

ChatGPT as a Bridge between Cancer Patients and AI-based Diagnostic Tools

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Abstract

Background: Cancer diagnosis and treatment is highly dependent on conventional pathology techniques such as histopathology, cytopathology and ancillary approaches. Artificial intelligence (AI)-powered data processing and learning has emerged as a key driver for medical progress, and pathology and laboratory medicine are no exception.

Objective: This study highlights the significance of cancer diagnosis within the framework of ChatGPT, a language model driven by "artificial intelligence" (AI). Through data analysis and useful answer generation, ChatGPT offers invaluable insights and support for cancer diagnosis, treatment, and patient education.

Methods: The purpose of this paper is to create 21 cancer-related questions. We used Google Bard and the most recent version of ChatGPT 4.0 to get responses. We performed an intermodal evaluation and double-checked the answers to these inquiries.

Results: We were able to identify 12 prevalent cancer types and provide information on their symptoms, recommended course of treatment, and available medications. The precision and dependability of the data provided by ChatGPT were confirmed by the use of publications from the National Cancer Institute (NCI) and the PubMed online databases. In addition, we compared the output produced by the ChatGPT application using Bard, a large language model. The results demonstrated that the ChatGPT application can identify the most serious types of cancer, including pancreatic, lung, and brain malignancies.

Conclusions: This research indicates that future developments in AI technology and real-time data integration can further enhance the usefulness of ChatGPT and other similar applications in cancer management and treatment.

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Original Manuscript

ChatGPT as a Bridge between Cancer Patients and AI-based Diagnostic Tools

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Abstract

Cancer diagnosis and treatment is highly dependent on conventional pathology techniques such as histopathology, cytopathology and ancillary approaches. Artificial intelligence (AI)-powered data processing and learning has emerged as a key driver for medical progress, and pathology and laboratory medicine are no exception. This study highlights the significance of cancer diagnosis within the framework of ChatGPT, a language model driven by "artificial intelligence" (AI). Through data analysis and useful answer generation, ChatGPT offers invaluable insights and support for cancer diagnosis, treatment, and patient education. The purpose of this paper is to create 21 cancer-related questions. We used Google Bard and the most recent version of ChatGPT 4.0 to get responses. We performed an intermodal evaluation and double-checked the answers to these inquiries. As a result, we were able to identify 12 prevalent cancer types and provide information on their symptoms, recommended course of treatment, and available medications. The precision and dependability of the data provided by ChatGPT were confirmed by the use of publications from the National Cancer Institute (NCI) and the PubMed online databases. In addition, we compared the output produced by the ChatGPT application using Bard, a large language model. The results demonstrated that the ChatGPT application can identify the most serious types of cancer, including pancreatic, lung, and brain malignancies. This research indicates that future developments in AI technology and real-time data integration can further enhance the usefulness of ChatGPT and other similar applications in cancer management and treatment.

Keywords: artificial intelligence, breast cancer, ChatGPT, Bard, decision making, personalized therapy.

1. Introduction

The human body has billions of cells, and cancer may start almost everywhere in the body. Cancer is a condition where some of those cells develop uncontrolled growth and spread to other regions of the body. The second leading cause of mortality in America is still cancer, which is a serious public health problem [1]. Earlier recognition of cancer may increase the possibility of

conducting earlier treatments effectively, thus improving the survival rate of patients [2]. A critical component of personalized medical care for cancer patients is the identification of the initial response to cancer and treatment [3].

On 30 November 2022, OpenAI launched ChatGPT, an advanced generative language model that enables users to interact with a highly capable Chatbot. ChatGPT is trained on a vast corpus of more than 300 billion words and is intended to participate in discussions on a variety of topics. It was the fastest growing user application in history, drawing in 57 million users in its first month and reaching 100 million users by January 2023 [4]. It soon gained popularity. For physicians, as well as other healthcare providers and communication specialists in general, assessing the veracity of AI-generated material through ChatGPT is crucial. This is especially important in the field of cancer therapy and research, where accurate and reliable data are essential.

According to a recent news article, ChatGPT passed the medical licensure exam with flying colours. To assess ChatGPT's effectiveness, a study team supplied 376 questions from the June 2022 mock exam of the United States Medical Licensing Examination (USMLE). Crucially, prior to the exam, ChatGPT was not given any particular guidance on these questions [5]. No pertinent background information or answers to these queries were obtained from Google. Interestingly, ChatGPT scored so close to qualifying for the three USMLE tests, although they had no specific training. The potential use of ChatGPT as a teaching tool for medical students has been emphasized in a recent study [6]. In addition, ChatGPT may be able to assist medical experts in the diagnosis and treatment of cancer patients.

