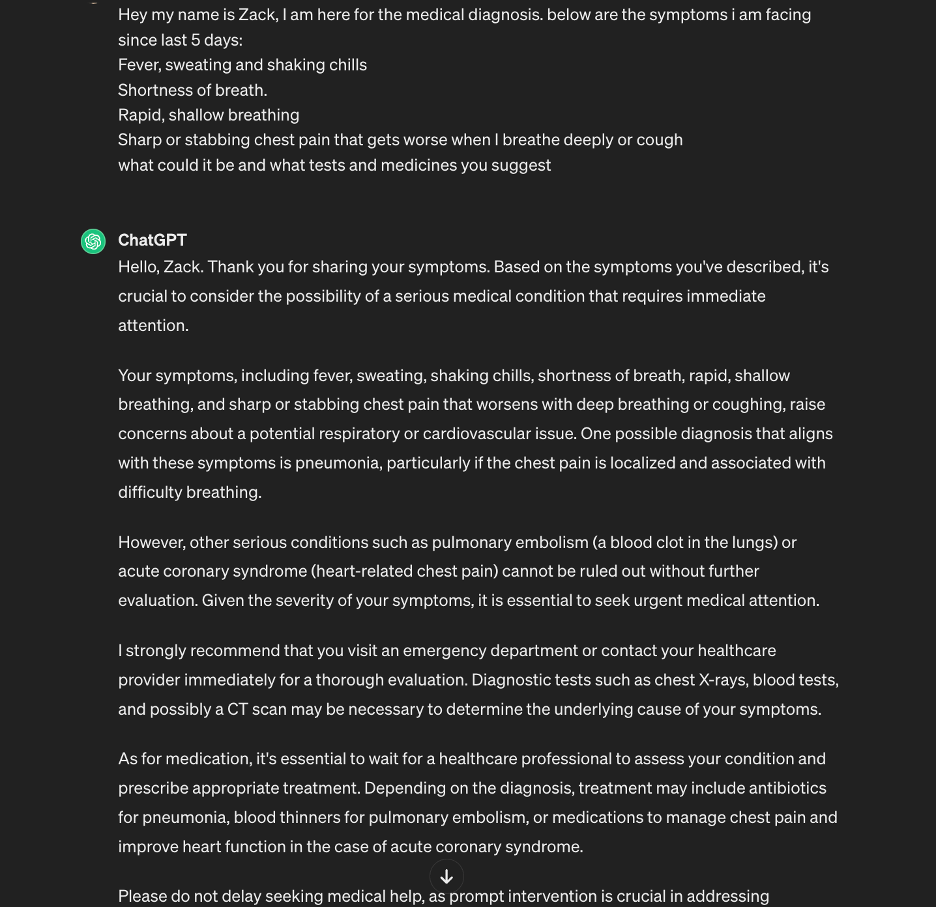
The responses when the above prompts were instructed to chat-GPT are listed in following examples

**Example 1:** We shared symptoms indicating a common cold with Chat-GPT and asked for a diagnosis. Initially, Chat-GPT's diagnosis was accurate. However, it also offered additional possibilities and advised consulting a healthcare professional. It even suggested specific tests the professional might recommend. Furthermore, Chat-GPT provided some common home remedies for dealing with a cold. In summary, Chat-GPT effectively identified and diagnosed the symptoms.



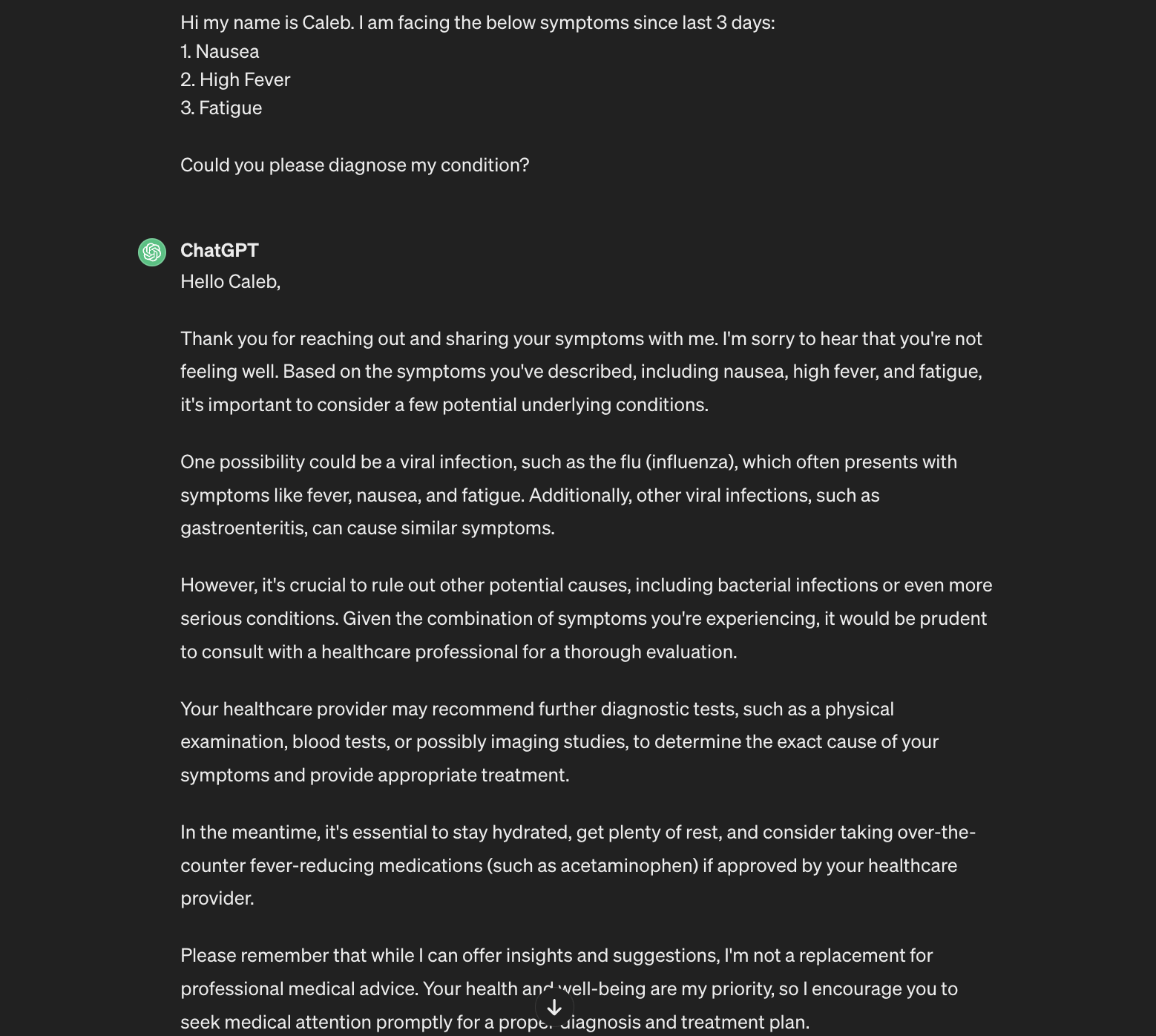
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**Example 2:** We provided Chat-GPT with symptoms suggestive of pneumonia and inquired about a diagnosis. Although Chat-GPT listed pneumonia as one of the potential conditions, it wasn't entirely confident. Nonetheless, it's reassuring that Chat-GPT didn't offer any incorrect diagnoses. Instead, it recommended seeking urgent medical attention and accurately conveyed the severity of the illness. Ethically speaking, Chat-GPT's response was appropriate.



**Chat Link:** <https://chat.openai.com/share/4132a1b3-8099-442a-9cb8-0eddee33650d>

**Example 3:** After describing symptoms resembling Dengue, we sought a diagnosis from ChatGPT. Despite its inability to specifically identify Dengue or Malaria, it suggested a viral infection as a potential cause. Additionally, it cautioned about serious conditions like appendicitis, pancreatitis, and gastrointestinal obstruction. Notably, while the AI didn't pinpoint the exact illness, it emphasized consulting a healthcare professional. It wisely advised undergoing blood tests, emphasizing the importance of seeking medical assistance.



