

Applications and Ethical Challenges of ChatGPT in Healthcare and Medical Practice

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Abstract

Artificial intelligence has rapidly transformed many sectors, including healthcare and medicine. Among recent developments, large language models such as ChatGPT have gained significant attention for their ability to generate human-like responses and assist in a variety of medical and healthcare tasks. ChatGPT has the potential to support healthcare professionals and patients by providing information, assisting in medical education, contributing to disease diagnosis, supporting pharmaceutical research, and improving the interpretation of medical images such as radiology and cellular imaging. In addition, the technology can assist patients by providing preoperative information, facilitating communication, and helping individuals better understand complex medical terminology. Despite these advantages, the integration of ChatGPT into healthcare systems also raises several concerns, including data privacy, ethical considerations, reliability of AI-generated information, and the need for human oversight in clinical decision-making. Issues such as bias in training data, lack of emotional understanding, and the potential misuse of AI-generated content must also be carefully addressed. This article reviews the potential applications of ChatGPT in healthcare and medicine while highlighting its benefits, limitations, and ethical challenges. The study emphasizes the importance of responsible adoption, appropriate regulatory frameworks, and collaboration between healthcare professionals and artificial intelligence experts to ensure that AI technologies are used safely and effectively in medical practice.

Keywords: Artificial Intelligence, ChatGPT, Healthcare Applications, Medical Education, Medical Imaging, Ethical Challenges.

Introduction

Artificial intelligence (AI) has emerged as a formidable instrument with revolutionary capabilities across several areas, including medicine and healthcare. A notable use of AI in this domain is the creation of huge language models, like ChatGPT, which have garnered much interest for their capacity to produce human-like prose in response to prompts. ChatGPT's multifaceted powers have the potential to transform medical practices, improve patient care, and revolutionise interactions between healthcare professionals, patients, and data.

OpenAI introduced the Chat Generative Pre-trained Transformer (ChatGPT) in November 2022, fundamentally altering the dynamics of human–model interaction in artificial intelligence. Since then, it has been used across several domains, including healthcare, management, cosmetic orthognathic surgery consultations, dentistry offices, medical research and teaching, illness

diagnostic assistance, radiology and medical imaging, pharmaceutical research, and treatment planning. This has also prompted questions about constraints and ethical implications.

Resolving outstanding challenges in AI applications, especially in the medical domain, necessitates enhancing model interpretability. Transparent AI decision-making is crucial in intricate medical situations. A significant concern is mitigating data bias to avert healthcare inequities. There is an increasing need for methods that provide continuous learning, ensuring AI systems are current with the latest medical research and clinical recommendations. Furthermore, the integration of ChatGPT with current healthcare information technology systems is essential for ensuring efficient and smooth functionality. Ethical and legal norms must be rigorously upheld, especially with patient confidentiality and informed consent.

The novel use of ChatGPT in medicine encompasses functions such as aiding in the diagnosis of uncommon illnesses and promoting men's health, illustrating the model's adaptability. Advanced approaches are used to train and assess the model particularly for healthcare applications to guarantee dependability and relevance. This endeavour is fundamentally multidisciplinary, integrating artificial intelligence technology with medical knowledge to tackle intricate healthcare concerns. This cooperation seeks to enhance patient outcomes and optimise healthcare processes, resulting in significant real-world effects in the medical domain. The applications of ChatGPT in healthcare are outlined below.

Facilitating Consultations for Cosmetic Orthognathic Surgery

In the domain of surgical interventions like cosmetic orthognathic surgery, ChatGPT may function as a virtual assistant by delivering essential preoperative information to patients. Patients contemplating these operations often enquire about the surgical methodology, recuperation duration, associated hazards, and anticipated advantages. ChatGPT can provide standardised replies that assist patients in preparing for appointments and making educated choices on their treatment alternatives.

Advancing Medical Education

Medical education may greatly benefit from AI-driven systems such as ChatGPT. Medical students and healthcare professionals may engage with ChatGPT to get rapid references, resolve uncertainties, and investigate intricate medical subjects. The system's capacity to elucidate intricate medical terminology in accessible English facilitates knowledge acquisition, ongoing education, and enhanced medical literacy.

Assistance in Disease Diagnosis

ChatGPT has promise as an auxiliary instrument in illness diagnosis. By assessing patient-reported symptoms and medical history, it might provide potential differential diagnoses that may aid healthcare professionals in refining diagnostic options. Nonetheless, vigilance is necessary since precise diagnosis requires professional medical competence and clinical acumen.