The ChatGPT app has demonstrated a respectable level of decision-making precision in the medical field. The importance of ChatGPT in decision-making for radiological and screening reasons in the treatment of breast cancer is highlighted by a recent study. This helped us in our evaluation of additional use cases for large language models (LLMs) to improve accuracy and their application in healthcare contexts [7]. The ChatGPT application showed better feasibility in improving clinical workflow. However, rigorous involvement of human review in the work flow process is essential [8].

This study has the following contributions:

- This paper proposes a set of 21 questions related to cancer diagnosis, treatment, and patient education specifically tailored for ChatGPT application. This contribution is vital as it

highlights the potential capabilities of ChatGPT in providing valuable insight and support for cancer-related inquiries.

- This article provides a rigorous evaluation process conducted on the responses given by the ChatGPT application. Through cross-checking and intermodal evaluation, this study identifies dominant types of cancer, their symptoms, therapeutic techniques, and recommended prescriptions.
- This article contributes by conducting a comparative analysis of ChatGPT's responses with the Bard application, demonstrating the superior performance of ChatGPT application in providing comprehensive responses to cancer related queries.
- This article presents limitations of the ChatGPT and its reliance on learned patterns and a potential lack of latest research. This study suggests avenues for future advancement from the integration of real-time data to enhance the usefulness of ChatGPT and other applications in cancer diagnosis and treatment.

The layout of the article is structured as follows.

Section 2 presents the methods used in this paper. Section 3 provides us with the results of the queries and their responses. This section also gives us some insight into specific cancer types and their characteristics in relation to ChatGPT information and the published literature. Section 4 gives us a discussion on the results of this study. The limitations and future use of ChatGPT in the context of cancer diagnosis and treatment are discussed in Section 5. Section 6 summarizes the key points of the paper.

2. Methods

This section presents an overview of the proposed methods. The methods for developing diagnostic questions, evaluating questions and results, and synthesis of data are briefly described. Moreover, this section presents ethical considerations, if any, required.

2.1 Creating diagnostic questions

The question proposed in this research is related to cancer diagnosis and treatment. The questions were proposed by consultation with all coauthors. Any disagreement on the question was resolved by mutual consensus. We corrected and refined the questions for clarity. Questions beyond the scope of research were excluded from this study. We also excluded duplicate questions. Feedback from other authors was incorporated into a set of final questions. Before asking these questions, we corrected the grammar to receive exact responses from the ChatGPT application and the Bard application. Finally, we had a set of 21 questions about cancer.

All authors of this study are experts in their respective domains. The proposed questions were thoroughly examined and corrected before being posed to both LLMs. One of the authors has a keen interest and strong knowledge in health-related topics. Before this study, the authors have published articles on topics such as ocular cancer and the COVID-19 pandemic [9-10].

ChatGPT and other LLMs operate in an environment to obtain consistent results. The temperature level is maintained at a low to receive deterministic responses from the ChatGPT application. Otherwise, we will receive various responses if the temperature is high. The term temperature is metaphorically applied to represent the level of uncertainty or randomness in the responses generated by the ChatGPT application. Although temperature has no direct link with the physical concept, it has been re-proposed in the natural language processing (NLP) field. Thus, the variability or randomness in the responses generated by LLMs is controlled without any impact on the physical temperature values. In addition, temperature, uniform hardware, and network requirements also enhance the ability of the large-language model to provide consistent and reliable results.

When posing a question, we maintain a neutral tone and choose words carefully, focusing on facts rather than expressing opinions and avoiding confrontation. This approach ensures that the responses generated LLMs remain rational and logical.

When using ChatGPT version 4.0, maintaining balance in environmental factors, we ensured uniformity in using the hardware, software and temperature while posing the question to ChatGPT applications. We consistently received reliable information by adjusting the balance between randomness and deterministic in ChatGPT responses.

2.2 Validation of questions

To validate the designed questions, a four-point criterion was used in this study. The criteria are comprehensiveness, scientific accuracy, clarity, and relevance. The criteria for evaluating the questions are adopted from a study [11].

Responses to the designed questions were evaluated and rated by two colleague authors, namely SSA and MH, both of whom have Ph.D. degrees. LLM's responses were graded on a scale 0 to 10 points adhering a rubric defined in study Appendix A. The responses of the LLMs were coded with the specific letters, and both evaluators were blind to the letters of the codes. A correct answer from LLM was given a maximum grade of 10/10.

2.3 Evaluation of the results

The evaluators were tasked with examining the responses of the LLMs for completeness, clarity, accuracy, and relevance in textual form. Therefore, they were asked to provide their feedback on the responses and grade them accordingly. Then, the evaluators could point out the significant points that were outdated, false, irrelevant, or contradictory and their practical effects if applied by the oncologists. Feedback included the positive aspects of LLM's responses, such as stating that answers were detailed, accurate, and well-articulated to address the subject. The negative aspects of the answers point to inaccuracies, lack of clarity, incompleteness, and failure to meet the four-point criteria, thus hindering the provision of scientifically sound guidance for evidence-based practices.