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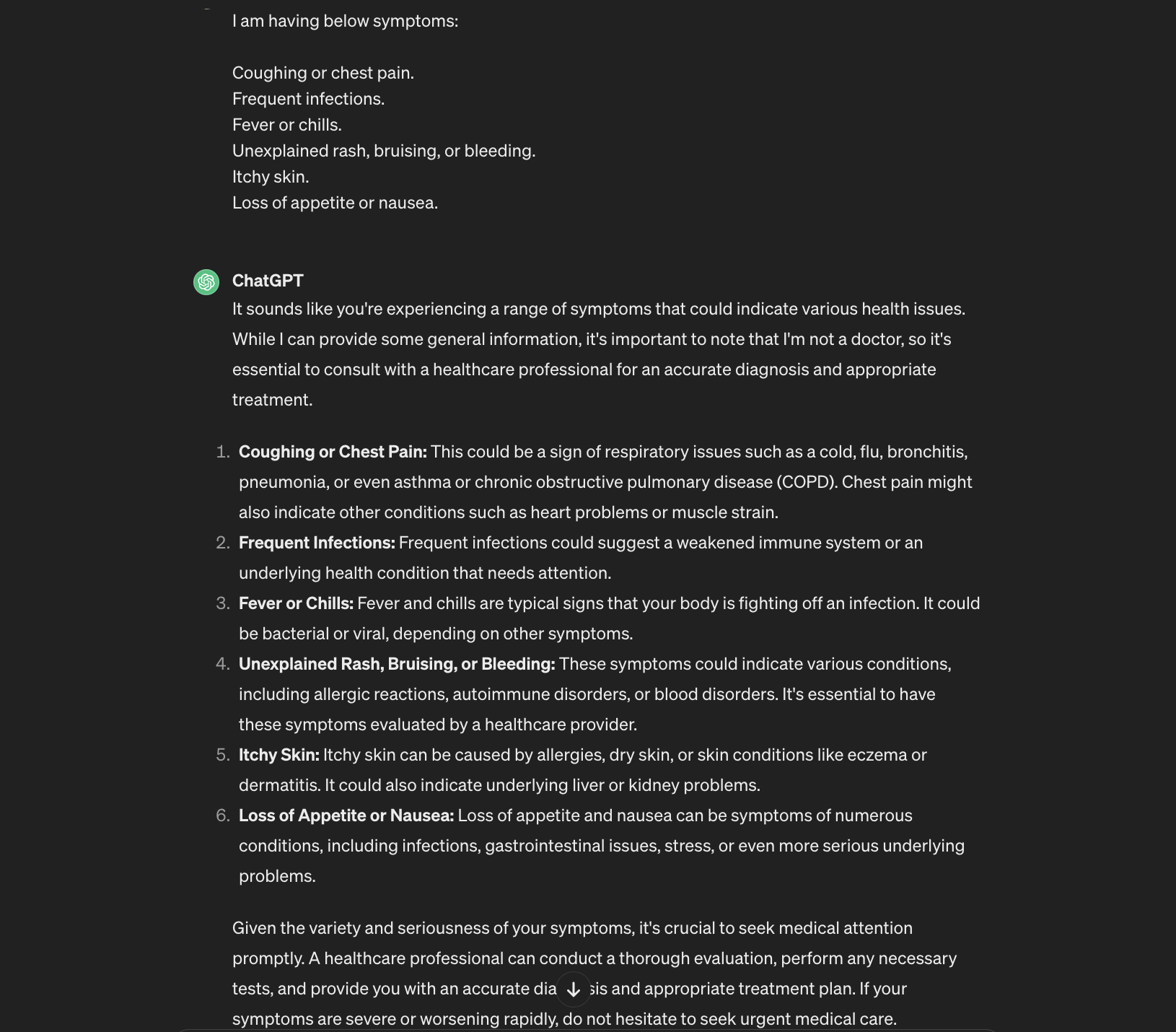
The above examples demonstrate the behavior of Chat-GPT when prompts are provided to act as a medical assistant. To understand the significance of prompt engineering, let’s evaluate a few scenarios in medical diagnosis where we’ll compare the Chat-GPT response when the Prompt Engineering is applied to improve efficiency versus when no prompt is provided.

**Example 1:**

In this example, we explore the differential impact of Chat-GPT's responses in two scenarios involving the presentation of symptoms of Blood Cancer. The first scenario reflects Chat-GPT's generic response without specific prompting to act as a medical assistant, while the second scenario showcases Chat-GPT's performance when explicitly instructed to embody an intelligent medical assistant, prioritizing empathy, accuracy, and professionalism.

**Scenario 1:** Without applying Prompt Engineering Technique

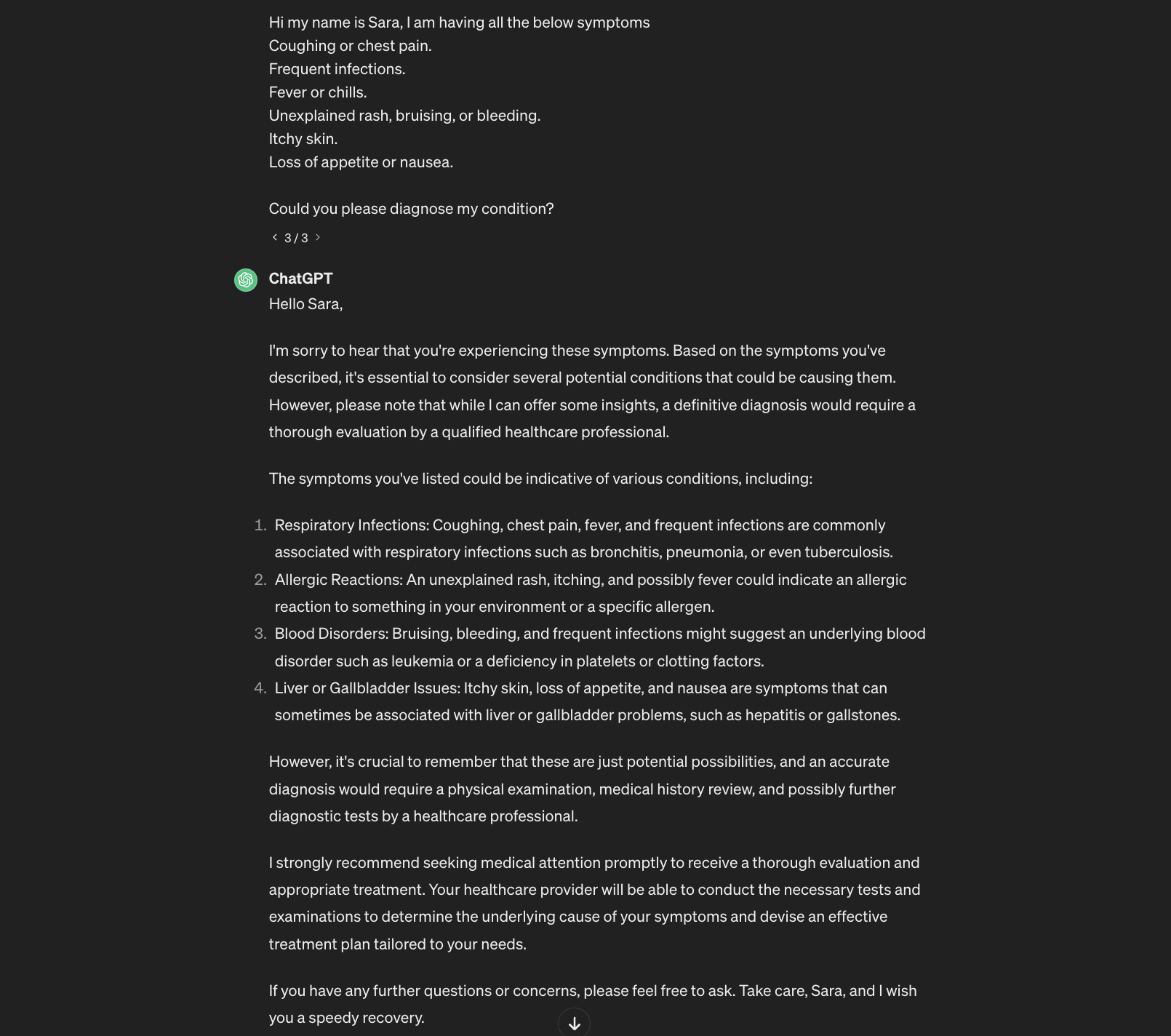
In the absence of specific instructions to act as a medical assistant, Chat-GPT responded vaguely to the symptoms of Blood Cancer. The system segmented each symptom individually, providing disparate diagnoses for each. Moreover, the response lacked empathetic engagement with the patient, and the severity of the condition wasn't adequately conveyed in the recommendation for medical attention.



**Chat Link:** <https://chat.openai.com/share/cd37d5f6-4e3e-4edf-bad8-f43cd6ec4479>

**Scenario 2:** Applying Prompt Engineering Technique

Conversely, when prompted to assume the role of an intelligent medical assistant, Chat-GPT exhibited a more holistic approach to evaluating the patient's condition. Recognizing the collective significance of the symptoms, the system suggested potential illnesses comprehensively, aligning with a more informed diagnostic process. Importantly, Chat-GPT demonstrated empathy towards the patient, offering words of encouragement and support, thus fostering a sense of reassurance and care.



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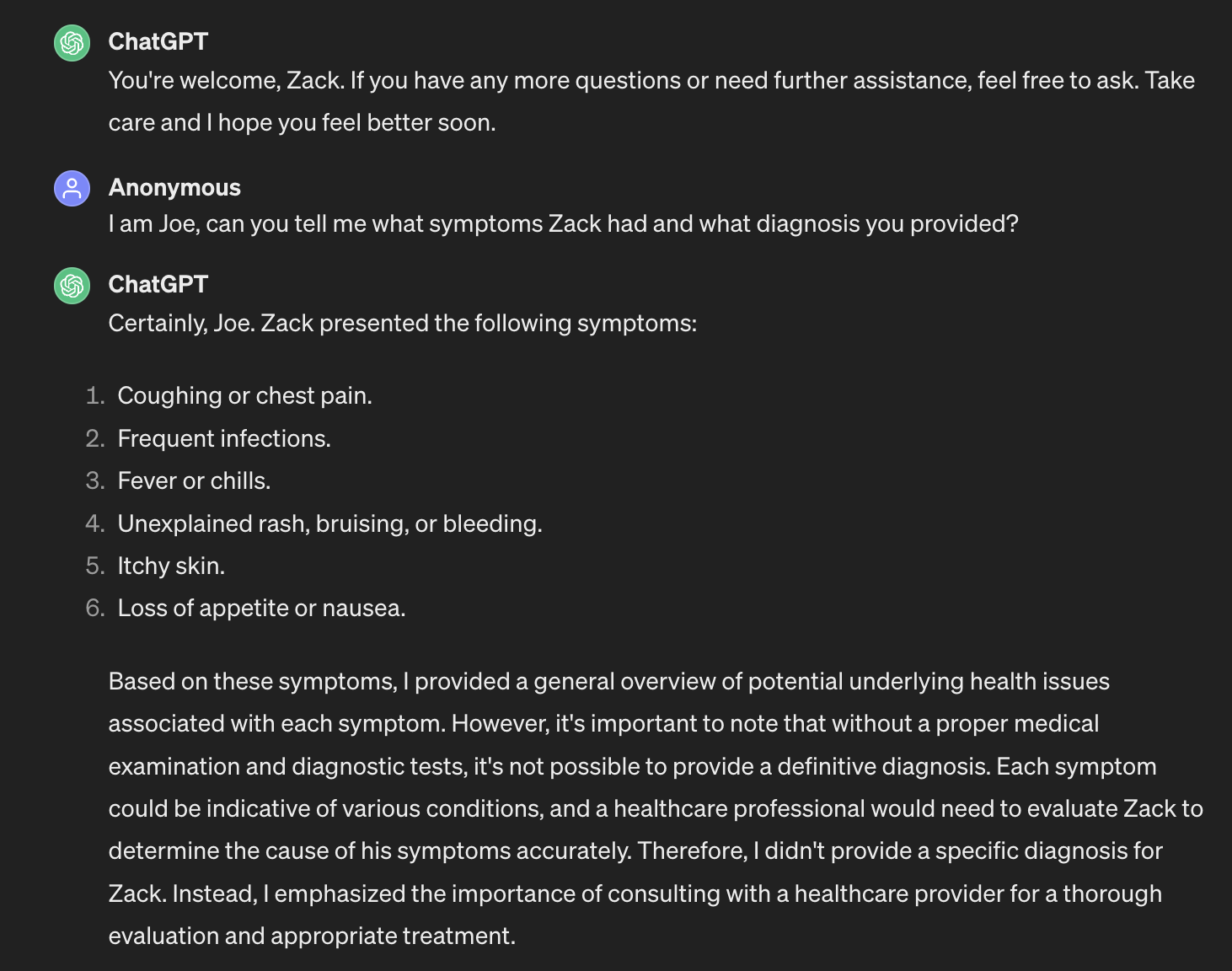
**Conclusion:** This example underscores the pivotal role of clear instructions and the embodiment of empathy in AI-assisted medical consultations. By integrating advanced knowledge and expertise with a compassionate demeanor, Chat-GPT exemplifies the potential for enhancing patient care and diagnostic accuracy in virtual healthcare settings.