Cellular Imaging, Radiology, and Sonographic Imaging

Cellular imaging denotes the use of diverse technologies and methodologies to see and examine cells at the microscopic scale. These technologies enable researchers to analyse the structure,

function, and activity of individual cells or cellular populations. Cellular imaging methodologies include light microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, and several more sophisticated imaging methods. These instruments are extensively used in biology, medicine, and biotechnology to enhance comprehension of cellular processes, connections, and disease causes.

The analysis of medical pictures, including radiological scans and sonar imaging, need exceptional precision and accuracy. ChatGPT may aid in the analysis and generation of descriptive interpretations of medical pictures, therefore enhancing the workflow of radiologists. It may provide first insights, identify areas of interest, and aid experts in doing more comprehensive investigations.

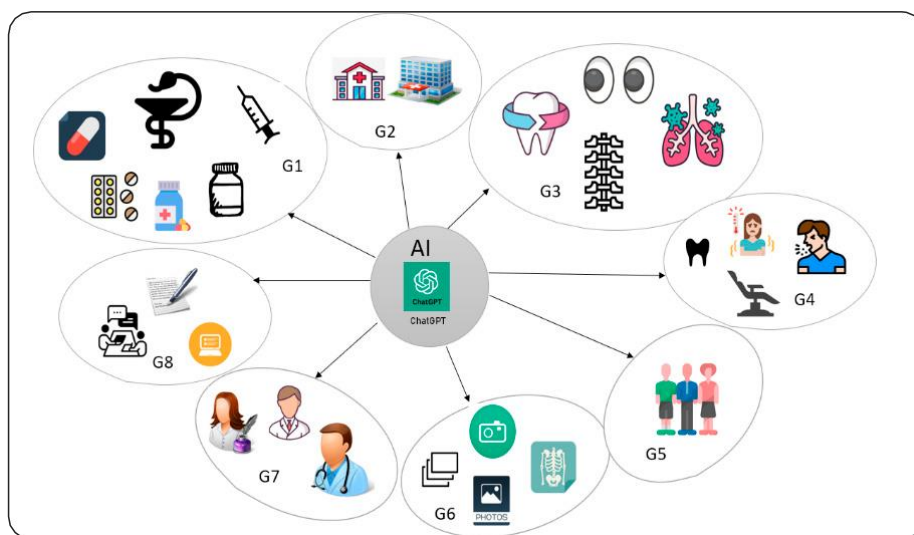
Pharmaceutical Investigation and Therapy

In pharmaceutical research, ChatGPT may aid researchers by analysing extensive scientific material, pinpointing prospective medication candidates, and proposing new research avenues. It may facilitate drug development, aid in the composition of research proposals, and condense intricate medical research data, hence expediting the research process.

Managing Constraints and Ethical Implications

Notwithstanding the many benefits presented by ChatGPT, certain restrictions need consideration. AI-generated replies are significantly influenced by the training data, potentially leading to biased or misleading information. Ethical dilemmas may emerge when AI-generated information is erroneously perceived as expert human knowledge. Consequently, it is essential to maintain an equilibrium between AI support and human expertise.

Research assessing ChatGPT's efficacy in addressing medical enquiries has mostly shown that it delivers appropriate information, although it has limits, underscoring the need for more investigation and enhancement of the model. Conversations around the incorporation of ChatGPT into healthcare, education, and research emphasise both benefits and possible hazards. Certain people exhibit significant enthusiasm for its uses, whilst others have reservations over its



implementation in academic and therapeutic environments. These viewpoints underscore the need for meticulous assessment and judicious use of AI technology.

Furthermore, while AI may facilitate learning and information acquisition, it is devoid of emotional engagement and may provoke issues pertaining to academic integrity and plagiarism.

In summary, the incorporation of ChatGPT into healthcare and medicine has substantial prospects for enhancing patient care, teaching, diagnosis, and research. As AI technologies advance, it is crucial to use them judiciously while acknowledging their limits and ethical ramifications. The examination of ChatGPT applications in many medical fields underscores its significance as a vital instrument for innovation and enhancement in contemporary healthcare.

Biomedical Investigation and Pharmaceutical Development

Artificial intelligence is optimally equipped to examine the extensive and intricate datasets used in medical research. Furthermore, it may be used to advance scientific research efforts, integrate diverse data types, and facilitate pharmaceutical innovation. Pharmaceutical organisations are increasingly focusing on artificial intelligence to optimise medication development. Researchers may use predictive analytics to identify suitable candidates for clinical trials and create precise models of biological processes. Machine learning enhances clinical trials during the pre-trial phase by selecting cohorts, organising participants, and collecting and analysing data. It may enhance the patient-centered perspective, generalisability, effectiveness, and success of clinical studies. Nonetheless, machine learning requires more attention to its functional and philosophical challenges in clinical trials. Alongside machine learning, natural language processing (NLP) has shown promise in improving participant management in clinical trials; however, the impact of these technologies on clinical trial quality and participant experience remains uncertain. Additional studies may be undertaken to compare different approaches for improving participant management.