2.4 Evaluation between models

The process of comparing outputs and performance of ChatGPT with another Chatbot is known as inter-model evaluation. Therefore, the responses generated by the ChatGPT application were compared with the Bard application, currently known as Gemini. The evaluation of models is crucial to understand the strengths and limitations of various models. This helps to identify the areas of improvement and to select the most appropriate model for the task. In addition, we used the published literature to compare the ChatGPT model chosen in our study. This benchmarking also aims to assess the accuracy and consistency of the output of the language models.

2.5 Ethical considerations

Our study did not involve human participants and no committee approval was needed for research.

3. Results

3.1 Experimental setting

We conducted experiments using ChatGPT version 4 [12] and Bard application [13]. Both LLMs were run on Windows 10 using a Google browser. The low temperature choice was found to be convenient for achieving deterministic answers in this study.

3.2 ChatGPT for cancer diagnosis: practical considerations

Although using ChatGPT in public health, there are restrictions and difficulties to be taken into account, as in any other technology [14]. In this paper, we were interested in examining the role of ChatGPT by asking the questions given in Tables 1 and Table 2. In response to these questions, ChatGPT presented some ways to help doctors diagnose and treat cancer patients. The results received from ChatGPT were also compared with the Bard application results, as provided in Tables

3 and 4.

The results listed in Table 1 and Table 3 are largely similar, with minor variations in their responses. For example, while Open AI Chatbot serves as a support role in accessing published cancer records, Bard assumes a knowledge assistant role in aiding the medical record. However, the results given by the ChatGPT application are more comprehensive. The role of ChatGPT in helping oncologists make decisions, as inferred from the responses of two LLMs, shows some variance. ChatGPT supports physicians in decision making, Bard LLM refutes this assertion.

The data provided by two LLMs in Table 2 and Table 4 vary in interpretation. For example, while ChatGPT reveals twelve important cancer types and their symptoms, Bard LLM could not provide the important cancer types and their symptoms. ChatGPT identified five severe types of cancer compared to Bard, who outlined three types of cancer. When both LLMs were asked about the most dangerous type of cancer, both responded with three types of cancer.

Table 5 presents common screening methods for ChatGPT and their corresponding cancer types. The data in the table highlight the effectiveness of each method. Screening methods such as mammograms for breast cancer and colonoscopies for colorectal cancer are well established and significantly reduce mortality rates through early detection. However, the effectiveness of these methods varies depending on factors such as age, genetic risk, and prevalence of the types of cancer. Compared to these results from ChatGPT, only five common screening methods were presented by Bard LLM. Variations in breadth and depth of information can affect the effectiveness and usability of the respective LLMs for users seeking information on cancer screening techniques.

Fig. 1. illustrates ten various ways ChatGPT helps in cancer diagnosis and supports cancer patients. These methods include accessing the literature on cancer topics and recommending treatment options. Furthermore, they underscore the versatility of ChatGPT in supporting healthcare professionals in their decision-making processes.

3.3 Comparative analysis of cancer information accuracy: ChatGPT vs. scientific literature

To verify the accuracy of the information provided by the ChatGPT application, we conducted an inquiry asking ChatGPT to state the important types of cancer, typical symptoms, therapy approaches, and prescription drugs. In response, we received information from ChatGPT that has been cross-checked in the literature. The purpose of cross-checking was to verify the accuracy of the answers given by the AI application and the available literature on cancers.

The results, presented in Table 6, show that ChatGPT lists numerous significant types of

cancer and associated characteristics, all of which have been cross-checked with the available literature on cancer.

4. Discussion

An important development in healthcare is provided by ChatGPT's application, which provides quick access to a wide range of cancer-related medical literature, including research articles and treatment suggestions. When accessing sensitive patient data, care must be taken to ensure data security and privacy. The Bard LLM's reaction reveals this as a significant limitation. Despite ChatGPT's wealth of information, there is a risk to privacy, since it can inadvertently display private patient data without any safeguards. Healthcare professionals should evaluate ChatGPT data with attention, comparing its quality and applicability with clinical evidence. Notwithstanding these drawbacks, ChatGPT's capacity to provide current information is beneficial for cancer diagnosis and therapy; nevertheless, it should be combined with comprehensive clinical evaluation.

Table 6 lists common cancer signs, all of which are essential for early diagnosis and identification. Fatigue and prolonged weight loss are common indicators of 12 types of cancers, including breast cancer. Certain malignancies are indicated by specific symptoms, such as alterations in the skin appearance and persistent pain. Severe signs, such as irregular bleeding, frequently indicate a more advanced state. The type and location of cancer can also affect other symptoms, as indicated in Table 6, which include changes in voice, coughing, difficulty swallowing, persistent fever, intestinal changes, night sweats, and lumps. The ChatGPT program provided a wider range of information than Bard's LLM by highlighting 12 primary cancer types and their associated symptoms. On the other hand, Bard's LLM revealed fewer signs of malignancy. This difference emphasizes ChatGPT's more thorough approach than Bard's.