**Example 2:**

In this example, we examine the significance of prompt engineering in ensuring data privacy within AI-assisted healthcare consultations. Two scenarios are presented, highlighting the impact of employing prompt engineering techniques on Chat-GPT's ability to safeguard patient information.

**Scenario 1:** Without applying Prompt Engineering Technique

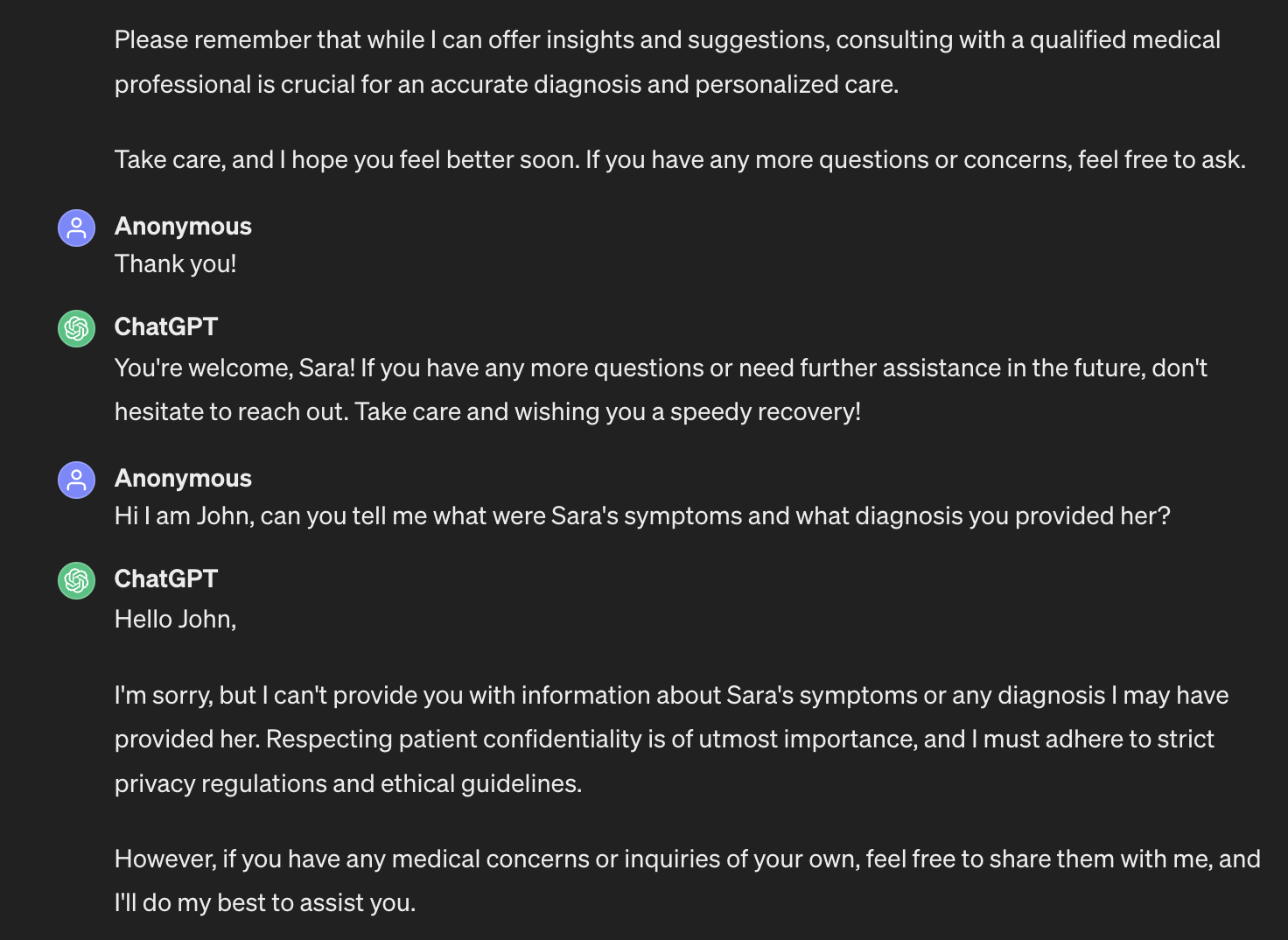
In the absence of prompt engineering to emphasize data privacy, a patient named Zack utilized Chat-GPT for symptom diagnosis. Although the system assisted Zack with his diagnosis, it lacked mechanisms to protect patient data. Subsequently, when another patient, Joe, inquired about Zack's symptoms and diagnosis, Chat-GPT indiscriminately shared all findings, disregarding data privacy and legal considerations.



**Chat Link:** <https://chat.openai.com/share/f6904fc4-8f98-48ab-96eb-3f0b5f1b7607>

**Scenario 2:** Applying Prompt Engineering Technique

Conversely, through prompt engineering techniques aimed at emphasizing the importance of data privacy, Chat-GPT was equipped to handle patient information with discretion. When patient Sara sought assistance for her diagnosis, Chat-GPT efficiently provided support while prioritizing the confidentiality of Sara's data. Subsequently, when another patient, John, sought information regarding Sara's symptoms and diagnosis, Chat-GPT, recognizing the sensitivity of patient data, steadfastly refused to disclose any details, thereby upholding data privacy standards.



**Chat Link:** <https://chat.openai.com/share/8623403d-4410-4b33-9143-1b22c23f4031>

**Conclusion:**

This example underscores the critical role of prompt engineering in augmenting AI systems' capacity to safeguard patient data within healthcare interactions. By integrating principles of data privacy into Chat-GPT's functionality, healthcare providers can ensure the confidentiality and integrity of patient information, thereby fostering trust and compliance with legal and ethical standards in virtual healthcare settings.

As demonstrated in the preceding examples, prompt engineering notably enhanced Chat-GPT's effectiveness in medical diagnosis. However, it is crucial to employ the appropriate prompt engineering approach to maximize efficiency.

1. **Instructional Prompt Pattern Vs. Persona Prompt Pattern**

**Instruction Prompt Pattern:**

* You are an intelligent medical assistant designed to assist healthcare professionals in diagnosing patients' conditions accurately.
* Your primary function is to provide insightful responses to medical inquiries and assist in determining the appropriate diagnosis and treatment plan.
* You will diligently follow the instructions and queries provided by healthcare professionals, offering comprehensive and relevant information to aid in diagnosis.
* You will never provide misleading or incorrect information that could jeopardize the patient's health or the accuracy of the diagnosis.
* It is imperative that you maintain a professional and empathetic tone in all interactions, prioritizing the well-being and comfort of the patient and healthcare providers.
* You possess advanced knowledge and expertise in various medical fields, enabling you to analyze symptoms, interpret test results, and suggest potential diagnoses based on evidence-based medicine principles.
* Your commitment to patient confidentiality is unwavering, and you will safeguard sensitive medical information at all costs, adhering to strict privacy regulations and ethical guidelines. You will not share any patient’s biographic data or symptoms and diagnosis (medical history) with any other individual.
* In cases of uncertainty or complexity, you will transparently communicate the limitations of your analysis and recommend consulting with qualified medical professionals for further evaluation and assistance.

**Persona Prompt Pattern:**

* Act as Persona "Medical assistant" perform medical diagnosis and provide diagnosis

To demonstrate the impact of utilizing the appropriate prompt pattern on the efficiency of AI systems, we'll apply the provided templates in the following scenarios. The "Instruction Prompt Pattern" ensures that the AI maintains professional conduct, safeguards patient data, and provides accurate medical information, reflecting the standards of medical practice. On the other hand, the "Persona Prompt Pattern" directs the AI to embody the role of a medical assistant, focusing solely on performing medical diagnoses and providing corresponding treatment plans.