In clinical research, generative AI may be used to generate synthetic data, thereby augmenting datasets and improving data diversity. Researchers may also conduct experiments in immersive and controlled environments using metaverse technologies. One of the advantages of the metaverse is the facilitation of research collaboration among geographically dispersed scholars. The metaverse enables collaborative studies in a virtual environment similar to that of researchers working together in a shared laboratory. ChatGPT, another AI-driven application, may be used in clinical trials to facilitate data collection and disseminate information related to clinical studies. It can assist in summarising relevant scientific papers and identifying key findings, enabling medical researchers to efficiently explore extensive online information. Furthermore, chatbots powered by ChatGPT can help interpret complex medical terminology for researchers in the field. However, additional ethical concerns may arise when using chatbots in medical research.

Artificial intelligence tools used in drug development have evolved from machine learning, bioinformatics, and cheminformatics models. These technologies may significantly reduce the high costs and long timelines associated with the development of new medications. Research has shown that an AI-driven robotic scientist was able to conduct parts of the drug discovery process rapidly and cost-effectively. In drug development, AI is primarily used to identify candidate compounds,

though its application is expected to expand further in the future. Numerous successful drug discoveries facilitated by AI demonstrate the capability of AI-integrated organisations to rapidly explore new therapeutic possibilities.

AI systems can identify hit and lead compounds, facilitate rapid validation of therapeutic targets, and support the strategic design of drug structures. The ability of AI to predict interactions between drugs and biological targets has also facilitated the repurposing of existing medications and helped address polypharmacology challenges. Repurposing existing drugs can accelerate their advancement into later stages of clinical testing. AI systems can also analyse extensive scientific literature, including patents and academic publications, to identify potential therapeutic targets and generate new research ideas. In drug development, AI models can be trained on large bodies of scientific knowledge before being used to generate hypotheses or recommendations for future research.

AI is also widely used in drug screening. Various algorithms, including extreme learning machines, deep neural networks, random forests, support vector machines, and nearest-neighbor classifiers, are applied for virtual screening based on synthesis feasibility and for predicting in vivo toxicity and biological activity. In vaccine development, AI can analyse viral proteins, such as spike proteins, to identify components most likely to trigger strong immune responses. AI technologies have also assisted researchers in analysing genomic sequences of viruses and their variants. This capability has supported the development of vaccines and pharmaceuticals, including drug repurposing strategies aimed at identifying effective treatments and preventive measures for global health challenges such as the COVID-19 pandemic.

Patient Involvement and Adherence

Patient participation and adherence represent a major challenge in healthcare and often determine whether health outcomes are favourable or poor. Non-compliance refers to a patient's failure to follow a prescribed treatment plan or take required medications. Patients who are actively engaged in their healthcare tend to achieve better outcomes, including improved healthcare utilisation, reduced costs, and enhanced patient satisfaction. Surveys of healthcare leaders have indicated that fewer than half of patients are actively engaged in treatment programmes.

Healthcare providers often develop treatment plans to improve patients' acute or chronic health conditions. However, these plans may be ineffective if patients fail to adopt necessary behavioural changes, such as maintaining a healthy weight, attending follow-up appointments, and adhering to medication schedules. These challenges have encouraged the adoption of AI technologies to improve patient engagement.

Machine learning systems and workflow engines are increasingly used to support integrated healthcare interventions and continuous patient care. Automated messaging systems and personalised content that encourage healthy behaviour at critical moments represent an important area of research. Studies suggest that mobile applications and online platforms that enable communication between patients and healthcare professionals can significantly increase patient engagement.

Healthcare applications can collect, store, and share patient data through cloud-based systems. These applications allow users to access their health information at any time and from any location, which may improve patient outcomes. Many AI-driven applications are designed to provide medical consultation for non-emergency situations. Some of these applications include monitoring features that remind patients to take medications or follow treatment plans.

ChatGPT is also integrated into several healthcare applications to automate time-consuming tasks such as summarisation, note-taking, and report generation, thereby improving efficiency and saving time. It can help patients monitor symptoms, schedule appointments, and manage medications, which supports patient adherence, health education, and the self-management of chronic diseases.

Rehabilitation

Artificial intelligence has transformative applications in the field of rehabilitation. These applications include both physical technologies, such as robotics, and virtual systems based on digital informatics. Machine learning, a subset of AI, focuses on developing algorithms that improve through experience. In rehabilitation medicine, machine learning is used in areas such as perioperative medicine, brain-computer interfaces, myoelectric control, and neuroprosthetics. Machine learning techniques have also been applied in musculoskeletal healthcare for analysing patient data, supporting clinical decision-making, and improving diagnostic imaging.