When responding to inquiries, ChatGPT behaves like a human and contributes significantly to decision making by making recommendations and voicing opinions. Its recommendations, meanwhile, need to be thoroughly considered, reconciled with the results of current research, and free from prejudice in complex medical situations. The absence of evidence to support Bard's LLM in supporting oncology decision making points to possible gaps in his or her expertise or body of knowledge. This calls into question the accuracy and precision of the Bard LLM answers. This shows how crucial it is to fully validate the competencies of LLMs for the specialty oncology field.

ChatGPT is a useful tool for oncologists when making decisions, but it should not take the place of expert assessments that take into account more comprehensive elements like genetic counseling and family history. Furthermore, ChatGPT's capacity to promote cooperation between medical practitioners and researchers is advantageous, potentially improving the accuracy of cancer

diagnosis and treatment outcomes. To guarantee that ChatGPT's information is applicable and trustworthy when it comes to patient treatment, we must carefully verify it. Although it has great potential in cancer, its limits must be carefully considered.

We talk about the classification and severity of different types of cancer as well as the variables that lead to the development of cancer as we review ChatGPT's reactions. The primary cancer types and associated symptoms are summarized in ChatGPT, but it is important to understand that symptoms can vary widely in appearance. According to our research, lung, brain, and pancreatic cancers are especially fatal, and the prognosis is greatly impacted by the stage of diagnosis and the accessibility of treatment.

With more than 200 distinct cancer types [20], they can be classified according to their origin in the body, including diseases such as breast cancer, brain tumors, and skin cancer. Each type exhibits specific symptoms crucial to early detection and diagnosis. Treatment options vary depending on the type and stage of cancer.

Table 6 describes standard medications for each type of cancer. ChatGPT's responses regarding popular cancer drugs align precisely with NCI and PubMed recommendations, confirming their accuracy against existing literature. However, the AI application's inability to cite correct information sources highlights a critical limitation, emphasizing the need for AI scholars to refine the literature categorization and regularly update ChatGPT versions for enhanced accuracy and reliability.

This study identifies 10 common screening methods for various types of cancer. ChatGPT is capable of presenting the specific method for each type of cancer. For example, mammograms are specifically used for the detection of breast cancer. All identified screening methods are targeted at specific types of cancer. These methods underscore their effectiveness in early detection of cancer. However, the study also highlights the need for the continuous development and improvement of screening methods that are less invasive and more accurate.

Infectious diseases such as COVID-19 have an impact on several types of cancer. Due to the COVID-19 pandemic, cancer patients have faced delays in diagnosis and treatment. Since COVID-19 infection has wide-ranging effects on different aspects of human health and cancer patients can be particularly vulnerable [28-29], AI applications could be further enhanced and developed to provide personalized care to cancer patients, especially in addressing the challenges posed by the COVID-19 pandemic.

It is crucial to emphasize that, while ChatGPT and other LLMs can provide valuable assistance,

they should only be regarded as complementary tools to support physicians in making clinical judgments. The integration of ChatGPT support, combined with the expertise of physicians, patient interaction, and the use of multiple sources of information, empowers healthcare professionals to make informed decisions about cancer diagnosis and treatments.

5. Limitations of the ChatGPT Application

ChatGPT, an artificial intelligence (AI) language model, has multiple limitations, particularly when it comes to producing cancer-related data. ChatGPT does not have real-time data access and the capacity to refresh its knowledge base are not available to ChatGPT. The data it provides are based on knowledge that already exists as of September 2021, which is the final training cut-off date of earlier versions (v. 3.0 and v. 3.5). As a result, it may not be up to date with the latest developments in cancer research, therapies, drugs, or supporting literature. The results of ChatGPT are produced using patterns and relationships discovered from the training information it receives, which includes a variety of text sources. Although it attempts to provide accurate data, it may not know some forms of cancer or the subtleties of symptoms, therapies, drugs, or alternative therapies.

The LLM response must be validated and cross-checked against current and trusted information sources. A key consideration when using ChatGPT is its lack of reliable references, which makes it unsuitable for sourcing bibliographies for specific research. Crucially, ChatGPT recommendations should never take the place of professional medical advice. While offering broad details, it is unable to take into account the patient's particular circumstances, medical background, or recommended course of action. However, Bard LLM has limitations when it comes to responding to every query. It does not provide thorough and in-depth responses to the questions posed. Consultation with medical professionals and reliable sources is essential for accurate and individualized information on the management and treatment of cancer.