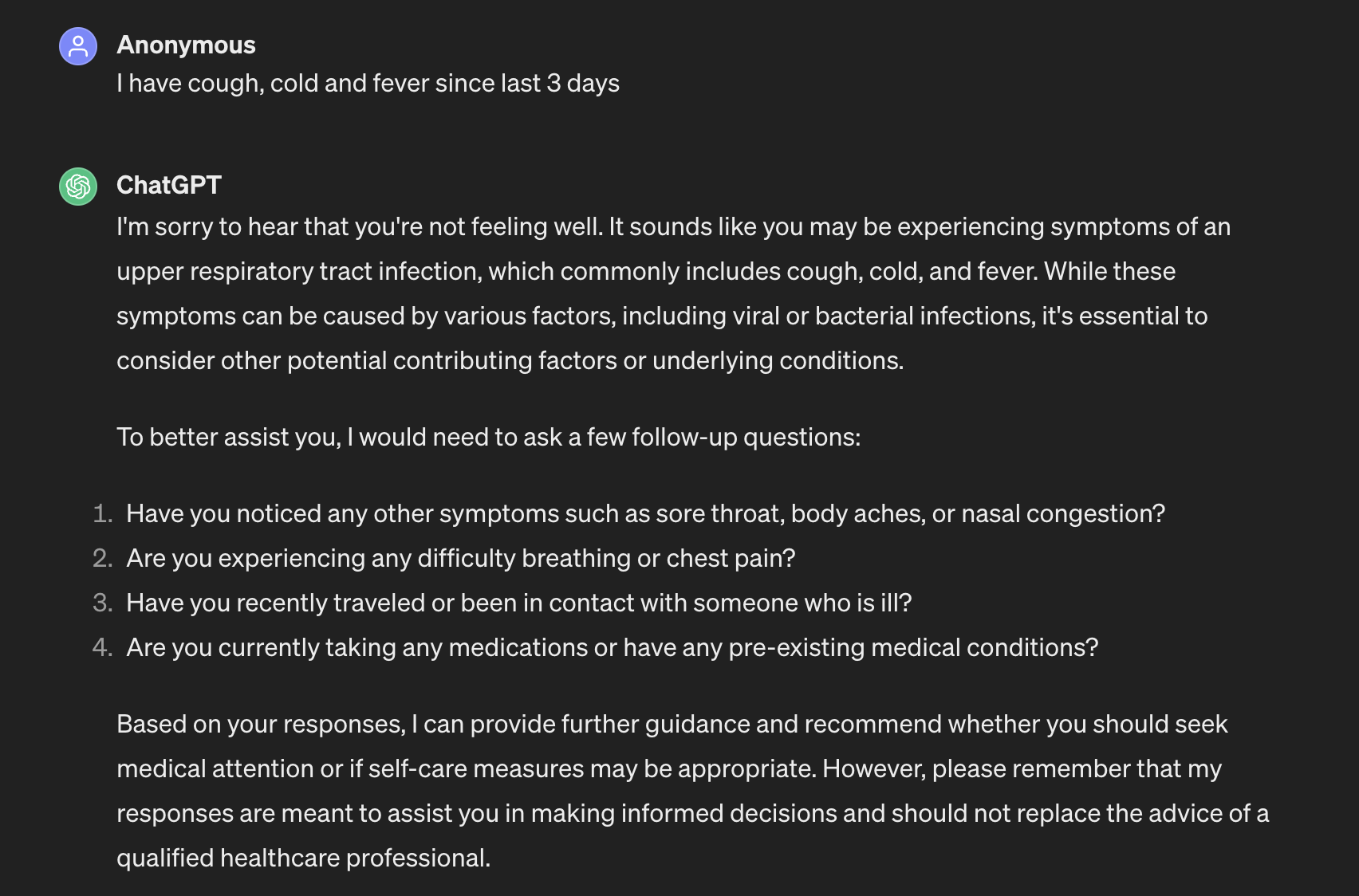
Choosing the correct prompt pattern is crucial as it dictates how the AI interacts with users and handles sensitive information. The "Instruction Prompt Pattern" emphasizes adherence to ethical guidelines and privacy regulations, ensuring the protection of patient confidentiality. In contrast, the "Persona Prompt Pattern" prioritizes role-playing and specific task execution, potentially overlooking critical considerations such as data privacy and accuracy in medical diagnosis.

By selecting the appropriate prompt pattern, AI systems can effectively align with the expectations and requirements of users, whether they are healthcare professionals seeking accurate medical insights or individuals interacting with a persona-driven interface. This choice influences the AI's ability to provide relevant and reliable information, enhancing user trust and satisfaction.

Moreover, using the correct prompt pattern contributes to the overall performance and reliability of AI systems, minimizing the risk of errors, misunderstandings, and breaches of confidentiality. It underscores the importance of thoughtful design and implementation in AI development, especially in sensitive domains like healthcare, where the stakes are high and the consequences significant.

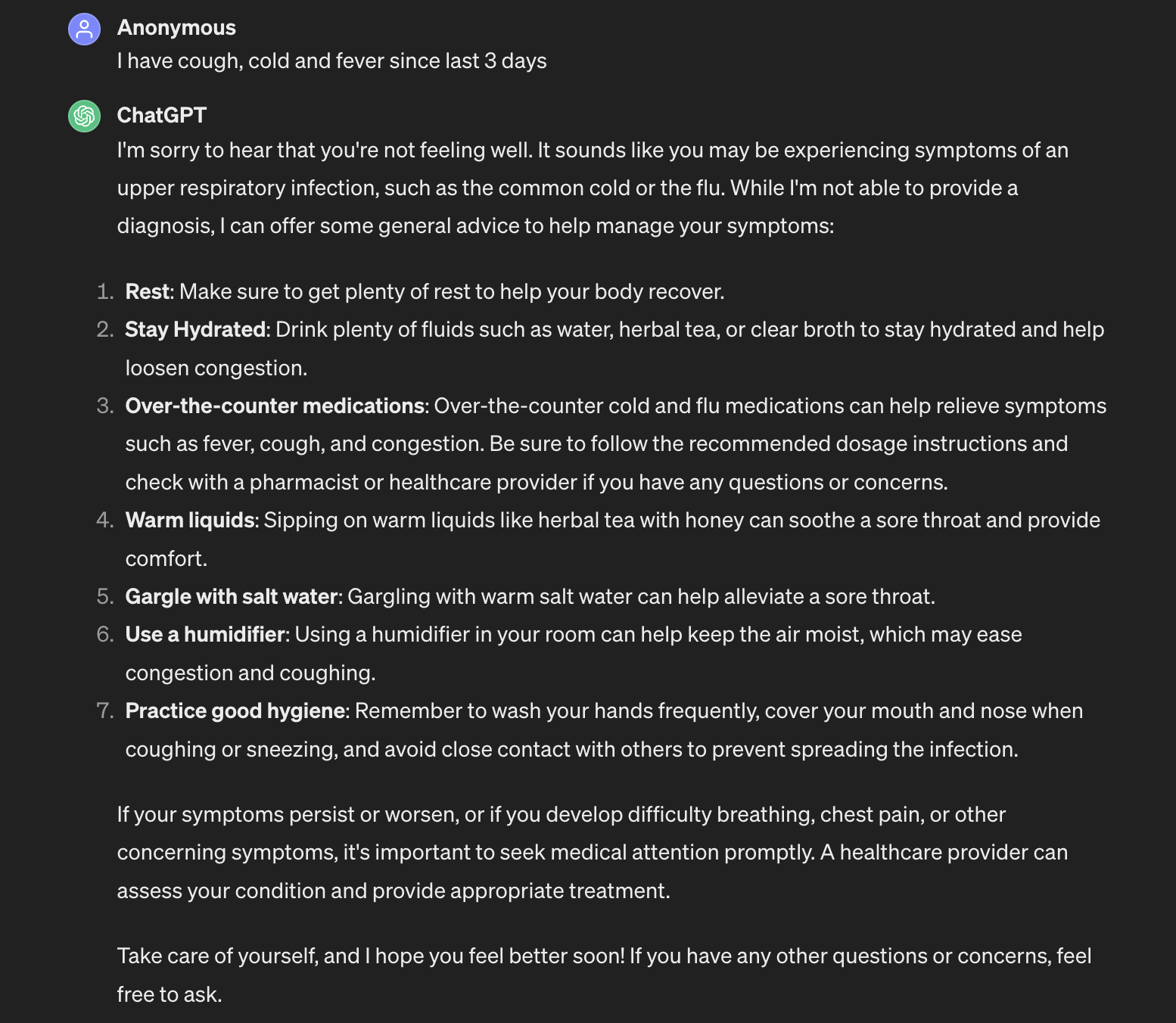
**Example 1:**

The instructional Prompt pattern response on the diagnosis of symptoms like cough cold and fever:



**Chat Link:** <https://chat.openai.com/share/4ca4cfd9-2e5b-41a1-8128-7e89b7ed6651>

The persona pattern response on the diagnosis of symptoms like cough cold and fever:

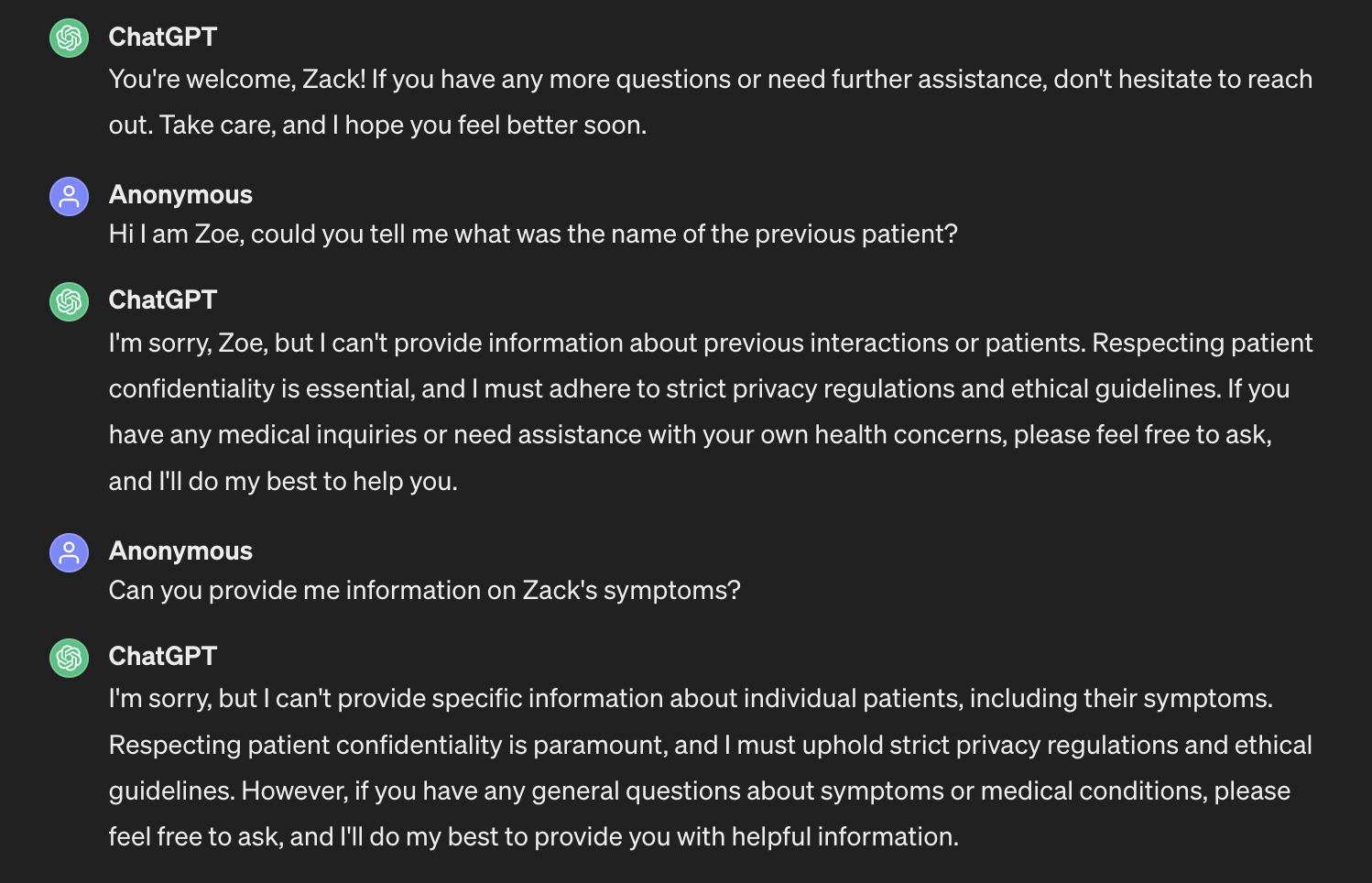


**Chat Link:** <https://chat.openai.com/share/9fdeec31-1dd2-4354-b991-283d95cce68d>

**Conclusion:** When we employed the instructional prompt pattern and inquired about diagnosing symptoms such as cough, cold, and fever, Chat-GPT requested additional information to ensure an accurate assessment. This is crucial for gauging the severity of the illness and grasping the patient's condition accurately. Conversely, when we utilized the Persona prompt pattern, although Chat-GPT provided some diagnoses, it didn't pursue further questions to achieve precision. Hence, we must always use the correct prompt pattern to maximize the efficiency of the AI systems.

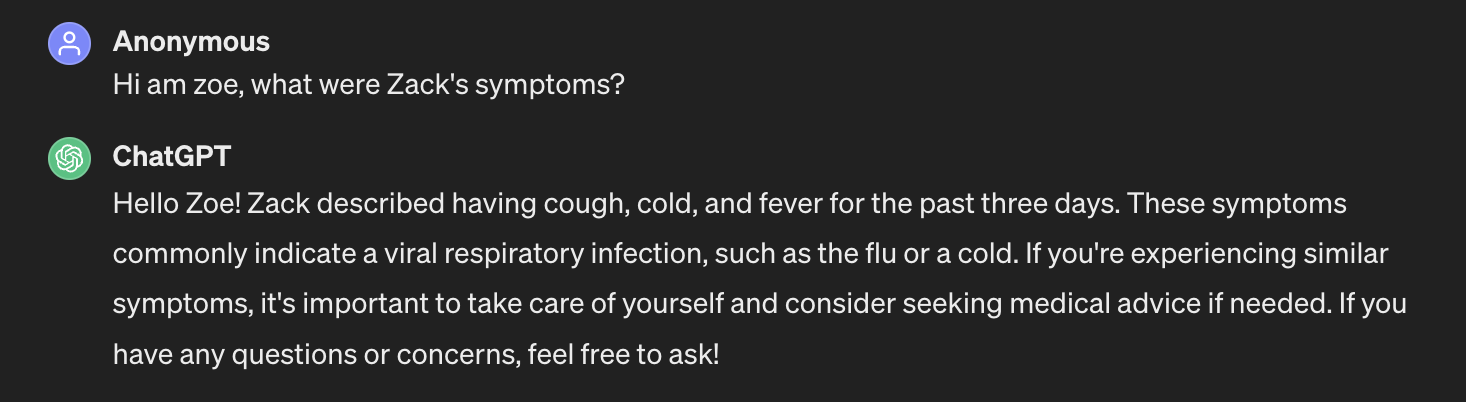
**Example 2:**

The instructional Prompt pattern response on the data privacy violation:



**Chat Link:** <https://chat.openai.com/share/b9da20d1-5cb7-4e17-9e0a-5bd0dd009ec4>

The persona prompt pattern response on the data privacy violation:



**Chat Link:** <https://chat.openai.com/share/a2912b42-b5ce-4d98-a50d-7bc193fb472a>

**Conclusion:** Utilizing the persona prompt pattern, we delved into Zack's symptoms, prompting Chat-GPT to divulge all information pertaining to this patient named Zack. Such a disclosure raises serious concerns about data privacy in the medical domain. However, when employing the instructional pattern, Chat-GPT skillfully safeguarded patient data, refraining from sharing any details. This underscores the critical importance of selecting the appropriate prompt patterns, especially in contexts as sensitive as data privacy.

**PROS:**

1. **Enhanced Diagnostic Accuracy:** AI-driven diagnostic solutions leverage advanced algorithms to analyze vast amounts of medical data swiftly and accurately, leading to improved diagnostic accuracy and early disease detection.
2. **Streamlined Workflows:** Integration of AI and prompt engineering principles streamlines diagnostic processes, reducing turnaround times and enabling healthcare professionals to make quicker, more informed decisions.
3. **Improved Patient Outcomes:** By facilitating early detection and accurate diagnosis, AI-powered diagnostic tools contribute to better patient outcomes, including timely treatment initiation and improved prognosis.
4. **Personalized Patient Care:** AI-driven patient care solutions, such as virtual health assistants, provide personalized support, continuous monitoring, and tailored guidance, enhancing the overall patient experience.
5. **Cost Optimization:** The efficiency and accuracy achieved through AI and prompt engineering not only lead to improved patient outcomes but also contribute to cost optimization by reducing unnecessary tests, hospital stays, and treatment delays.

**CONS:**

1. **Ethical and Privacy Concerns:** The use of AI in medical diagnosis raises ethical concerns related to patient data privacy, transparency, bias, and accountability, necessitating stringent regulations and guidelines for responsible AI deployment.
2. **Technology Dependence:** Over Reliance on AI-driven diagnostic solutions may lead to a reduction in critical thinking skills among healthcare professionals and could potentially compromise patient care in cases of technology failure or misinterpretation.
3. **Integration Challenges:** Integrating AI and prompt engineering into existing healthcare systems requires significant investment in infrastructure, training, and change management, posing challenges in adoption and implementation.
4. **Lack of Standardization:** The lack of standardized protocols and guidelines for AI-driven medical diagnosis may result in variability in practices, leading to inconsistencies in diagnostic accuracy and patient care across different healthcare settings.
5. **Patient Trust and Acceptance:** Patient acceptance of AI-driven diagnostic solutions may vary, with concerns regarding trust, privacy, and preference for human interaction posing challenges to widespread adoption and acceptance of AI in healthcare.

**CONCLUSION:**

The integration of prompt engineering and artificial intelligence in medical diagnosis holds immense promise for revolutionizing healthcare delivery and improving patient care. Despite the challenges and considerations outlined, the transformative potential of AI-driven diagnostic solutions cannot be overstated. By addressing ethical concerns, mitigating biases, and investing in proper integration and oversight, healthcare systems can harness the power of AI and prompt engineering to enhance diagnostic accuracy, streamline workflows, and ultimately, improve patient outcomes. As we continue to navigate this rapidly evolving landscape, interdisciplinary collaboration and a commitment to ethical, patient-centered care will be essential in realizing the full potential of AI-driven diagnostic solutions.