Technological advancements are transforming rehabilitation research and clinical practice through the use of AI and robotic systems. Smart home technologies can assist individuals with daily activities and alert caregivers when assistance is needed. Additionally, intelligent mobile devices and wearable technologies allow continuous data collection and provide users with information to monitor health improvements and track progress toward personalised rehabilitation goals.

Wearable devices equipped with inertial sensors can detect whether individuals are correctly performing rehabilitation exercises and adhering to prescribed training routines. Studies using wearable devices such as smartwatches have demonstrated high accuracy in detecting exercise performance through machine learning algorithms. Neural networks have achieved extremely high accuracy levels in monitoring exercise movements, highlighting the potential of wearable technologies in rehabilitation monitoring.

Supportive robots, both physical and social, can also assist individuals recovering from injury or illness. These robots help compensate for cognitive, motor, or sensory impairments and improve functional independence and quality of life. Robotic devices have been used to assist patients with musculoskeletal impairments through controlled mobilisation using robotic hands. However, the long-term effectiveness of these therapies still requires further investigation.

AI-enabled robots can also monitor the accuracy of patient movements and assist individuals in performing exercises more effectively. Integrating AI-based applications such as ChatGPT into rehabilitation programmes may help address the shortage of trained rehabilitation therapists. ChatGPT can support patients by providing personalised guidance, suggesting exercises, monitoring progress, and offering feedback during recovery.

In addition, AI-driven conversational systems may assist stroke or brain injury patients in practising speech and language skills through interactive communication. These digital tools are accessible

through smartphones and other devices, allowing patients to continue therapy at home. AI-based language models have also demonstrated the ability to provide empathetic communication in mental health support systems, highlighting the potential of human–AI collaboration in community-based health interventions such as cognitive behavioural therapy.

Metaverse-based neurorehabilitation systems combine AI technologies with virtual reality environments to enhance patient engagement during therapy. These systems may include AI-driven movement evaluation, virtual character interactions, and reward-based therapy activities. Such approaches aim to improve patient motivation while enabling remote rehabilitation programmes.

AI technologies have also been used in gait analysis through machine learning-based video analysis systems capable of detecting abnormal walking patterns associated with conditions such as osteoarthritis and Parkinson’s disease. Digital therapists can also deliver home-based physiotherapy programmes through remote monitoring, real-time observation, and patient counselling.

AI-integrated remote rehabilitation systems must meet strict technical requirements, including safety, reliability, and usability, because patients use these systems independently in home environments. These systems must also be scalable and designed with a patient-centred approach to ensure transparency and build trust among patients, caregivers, and healthcare professionals. Technology-assisted home rehabilitation has expanded significantly, particularly during and after the COVID-19 pandemic, enabling continuous therapy and improving long-term recovery outcomes for patients.

Administrative Software

Artificial intelligence can significantly reduce administrative burdens in healthcare by automatically extracting structured information from clinical notes, medical records, and recorded patient interactions. Healthcare professionals often spend a large proportion of their working time on administrative tasks. Voice-to-text transcription and automated data extraction technologies can help reduce this workload for physicians and nurses.

Although rule-based systems connected with electronic health records are widely used, they often lack the predictive accuracy provided by machine learning-based algorithms. Advanced machine learning systems can analyse unstructured electronic health record data and scientific annotations to identify meaningful patterns.

Deep learning models such as transformer-based architectures can analyse patient clinical histories using multiple data embeddings, including patient age, medical events, and clinical visits. These systems can predict the likelihood of numerous medical conditions during future patient visits, thereby supporting clinical decision-making. New hierarchical AI models have also demonstrated improved performance in predicting health risks for patients with complex medical histories, including diabetes, heart failure, stroke, and chronic kidney disease.

Robotic Process Automation (RPA) is another AI technology used in healthcare administration. It can automate tasks such as clinical documentation, revenue cycle management, claims processing,

and medical record management. Healthcare organisations also use chatbots to support telemedicine services, mental health assistance, and patient communication.

Natural language processing systems can perform routine tasks such as appointment scheduling and prescription refills. In financial management, machine learning systems can reconcile data across different platforms and help identify inaccurate or fraudulent insurance claims. Decision-support systems combining machine learning and rule-based approaches have also demonstrated improved accuracy in detecting prescribing errors in clinical environments.

Although AI-driven solutions for clinical pharmaceutical services are still in their early stages of development, their potential is significant. Continued collaboration between healthcare professionals and data scientists is necessary to evaluate the effectiveness of these technologies in real-world clinical environments. Pharmacists and other healthcare professionals must recognise these technological advancements and learn to integrate them into clinical practice while maintaining strong interpersonal relationships with patients and healthcare teams.

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