6. Conclusions

In summary, cancer, a deadly disease with a challenging treatment plan, can benefit from ChatGPT as a starting point to learn about different types of cancer, their symptoms, available treatments, drugs, and related literature. Although ChatGPT's language-based responses can raise awareness and facilitate discussions about cancer, it is crucial to understand its limitations. Responses are based on learned patterns and may not incorporate the latest developments in cancer research. It is important to always seek expert medical advice and personalized suggestions from healthcare professionals rather than relying solely on ChatGPT. As AI technology advances and real-time data integration improves, the potential role of ChatGPT and similar applications in cancer therapy and management

may be extended in future work.

Authors' contribution

SA: performed conceptualization and data curation. BM Formal analysis, funding acquisition, investigation, writing – original draft. MH: Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing.

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Data availability

All data associated with this article have been given in this article. The data that disappear in this paper are available from the corresponding author.

Conflict of interest statement

The authors have no relevant financial or non-financial interests to disclose.

Declaration of Competence of Interest

None.

Statement of Ethics

No ethics statement is required for this type of study; no human or animal subjects or materials were used.

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Table 1: ChatGPT questions and replies

Question and their replies
<p>Q 1. How can ChatGPT help accessing medical records for cancer patients?</p> <p>Research articles, clinical recommendations, and case studies are just a few of the many types of medical literature on which ChatGPT has been trained. It helps medical professionals stay informed about the latest developments in the detection and therapy of cancer by quickly retrieving relevant information and presenting it to them.</p>
<p>Q2. How does ChatGPT assist oncologists in the analysis of cancer symptoms in patients?</p> <p>Doctors may enter the symptoms of a patient into ChatGPT and it will analyze the symptoms using its knowledge. ChatGPT may prescribe particular testing or imaging methods to help detect cancer, as well as probable reasons and alternative treatments.</p>
<p>Q3. How can ChatGPT help you make decisions about cancer treatment?</p> <p>ChatGPT may help with decision making by providing opinions and suggestions according to the input of doctors. In certain situations, doctors do not have clarity about the upcoming diagnostic step; this application can recommend testing procedures and help them to discuss and perform a further examination.</p>
<p>Q4. How does ChatGPT help to assess cancer risks?</p> <p>Physicians may use the ChatGPT application to determine the possibility for individuals to acquire cancer and their lifestyle parameters. This application can help them to know the background information of cancer patients. This might help individuals to benefit from regular observing and genetic analysis. As a result, they can adopt cancer preventive treatment measures.</p>
<p>Q5. What are the prospects of using ChatGPT to access cancer-related literature?</p> <p>Cancer researchers can use the ChatGPT application to obtain an overview of recent research topics in the literature. Current knowledge on cancer topics, results, viewpoints, and summaries can be easily accessed from ChatGPT application. Using the knowledge accessed by ChatGPT, medical specialists can make informed decisions based on clinical evaluations</p>

and evidence.

Q6. Does ChatGPT serve as a tool for sharing information about cancer?

The ChatGPT application can serve as a tool for information sharing. It enables users to work in a collaborative environment. ChatGPT can work as a facilitator, physicians can discuss challenging issues. They can share information with their colleagues. As a result, this can aid in accurate diagnosis and improve patient outcomes.

Table 2: Common Questions and Their Replies from ChatGPT

Q7. What are important types of cancer and their symptoms?

In response, the ChatGPT application listed 12 main types of cancer along with their symptoms (see Table 6).

Q8. What are common types of cancer symptoms?

The ChatGPT application listed some common types of symptoms as outlined in Table 6.

Q9. Which type of cancer has severe consequences on humans?

ChatGPT listed five types of cancer that have serious consequences for humans. These cancer types include pancreatic cancer, brain cancer, lung cancer, esophageal cancer, and liver cancer.

Q10. Which is the most dangerous type of cancer?

Lungs, brain, and pancreatic cancers are the most dangerous types of cancers and are often considered among the deadliest.

Q11. What are the main causes and risk factors for various types of cancer?

Genetic mutation is a primary cause of various cancers. Beyond genetic factors, lifestyle choices such as physical inactivity, poor diet, and smoking contribute significantly to cancer risk. Environmental factors, including radiation and certain chemicals, along with infections such as Hepatitis and HPV, also pose challenges. In addition, family history and age are key factors in cancer development. Often, it is a combination of these causes that leads to the onset of cancer.

Q12. How do genetic and environmental factors contribute to cancer development?

Environmental triggers and genetic predisposition interact in the development of cancers. Mutations in DNA and hereditary factors increase susceptibility, while environmental elements, such as radiation and toxins, act as catalysts, promoting cancer growth.

Q13. What are the most effective early detection and screening methods for cancer?

Table 5 below displays the screening methods for their corresponding cancer types.

Q14. What is the role of immunotherapy in cancer treatment?

The role of immunotherapy in cancer treatment is to enhance the ability of the immune system to recognize and attack cancer cells and to offer targeted, personalized treatments. Consequently, improving the survival rates and quality of life of cancer patients.