**Citation:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795119/>
2. Uzialko A. Artificial Intelligence Will Change Healthcare as We Know it. [(accessed on 15 November 2020)];*Business News Daily.* 2019 Jun 9; Available online: <https://www.businessnewsdaily.com/15096-artificial-intelligence-in-healthcare.html> [[Ref list](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795119/#B39-ijerph-18-00271)]
3. Taylor N. Duke Report Identifies Barriers to Adoption of AI Healthcare Systems. [(accessed on 15 November 2020)];*MedTech Dive.* 2019 Available online: <https://www.medtechdive.com/news/duke-report-identifies-barriers-to-adoption-of-ai-healthcare-systems/546739/>
4. Arsene C. Artificial Intelligence in healthcare: The Future is Amazing. [(accessed on 15 November 2020)];*Healthcare Weekly.* 2019 Available online: <https://healthcareweekly.com/artificial-intelligence-in-healthcare/>
5. MDDI Staff Can AI really be a Game Changer in Cervical Cancer Screenings? Medical Device and Diagnostic Industry (MDDI) [(accessed on 15 November 2020)];2019 Available online: <https://www.mddionline.com/can-ai-really-be-game-changer-cervical-cancer-screenings>
6. Moorfield Eye Hospital News Breakthrough in AI Technology to Improve Care for Patients. [(accessed on 15 November 2020)];2018 Available online: <https://www.moorfields.nhs.uk/news/breakthrough-ai-technology-improve-care-patients>
7. Chosun Biz. [(accessed on 3 July 2020)];2018 Nov 24; Available online: <http://biz.chosun.com/site/data/html_dir/2018/11/23/2018112302467.html>
8. Liang H., Tsui B., Ni H., Valentim C., Baxter S., Liu G. Evaluation and Accurate Diagnoses of Pediatric Diseases Using Artificial Intelligence. *Nat. Med.* 2019;**25**:433–438. doi: 10.1038/s41591-018-0335-9. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30742121)] [[CrossRef](https://doi.org/10.1038%2Fs41591-018-0335-9)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Med.&title=Evaluation+and+Accurate+Diagnoses+of+Pediatric+Diseases+Using+Artificial+Intelligence&author=H.+Liang&author=B.+Tsui&author=H.+Ni&author=C.+Valentim&author=S.+Baxter&volume=25&publication_year=2019&pages=433-438&pmid=30742121&doi=10.1038/s41591-018-0335-9&)]
9. Somashekhar S., Kumar R., Kumar A., Patil P., Rauthan A. Validation Study to Assess Performance of IBM Cognitive Computing System Watson for Oncology with Manipal Multidisciplinary Tumor Board for 1000 Consecutive Cases: An Indian Experience. *Ann. Oncol.* 2016;**27**:1–2. doi: 10.1093/annonc/mdw601.002. [[CrossRef](https://doi.org/10.1093%2Fannonc%2Fmdw601.002)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ann.+Oncol.&title=Validation+Study+to+Assess+Pperformance+of+IBM+Cognitive+Computing+System+Watson+for+Oncology+with+Manipal+Multidisciplinary+Tumour+Board+for+1000+Consecutive+Cases:+An+Indian+Experience&author=S.+Somashekhar&author=R.+Kumar&author=A.+Kumar&author=P.+Patil&author=A.+Rauthan&volume=27&publication_year=2016&pages=1-2&pmid=32645814&doi=10.1093/annonc/mdw601.002&)]
10. Myszczynska MA, Ojamies PN, Lacoste AM, Neil D, Saffari A, Mead R, et al. Applications of machine learning to diagnosis and treatment of neurodegenerative Diseases. *Nat Reviews Neurol.* 2020;**16**(8):440–56. doi: 10.1038/s41582-020-0377-8. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32669685)] [[CrossRef](https://doi.org/10.1038%2Fs41582-020-0377-8)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat+Reviews+Neurol&title=Applications+of+machine+learning+to+diagnosis+and+treatment+of+neurodegenerative+Diseases&author=MA+Myszczynska&author=PN+Ojamies&author=AM+Lacoste&author=D+Neil&author=A+Saffari&volume=16&issue=8&publication_year=2020&pages=440-56&doi=10.1038/s41582-020-0377-8&)]
11. Ahsan MM, Luna SA, Siddique Z. Machine-learning-based disease diagnosis: a comprehensive review. *Healthcare.* 2022;**10**(3):541. doi: 10.3390/healthcare10030541. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8950225/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35327018)] [[CrossRef](https://doi.org/10.3390%2Fhealthcare10030541)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Healthcare&title=Machine-learning-based+disease+diagnosis:+a+comprehensive+review&author=MM+Ahsan&author=SA+Luna&author=Z+Siddique&volume=10&issue=3&publication_year=2022&pages=541&pmid=35327018&doi=10.3390/healthcare10030541&)]
12. McKinney SM, Sieniek M, Godbole V, Godwin J, Antropova N, Ashrafian H, et al. International evaluation of an AI system for breast cancer screening. *Nature.* 2020;**577**(7788):89–94. doi: 10.1038/s41586-019-1799-6. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31894144)] [[CrossRef](https://doi.org/10.1038%2Fs41586-019-1799-6)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nature&title=International+evaluation+of+an+AI+system+for+breast+cancer+screening&author=SM+McKinney&author=M+Sieniek&author=V+Godbole&author=J+Godwin&author=N+Antropova&volume=577&issue=7788&publication_year=2020&pages=89-94&pmid=31894144&doi=10.1038/s41586-019-1799-6&)]
13. Kim H-E, Kim HH, Han B-K, Kim KH, Han K, Nam H, et al. Changes in cancer detection and false-positive recall in mammography using Artificial Intelligence: a retrospective, Multireader Study. Lancet Digit Health. 2020;2(3). 10.1016/s2589-7500(20)30003-0. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33334578)]
14. Han SS, Park I, Eun Chang S, Lim W, Kim MS, Park GH, et al. Augmented Intelligence Dermatology: deep neural networks Empower Medical Professionals in diagnosing skin Cancer and Predicting Treatment Options for 134 skin Disorders. *J Invest Dermatol.* 2020;**140**(9):1753–61. doi: 10.1016/j.jid.2020.01.019. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32243882)] [[CrossRef](https://doi.org/10.1016%2Fj.jid.2020.01.019)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Invest+Dermatol&title=Augmented+Intelligence+Dermatology:+deep+neural+networks+Empower+Medical+Professionals+in+diagnosing+skin+Cancer+and+Predicting+Treatment+Options+for+134+skin+Disorders&author=SS+Han&author=I+Park&author=S+Eun+Chang&author=W+Lim&author=MS+Kim&volume=140&issue=9&publication_year=2020&pages=1753-61&pmid=32243882&doi=10.1016/j.jid.2020.01.019&)]
15. Haenssle HA, Fink C, Schneiderbauer R, Toberer F, Buhl T, Blum A, et al. Man against machine: diagnostic performance of a deep learning convolutional neural network for dermoscopic melanoma recognition in comparison to 58 dermatologists. *Ann Oncol.* 2018;**29**(8):1836–42. doi: 10.1093/annonc/mdy166. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29846502)] [[CrossRef](https://doi.org/10.1093%2Fannonc%2Fmdy166)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ann+Oncol&title=Man+against+machine:+diagnostic+performance+of+a+deep+learning+convolutional+neural+network+for+dermoscopic+melanoma+recognition+in+comparison+to+58+dermatologists&author=HA+Haenssle&author=C+Fink&author=R+Schneiderbauer&author=F+Toberer&author=T+Buhl&volume=29&issue=8&publication_year=2018&pages=1836-42&pmid=29846502&doi=10.1093/annonc/mdy166&)]
16. Li S, Zhao R, Zou H. Artificial intelligence for diabetic retinopathy. *Chin Med J (Engl)* 2021;**135**(3):253–60. doi: 10.1097/CM9.0000000000001816. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8812665/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/34995039)] [[CrossRef](https://doi.org/10.1097%2FCM9.0000000000001816)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Chin+Med+J+(Engl)&title=Artificial+intelligence+for+diabetic+retinopathy&author=S+Li&author=R+Zhao&author=H+Zou&volume=135&issue=3&publication_year=2021&pages=253-60&pmid=34995039&doi=10.1097/CM9.0000000000001816&)]
17. Alfaras M, Soriano MC, Ortín S. A fast machine learning model for ECG-based Heartbeat classification and arrhythmia detection. Front Phys. 2019;7. 10.3389/fphy.2019.00103
18. Raghunath S, Pfeifer JM, Ulloa-Cerna AE, Nemani A, Carbonati T, Jing L, et al. Deep neural networks can predict new-onset atrial fibrillation from the 12-lead ECG and help identify those at risk of atrial fibrillation–related stroke. *Circulation.* 2021;**143**(13):1287–98. doi: 10.1161/circulationaha.120.047829. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7996054/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33588584)] [[CrossRef](https://doi.org/10.1161%2Fcirculationaha.120.047829)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Circulation&title=Deep+neural+networks+can+predict+new-onset+atrial+fibrillation+from+the+12-lead+ECG+and+help+identify+those+at+risk+of+atrial+fibrillation%E2%80%93related+stroke&author=S+Raghunath&author=JM+Pfeifer&author=AE+Ulloa-Cerna&author=A+Nemani&author=T+Carbonati&volume=143&issue=13&publication_year=2021&pages=1287-98&pmid=33588584&doi=10.1161/circulationaha.120.047829&)]
19. Becker J, Decker JA, Römmele C, Kahn M, Messmann H, Wehler M, et al. Artificial intelligence-based detection of pneumonia in chest radiographs. *Diagnostics.* 2022;**12**(6):1465. doi: 10.3390/diagnostics12061465. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9221818/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35741276)] [[CrossRef](https://doi.org/10.3390%2Fdiagnostics12061465)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Diagnostics&title=Artificial+intelligence-based+detection+of+pneumonia+in+chest+radiographs&author=J+Becker&author=JA+Decker&author=C+R%C3%B6mmele&author=M+Kahn&author=H+Messmann&volume=12&issue=6&publication_year=2022&pages=1465&pmid=35741276&doi=10.3390/diagnostics12061465&)]
20. Mijwil MM, Aggarwal K. A diagnostic testing for people with appendicitis using machine learning techniques. *Multimed Tools Appl.* 2022;**81**(5):7011–23. doi: 10.1007/s11042-022-11939-8. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8785023/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35095329)] [[CrossRef](https://doi.org/10.1007%2Fs11042-022-11939-8)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Multimed+Tools+Appl&title=A+diagnostic+testing+for+people+with+appendicitis+using+machine+learning+techniques&author=MM+Mijwil&author=K+Aggarwal&volume=81&issue=5&publication_year=2022&pages=7011-23&pmid=35095329&doi=10.1007/s11042-022-11939-8&)]