Q16. What are the psychological impacts of a cancer diagnosis on patients?

Cancer diagnosis has crucial psychological effects on patients, including depression, anxiety, stress, fear, and a sense of uncertainty about their future, and affecting their overall quality of life.

Q17. How have cancer treatment strategies evolved over the years?

Over the last many years, the evolution in cancer treatment strategies is due to surgeries and radiations that include targeted therapies, chemotherapy, and precision medicine, highlighting the molecular features of tumors and individualized cancer patient care.

Q18. How do disparities in healthcare access affect cancer outcomes?

Delay in diagnosis is mainly due to disparities in access to health care. Additionally, less effective treatment strategies and poor cancer outcomes can disproportionately affect underprivileged communities, raising questions about quality of care and survival rates.

Q19. How can palliative care improve the quality of life of cancer patients?

Through the use of palliative care, the quality of life of cancer patients improves, focusing on the management of symptoms, emotional support, pain relief and addressing social, psychological and spiritual needs, and improving overall well-being of cancer patients.

Q20. What are the latest advances in targeted therapy for cancer?

The development of new monoclonal antibodies has led to the latest development in cancer-targeted therapy. Cancer vaccine, small-molecule inhibitors, gene therapy approaches, and innovation in precision medicine for personalized treatment are other developments in targeted therapies for cancer.

Q21. Does the COVID-19 pandemic affect cancer care?

The COVID-19 pandemic significantly affected cancer care worldwide. Delay in cancer diagnosis and treatments has arisen from the pandemic. Cancer patients faced disruptions in their scheduled surgeries, therapies, and follow-up appointments. Due to the exposure to the virus, people were deterred from seeking important cancer-related healthcare.

Table 3: Responses from Bard application

<p>Q 1. How can ChatGPT help accessing medical records for cancer patients?</p> <p>The ChatGPT application may have privacy concerns and cannot directly access medical records. A chatbot serves as a role of knowledge assistant and demystifies the jargons in medical records. However, a chatbot like ChatGPT cannot be an alternative of authorized access, it only supplements to empower the patients to navigate effectively a healthcare system.</p>
<p>Q2. How does ChatGPT assist oncologists in the analysis of cancer symptoms in patients?</p> <p>ChatGPT is capable of aiding in knowledge and research access for cancer specialists and potentially informs the analysis of symptoms.</p>
<p>Q3. How can ChatGPT help you make decisions about cancer treatment?</p> <p>ChatGPT lacks medical expertise and therefore cannot make treatment decisions. It has the ability to extensively analyze medical data. It suggests potential treatment options for oncologists. However, it cannot make individual treatment decisions and replaces qualified medical professionals.</p>
<p>Q4. How does ChatGPT help to assess cancer risks?</p> <p>ChatGPT cannot assess the cancer risks of individuals. However, it can process data, but fails to show patients' specifics and expertise. It offers general risk factors and information on cancer research.</p>
<p>Q5. What are the prospects of using ChatGPT to access cancer-related literature?</p> <p>ChatGPT is capable of exploring literature on cancer, summarizing, explaining, and personalizing information. It is not perfect in performing fact-checking and understanding limitations. The cancer professional participates in the interpretation of medical advice, and hence it must be used with caution.</p>
<p>Q6. Does ChatGPT serve as a tool for sharing information about cancer?</p> <p>ChatGPT is capable of sharing information on cancer but requires caution. It only simplifies terms, offers insights and engages users. However, be wary of oversimplification, false information, and lack of medical expertise.</p>

Table 4: Responses from Bard.ai on common questions

<p>Q7. What are important types of cancer and their symptoms?</p> <p>Bard Chatbot was unable to list important cancer types along with their symptoms. It provides general information about cancer.</p>

Q8. What are common types of cancer symptoms?

Bard did not reveal the specific symptoms of cancer. However, weight loss, unusual lumps, persistent fatigue, changes in bowel, bladder habits, and bleeding, etc. were presented as common warning types.

Q9. Which type of cancer has severe consequences on humans?

The Bard-ai response is focused on pancreatic cancer, acute myeloid leukemia (AML), and glioblastoma. According to the response, these types of cancer have severe consequences on human health.

Q10. Which is the most dangerous type of cancer?

Pancreatic, AML leukemia, and glioblastoma are dangerous types of cancer and often have a poor prognosis.

Q11. What are the primary causes and risk factors for various types of cancer?

The primary causes of cancer are diverse, including genetics, lifestyle, infections, and environment. For lung cancer, smoking is considered a specific risk to humans.

Q12. How do genetic and environmental factors contribute to cancer development?

Abnormal cell growth is triggered by genetic and environmental factors. Inheritance mutations and toxin radiations are genetic and environmental factors, respectively.

Q13. What are the most effective early detection and screening methods for cancer?

The most effective methods for early detection and detection are mammography, pap smears, stool test or colonoscopy, and skin examination.

Q14. What is the role of immunotherapy in cancer treatment?

Immunotherapy harnesses the immune system of a body in fighting cancer, stimulating the defenses, and targeting cancer cells. It has revolutionized cancer treatment, but individual effectiveness shows variances.

Q16. What are the psychological impacts of a cancer diagnosis on patients?

Emotions such as fear, anxiety, depression, and isolation are triggered by cancer diagnosis. Potential life changes, uncertainty, and side effects of treatment can increase these feelings.

Q17. How have cancer treatment strategies evolved over the years?

There is massive progress in cancer treatment. For example, surgery, immunotherapy, radiation, and targeted therapies have been successfully used over many years. In addition, minimally invasive and personalized approaches have brought greater benefits in the area of cancer.

Q18. How do disparities in healthcare access affect cancer outcomes?

There are certain effects of lack of quality healthcare. For example, diagnosis in the advanced stages results in less effective treatment. Many cancer patients do not have access to advanced therapies due to the high cost and location. Inadequate care and support, also, result in poorer health outcomes.

Q19. How can palliative care improve the quality of life of cancer patients?

The role of palliative care has been recognized as easing the physical and emotional burden of cancer, and thus improving the quality of life by using pain management, communication and guidance and focusing on the well-being of individuals.

Q20. What are the latest advances in targeted therapy for cancer?

Targeted therapy is the latest advancement in cancer treatment. CAR-T cells, antibody drug conjugates, and small-molecule inhibitors are all derived approaches from targeted therapies.

Q21. Does the COVID-19 pandemic affect cancer care?

COVID-19 pandemic significantly affected the cancer care. There was delayed screening and diagnosis of cancer patients. Cancer patients faced resource limitations and as a result, their mental health changes, i.e. anxiety, and isolation, increased during pandemic days.

Table 5: Common screening methods and types of cancer

Screening Method	Cancer Type
Mammograms	Breast Cancer
Colonoscopies	Colorectal Cancer
Pap Smears	Cervical Cancer
Prostate-Specific Antigen Tests	Prostate Cancer
Skin Examinations	Skin Cancer
Low-Dose Computed Tomography	Lung Cancer (in high-risk individuals)
Human Papillomavirus Testing	Cervical Cancer
Blood Tests for Cancer Markers	Varies by Cancer Type
Endoscopy	Gastrointestinal Cancers
Ultrasound	Various Types (e.g., Ovarian Cancer)

Table 6: Important Cancer Types and Their Merits

Cancer Type	Typical Symptoms	Therapy Approaches	Prescription Drugs	Literature support for medications	Approval of medications
Breast	Breast lump or enlargement	X-rays, chemotherapy, surgery, treatment with hormones, specific treatment	Palbociclib, Tamoxifen, Anastrozole, Trastuzumab	[15]	Yes
Lung	Prolonged cough, heartburn, and breathlessness	Operation, chemotherapy, radiotherapy, particular therapy, and immunotherapy	Nivolumab, Erlotinib, Crizotinib, Pembrolizumab	[16]	Yes
Prostate	Constantly urinating, having blood in your pee or semen	Surgical active monitoring, radiation treatment, hormone replacement therapy, chemotherapy, and immunotherapy	Docetaxel, Leuprolide, Bicalutamide, Abiraterone	[17]	Yes
Colorectal	Altered bowel behavior, blood in stool	Operation, chemotherapy, radiation treatment, therapy, targeted treatment, and immunotherapy	Oxaliplatin, Bevacizumab, Cetuximab, and 5-Fluorouracil	[18]	Yes
Pancreatic	Weight loss, biliary symptoms, and stomach pain	Surgical procedures, radiation treatment, chemotherapy, targeted therapies, and immunotherapy	Erlotinib, Gemcitabine, Nab-paclitaxel, and FOLFIRINOX	[19]	Yes
Leukemia	Anxiety, recurring infections, and simple bleeding	Radiation treatment, selective therapy, immunotherapy, transplantation of stem cells transplant, and chemo	Cyclophosphamide, Rituximab, Methotrexate, and Imagined	[20]	Yes
Lymphoma	Fever, swollen lymph nodes, and nocturnal sweats	The procedure includes a stem cell transplantation, radiation treatment, personalized therapy, and chemotherapy	Prednisone, Rituximab, Cyclophosphamide, Adriamycin	[21]	Yes
Brain	Migraines,	Chemotherapy,	Bevacizumab,	[22]	Yes