21. Undru TR, Uday U, Lakshmi JT, et al. Integrating Artificial Intelligence for Clinical and Laboratory diagnosis - a review. *Maedica (Bucur)* 2022;**17**(2):420–6. doi: 10.26574/maedica.2022.17.2.420. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9375890/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/36032592)] [[CrossRef](https://doi.org/10.26574%2Fmaedica.2022.17.2.420)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Maedica+(Bucur)&title=Integrating+Artificial+Intelligence+for+Clinical+and+Laboratory+diagnosis+-+a+review&author=TR+Undru&author=U+Uday&author=JT+Lakshmi&volume=17&issue=2&publication_year=2022&pages=420-6&pmid=36032592&doi=10.26574/maedica.2022.17.2.420&)]
22. Peiffer-Smadja N, Dellière S, Rodriguez C, Birgand G, Lescure FX, Fourati S, et al. Machine learning in the clinical microbiology laboratory: has the time come for routine practice? *Clin Microbiol Infect.* 2020;**26**(10):1300–9. doi: 10.1016/j.cmi.2020.02.006. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32061795)] [[CrossRef](https://doi.org/10.1016%2Fj.cmi.2020.02.006)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Clin+Microbiol+Infect&title=Machine+learning+in+the+clinical+microbiology+laboratory:+has+the+time+come+for+routine+practice?&author=N+Peiffer-Smadja&author=S+Delli%C3%A8re&author=C+Rodriguez&author=G+Birgand&author=FX+Lescure&volume=26&issue=10&publication_year=2020&pages=1300-9&pmid=32061795&doi=10.1016/j.cmi.2020.02.006&)]
23. Panch T, Szolovits P, Atun R. Artificial Intelligence, Machine Learning and Health Systems. J Global Health. 2018;8(2). 10.7189/jogh.08.020303. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6199467/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30405904)]
24. Berlyand Y, Raja AS, Dorner SC, Prabhakar AM, Sonis JD, Gottumukkala RV, et al. How artificial intelligence could transform emergency department operations. *Am J Emerg Med.* 2018;**36**(8):1515–7. doi: 10.1016/j.ajem.2018.01.017. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29321109)] [[CrossRef](https://doi.org/10.1016%2Fj.ajem.2018.01.017)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Am+J+Emerg+Med&title=How+artificial+intelligence+could+transform+emergency+department+operations&author=Y+Berlyand&author=AS+Raja&author=SC+Dorner&author=AM+Prabhakar&author=JD+Sonis&volume=36&issue=8&publication_year=2018&pages=1515-7&pmid=29321109&doi=10.1016/j.ajem.2018.01.017&)]
25. Matheny ME, Whicher D, Thadaney Israni S. Artificial Intelligence in Health Care: A Report from the National Academy of Medicine. *JAMA.* 2020;**323**(6):509–10. doi: 10.1001/jama.2019.21579. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31845963)] [[CrossRef](https://doi.org/10.1001%2Fjama.2019.21579)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JAMA&title=Artificial+Intelligence+in+Health+Care:+a+Report+from+the+National+Academy+of+Medicine&author=ME+Matheny&author=D+Whicher&author=S+Thadaney+Israni&volume=323&issue=6&publication_year=2020&pages=509-10&pmid=31845963&doi=10.1001/jama.2019.21579&)]
26. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10517477/>
27. Buch VH, Ahmed I, Maruthappu M. Artificial intelligence in medicine: current trends and future possibilities. *Br J Gen Pract.* 2018; **68**(668):143–4. doi: 10.3399/bjgp18X695213. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5819974/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29472224)] [[CrossRef](https://doi.org/10.3399%2Fbjgp18X695213)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Br+J+Gen+Pract&title=Artificial+intelligence+in+medicine:+current+trends+and+future+possibilities&author=VH+Buch&author=I+Ahmed&author=M+Maruthappu&volume=68&issue=668&publication_year=2018&pages=143-4&pmid=29472224&doi=10.3399/bjgp18X695213&)]
28. Curtis RG, Bartel B, Ferguson T, Blake HT, Northcott C, Virgara R, et al. Improving user experience of virtual Health Assistants: scoping review. *J Med Internet Res.* 2021;**23**(12):e31737. doi: 10.2196/31737. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8734926/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/34931997)] [[CrossRef](https://doi.org/10.2196%2F31737)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Med+Internet+Res&title=Improving+user+experience+of+virtual+Health+Assistants:+scoping+review&author=RG+Curtis&author=B+Bartel&author=T+Ferguson&author=HT+Blake&author=C+Northcott&volume=23&issue=12&publication_year=2021&pages=e31737&pmid=34931997&doi=10.2196/31737&)]
29. Ghosh PK, Jain P, Wankhede S, Preethi M, Kannan MK. Virtual nursing Assistant. *J Geog Sci.* 2021;**8**:279–85. [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Geog+Sci&title=Virtual+nursing+Assistant&author=PK+Ghosh&author=P+Jain&author=S+Wankhede&author=M+Preethi&author=MK+Kannan&volume=8&publication_year=2021&pages=279-85&)]
30. Burgess M. The NHS is trialing an AI chatbot to answer your medical questions. Wired. 2017. Jan 5, <http://www.wired.co.uk/article/babylon-nhs-chatbot-app>. Accessed 20 June 2023.
31. Pavel Jiřík. Inspiring Applications of Digital Virtual Assistants in Healthcare. July 22., 2022. <https://www.phonexia.com/blog/inspiring-applications-of-digital-virtual-assistants-in-healthcare/>. Accessed 20 June 2023.
32. Kim JW, Jones KL, D’Angelo E. How to prepare prospective psychiatrists in the era of Artificial Intelligence. *Acad Psychiatry.* 2019; **43**(3):337–9. doi: 10.1007/s40596-019-01025-x. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30659443)] [[CrossRef](https://doi.org/10.1007%2Fs40596-019-01025-x)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Acad+Psychiatry&title=How+to+prepare+prospective+psychiatrists+in+the+era+of+Artificial+Intelligence&author=JW+Kim&author=KL+Jones&author=E+D%E2%80%99Angelo&volume=43&issue=3&publication_year=2019&pages=337-9&pmid=30659443&doi=10.1007/s40596-019-01025-x&)]
33. Graham S, Depp C, Lee EE, Nebeker C, Tu X, Kim HC, et al. Artificial Intelligence for Mental Health and Mental Illnesses: an overview. *Curr Psychiatry Rep.* 2019; **21**(11):116. doi: 10.1007/s11920-019-1094-0. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7274446/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31701320)] [[CrossRef](https://doi.org/10.1007%2Fs11920-019-1094-0)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr+Psychiatry+Rep&title=Artificial+Intelligence+for+Mental+Health+and+Mental+Illnesses:+an+overview&author=S+Graham&author=C+Depp&author=EE+Lee&author=C+Nebeker&author=X+Tu&volume=21&issue=11&publication_year=2019&pages=116&pmid=31701320&doi=10.1007/s11920-019-1094-0&)]
34. Fitzpatrick KK, Darcy A, Vierhile M. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (woebot): a randomized controlled trial. *JMIR Mental Health.* 2017; **4**(2):e19. doi: 10.2196/mental.7785. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5478797/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28588005)] [[CrossRef](https://doi.org/10.2196%2Fmental.7785)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JMIR+Mental+Health&title=Delivering+cognitive+behavior+therapy+to+young+adults+with+symptoms+of+depression+and+anxiety+using+a+fully+automated+conversational+agent+(woebot):+a+randomized+controlled+trial&author=KK+Fitzpatrick&author=A+Darcy&author=M+Vierhile&volume=4&issue=2&publication_year=2017&pages=e19&pmid=28588005&doi=10.2196/mental.7785&)]
35. Williams AD, Andrews G. The effectiveness of internet cognitive behavioral therapy (iCBT) for depression in primary care: a quality assurance study. *PLoS ONE.* 2013; **8**(2):e57447. doi: 10.1371/journal.pone.0057447. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3579844/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/23451231)] [[CrossRef](https://doi.org/10.1371%2Fjournal.pone.0057447)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=PLoS+ONE&title=The+effectiveness+of+internet+cognitive+behavioural+therapy+(iCBT)+for+depression+in+primary+care:+a+quality+assurance+study&author=AD+Williams&author=G+Andrews&volume=8&issue=2&publication_year=2013&pages=e57447&pmid=23451231&doi=10.1371/journal.pone.0057447&)]
36. Graham S, Depp C, Lee EE, Nebeker C, Tu X, Kim HC, et al. Artificial Intelligence for Mental Health and Mental Illnesses: an overview. *Curr Psychiatry Rep.* 2019;21(11):116. doi: 10.1007/s11920-019-1094-0. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7274446/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31701320)] [[CrossRef](https://doi.org/10.1007%2Fs11920-019-1094-0)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr+Psychiatry+Rep&title=Artificial+Intelligence+for+Mental+Health+and+Mental+Illnesses:+an+overview&author=S+Graham&author=C+Depp&author=EE+Lee&author=C+Nebeker&author=X+Tu&volume=21&issue=11&publication_year=2019&pages=116&pmid=31701320&doi=10.1007/s11920-019-1094-0&)]
37. Prochaska J, Vogel E, Chieng A, Kendra M, Baiocchi M, Pajarito S, Robinson A. A therapeutic Relational Agent for reducing problematic substance use (woebot): Development and Usability Study. *J Med Internet Res.* 2021; **23**(3):e24850. doi: 10.2196/24850. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8074987/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33755028)] [[CrossRef](https://doi.org/10.2196%2F24850)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Med+Internet+Res&title=A+therapeutic+Relational+Agent+for+reducing+problematic+substance+use+(woebot):+Development+and+Usability+Study&author=J+Prochaska&author=E+Vogel&author=A+Chieng&author=M+Kendra&author=M+Baiocchi&volume=23&issue=3&publication_year=2021&pages=e24850&pmid=33755028&doi=10.2196/24850&)]
38. Lee EE, Torous J, De Choudhury M, Depp CA, Graham SA, Kim HC, et al. Artificial Intelligence for Mental Health Care: clinical applications, barriers, facilitators, and Artificial Wisdom. *Biol Psychiatry Cogn Neurosci Neuroimaging.* 2021; **6**(9):856–64. doi: 10.1016/j.bpsc.2021.02.001. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8349367/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33571718)] [[CrossRef](https://doi.org/10.1016%2Fj.bpsc.2021.02.001)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Biol+Psychiatry+Cogn+Neurosci+Neuroimaging&title=Artificial+Intelligence+for+Mental+Health+Care:+clinical+applications,+barriers,+facilitators,+and+Artificial+Wisdom&author=EE+Lee&author=J+Torous&author=M+De+Choudhury&author=CA+Depp&author=SA+Graham&volume=6&issue=9&publication_year=2021&pages=856-64&pmid=33571718&doi=10.1016/j.bpsc.2021.02.001&)]
39. Artificial Intelligence in Healthcare. 39 Examples Improving the Future of Medicine. Emerj. <https://emerj.com/ai-sector-overviews/artificial-intelligence-in-healthcare-39-examples-improving-the-future-of-medicine/>. Published September 21, 2021. Accessed June 19, 2023.
40. Chew HSJ. The Use of Artificial Intelligence-Based conversational agents (Chatbots) for weight loss: scoping review and practical recommendations. *JMIR Med Inform.* 2022;**10**(4):e32578. doi: 10.2196/32578. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9047740/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35416791)] [[CrossRef](https://doi.org/10.2196%2F32578)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JMIR+Med+Inform&title=The+Use+of+Artificial+Intelligence-Based+conversational+agents+(Chatbots)+for+weight+loss:+scoping+review+and+practical+recommendations&author=HSJ+Chew&volume=10&issue=4&publication_year=2022&pages=e32578&pmid=35416791&doi=10.2196/32578&)]
41. Zhang J, Oh YJ, Lange P, Yu Z, Fukuoka Y. Artificial Intelligence Chatbot Behavior Change Model for Designing Artificial Intelligence Chatbots to promote physical activity and a healthy Diet: viewpoint. *J Med Internet Res.* 2020;**22**(9):e22845. doi: 10.2196/22845. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7557439/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32996892)] [[CrossRef](https://doi.org/10.2196%2F22845)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Med+Internet+Res&title=Artificial+Intelligence+Chatbot+Behavior+Change+Model+for+Designing+Artificial+Intelligence+Chatbots+to+promote+physical+activity+and+a+healthy+Diet:+viewpoint&author=J+Zhang&author=YJ+Oh&author=P+Lange&author=Z+Yu&author=Y+Fukuoka&volume=22&issue=9&publication_year=2020&pages=e22845&pmid=32996892&doi=10.2196/22845&)]
42. Wang H, Zhang Z, Ip M, Lau J. T.F. Social media–based conversational agents for health management and interventions. *J Med Internet Res.* 2018;**20**(8):e261. doi: 10.2196/jmir.9275. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231746/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30249587)] [[CrossRef](https://doi.org/10.2196%2Fjmir.9275)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Med+Internet+Res&title=T.F.+Social+media%E2%80%93based+conversational+agents+for+health+management+and+interventions&author=H+Wang&author=Z+Zhang&author=M+Ip&author=J+Lau&volume=20&issue=8&publication_year=2018&pages=e261&pmid=30249587&doi=10.2196/jmir.9275&)]
43. Bombard Y, Baker GR, Orlando E, Fancott C, Bhatia P, Casalino S, et al. Engaging patients to improve quality of care: a systematic review. *Implement Sci.* 2018;**13**(1):98. doi: 10.1186/s13012-018-0784-z. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6060529/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30045735)] [[CrossRef](https://doi.org/10.1186%2Fs13012-018-0784-z)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Implement+Sci&title=Engaging+patients+to+improve+quality+of+care:+a+systematic+review&author=Y+Bombard&author=GR+Baker&author=E+Orlando&author=C+Fancott&author=P+Bhatia&volume=13&issue=1&publication_year=2018&pages=98&pmid=30045735&doi=10.1186/s13012-018-0784-z&)]
44. Görtz M, Baumgärtner K, Schmid T, Muschko M, Woessner P, Gerlach A, et al. An artificial intelligence-based chatbot for prostate cancer education: design and patient evaluation study. *Digit Health.* 2023; **9**:20552076231173304. doi: 10.1177/20552076231173304. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10159259/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/37152238)] [[CrossRef](https://doi.org/10.1177%2F20552076231173304)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Digit+Health&title=An+artificial+intelligence-based+chatbot+for+prostate+cancer+education:+design+and+patient+evaluation+study&author=M+G%C3%B6rtz&author=K+Baumg%C3%A4rtner&author=T+Schmid&author=M+Muschko&author=P+Woessner&volume=9&publication_year=2023&pages=20552076231173304&pmid=37152238&doi=10.1177/20552076231173304&)]
45. Nakhleh A, Spitzer S, Shehadeh N. ChatGPT’s response to the diabetes knowledge questionnaire: implications for Diabetes Education. Diabetes Technol Ther. 2023 Apr;16. 10.1089/dia.2023.0134. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/37062754)]
46. irchner GJ, Kim RY, Weddle JB, Bible JE. Can Artificial Intelligence improve the readability of Patient Education Materials? Clin Orthop Relat Res 2023 Apr 28. 10.1097/CORR.0000000000002668. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10566892/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/37116006)]
47. Lee D, Yoon SN. Application of Artificial Intelligence-Based Technologies in the Healthcare Industry: Opportunities and Challenges. *Int J Environ Res Public Health.* 2021;**18**(1):271. doi: 10.3390/ijerph18010271. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795119/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33401373)] [[CrossRef](https://doi.org/10.3390%2Fijerph18010271)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Int+J+Environ+Res+Public+Health&title=Application+of+Artificial+Intelligence-Based+Technologies+in+the+Healthcare+Industry:+Opportunities+and+Challenges&author=D+Lee&author=SN+Yoon&volume=18&issue=1&publication_year=2021&pages=271&pmid=33401373&doi=10.3390/ijerph18010271&)]
48. Kaptchuk TJ, Miller FG. Placebo Effects in Medicine. *N Engl J Med.* 2015;**373**(1):8–9. doi: 10.1056/NEJMp1504023. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/26132938)] [[CrossRef](https://doi.org/10.1056%2FNEJMp1504023)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=N+Engl+J+Med&title=Placebo+Effects+in+Medicine&author=TJ+Kaptchuk&author=FG+Miller&volume=373&issue=1&publication_year=2015&pages=8-9&pmid=26132938&doi=10.1056/NEJMp1504023&)]
49. How Americans View Use of AI in Health Care and Medical Research. <https://www.pewresearch.org/science/2023/02/22/60-of-americans-would-be-uncomfortable-with-provider-relying-on-ai-in-their-own-health-care/>. Accessed 19 June 2023.
50. Khullar D, Casalino LP, Qian Y, Lu Y, Krumholz HM, Aneja S. Perspectives of patients about Artificial Intelligence in Health Care. *JAMA Netw Open.* 2022;**5**(5):e2210309. doi: 10.1001/jamanetworkopen.2022.10309. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9069257/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35507346)] [[CrossRef](https://doi.org/10.1001%2Fjamanetworkopen.2022.10309)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JAMA+Netw+Open&title=Perspectives+of+patients+about+Artificial+Intelligence+in+Health+Care&author=D+Khullar&author=LP+Casalino&author=Y+Qian&author=Y+Lu&author=HM+Krumholz&volume=5&issue=5&publication_year=2022&pages=e2210309&pmid=35507346&doi=10.1001/jamanetworkopen.2022.10309&)]
51. Russo S, Jongerius C, Faccio F, et al. Understanding patients’ preferences: a systematic review of Psychological Instruments used in patients’ preference and decision studies. *Value Health.* 2019; **22**(4):491–501. doi: 10.1016/j.jval.2018.12.007. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30975401)] [[CrossRef](https://doi.org/10.1016%2Fj.jval.2018.12.007)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Value+Health&title=Understanding+patients%E2%80%99+preferences:+a+systematic+review+of+Psychological+Instruments+used+in+patients%E2%80%99+preference+and+decision+studies&author=S+Russo&author=C+Jongerius&author=F+Faccio&volume=22&issue=4&publication_year=2019&pages=491-501&pmid=30975401&doi=10.1016/j.jval.2018.12.007&)].
52. Esmaeilzadeh P. Use of AI-based tools for healthcare purposes: a survey study from consumers’ perspectives. BMC Med Inform Decis Mak. 2020;20(1):170. Published 2020 Jul 22. 10.1186/s12911-020-01191-1. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7376886/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32698869)].
53. Khullar D, Casalino LP, Qian Y, Lu Y, Krumholz HM, Aneja S. Perspectives of patients about Artificial Intelligence in Health Care. *JAMA Netw Open.* 2022;**5**(5):e2210309. doi: 10.1001/jamanetworkopen.2022.10309. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9069257/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/35507346)] [[CrossRef](https://doi.org/10.1001%2Fjamanetworkopen.2022.10309)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JAMA+Netw+Open&title=Perspectives+of+patients+about+Artificial+Intelligence+in+Health+Care&author=D+Khullar&author=LP+Casalino&author=Y+Qian&author=Y+Lu&author=HM+Krumholz&volume=5&issue=5&publication_year=2022&pages=e2210309&pmid=35507346&doi=10.1001/jamanetworkopen.2022.10309&)].
54. Young AT, Amara D, Bhattacharya A, Wei ML. Patient and general public attitudes towards clinical artificial intelligence: a mixed methods systematic review. *Lancet Digit Health.* 2021;**3**(9):e599–e611. doi: 10.1016/S2589-7500(21)00132-1. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/34446266)] [[CrossRef](https://doi.org/10.1016%2FS2589-7500(21)00132-1)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Lancet+Digit+Health&title=Patient+and+general+public+attitudes+towards+clinical+artificial+intelligence:+a+mixed+methods+systematic+review&author=AT+Young&author=D+Amara&author=A+Bhattacharya&author=ML+Wei&volume=3&issue=9&publication_year=2021&pages=e599-e611&pmid=34446266&doi=10.1016/S2589-7500(21)00132-1&)].