Tumor	convulsions, and verbal problems	surgical or targeted treatment, radiation, immunotherapy	Carmustine, Limestone, Temozolomide		
Ovarian	Pelvic discomfort, bloating in the abdomen, and changes in appetite	Radiation therapy, targeted treatment, medication for hormones, and surgery	Olaparib, Paclitaxel, Carboplatin, and Bevacizumab	[23]	Yes
Liver	Weight loss, biliary symptoms, and stomach pain	The use of surgery, radiation treatment, chemotherapy, targeted therapy, and immunotherapy	Regorafenib, Pembrolizumab, Lenvatinib, Sorafenib	[24]	Yes
Skin Cancer	Alterations in moles and skin lesions	Treatment with chemotherapy, radiation treatment, and surgery	Imiquimod, Tretinoin, and Fluorouracil	[25]	Yes
Cervical Cancer	Pelvic discomfort and abnormal vaginal hemorrhage	Treatment with radiation, chemotherapy, and surgery	Paclitaxel, Bevacizumab, and Cisplatin	[26]	Yes

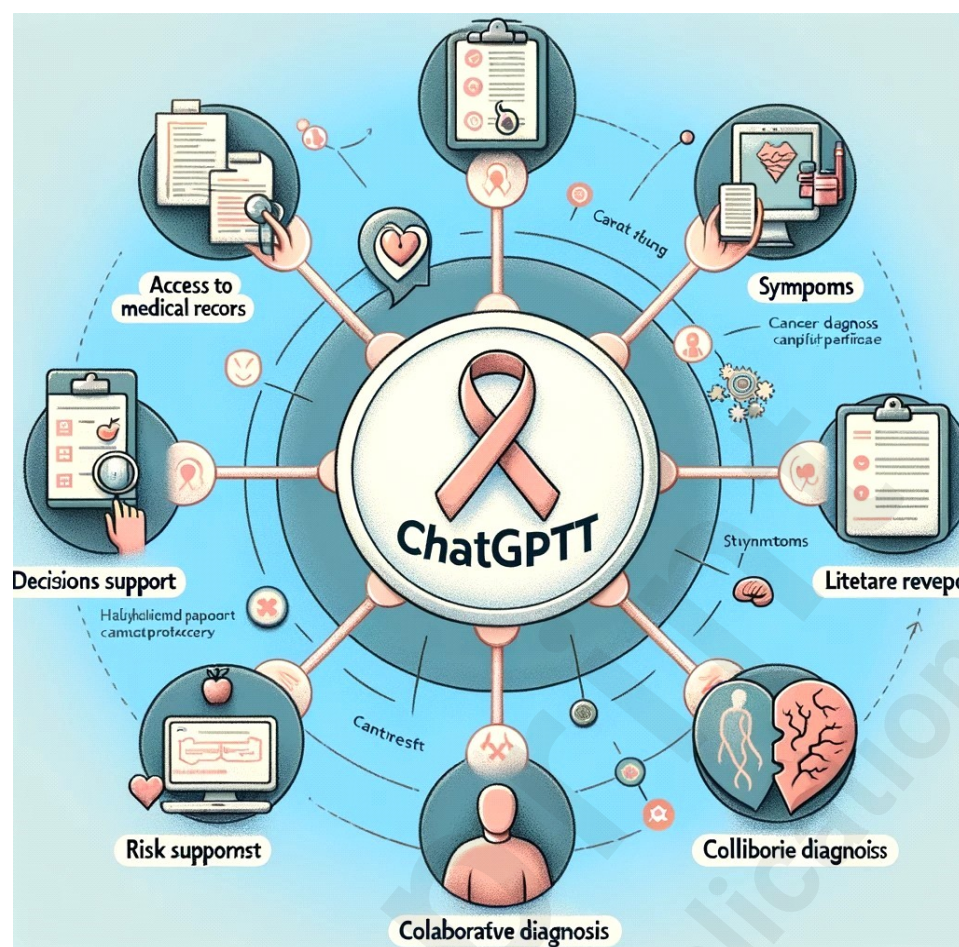


Fig. 1. Illustration of ChatGPT support to diagnose cancer patients

Appendix A

Question evaluation criteria

Criteria	0	1-2	3-4	5-7	8-9	10
Comprehensiveness [25%]	Not at all response is comprehensive	Only small number of key points are incorporated	A fundamental set of key points is included	Numerous key points are included; however, some essential information is missing	Nearly all key points are included	Every key point has been included
Scientific accuracy [25%]	The response is completely inaccurate	Most response are inaccurate	The responses show a basic level accuracy	The responses show a good level of accuracy, albeit with some inaccurate key points not accurately presented	Nearly all key points are presented accurately	Every key point has been accurately presented

Clarity [25%]	There is no clarity in response at all	Responses obfuscate majority of key points	Many key points are obscured due to responses	Most responses are clear but a few lack clarity	Nearly all key points are clearly revealed	Every key point has been clearly presented
Relevance [25%]	Response is not at all relevant	Numerous irrelevant points are included	Some irrelevant points are included	The majority of included key points are relevant	Nearly all included points are relevant	Every included point is relevant
Total score [rounded to the next integer]						