

CHALLENGES WITH THE USE OF CHATGPT

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Master of Pharmacy*

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DEDICATION

I dedicate this thesis to God Almighty for good health and sustenance all through my academic pursuits, and to my family, friends, and mentors who have supported me throughout my academic journey. Your encouragement, guidance, and unwavering belief in me have been my greatest source of motivation.

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ABSTRACT

The research explores awareness on the use of ChatGPT, and challenges of ChatGPT in healthcare and pharmacy education. With the increasing integration of artificial intelligence (AI) in academic and clinical settings, ChatGPT has gained attention as a potential tool for improving learning experiences, patient care, and research efficiency. Systematic literature review was conducted following PRISMA 2020 guidelines (Page et al, 2021) to understand the awareness of healthcare professionals on the use of ChatGPT in healthcare practice, and pharmacy education. Review made use of Pubmed, Google Scholar, Scopus, Proquest and ResearchGate. A total of 107 studies were reviewed and while 40% of the reviewed articles focused on the applications of ChatGPT in healthcare, 22% were about the limitations and ethical concerns associated with the use of ChatGPT in healthcare. The findings highlight the benefits of ChatGPT in enhancing personalized learning (n=11), facilitating research and supporting healthcare professionals in decision-making (n=43). Limitations and challenges such as ethical concerns, accuracy limitations, AI hallucinations and data privacy issues were also identified (n=23). The study presents evidence that while use of ChatGPT presents advantages, its integration into healthcare and pharmacy education requires caution, regulatory oversight, and continuous evaluation. Recommendations for future research, policy development, and educational frameworks are suggested to optimize the safe and effective use of AI-driven tools in healthcare.

TABLE OF CONTENTS

Title Page.....	i
Dedication.....	ii
Acknowledgments	iii
Abstract	iv
Table of Contents.....	v
List of Figures.....	ix
List of Tables	x
List of Appendices	xi
List of Abbreviations.....	xii
 CHAPTER ONE:	
INTRODUCTION.....	1
1.1 Background of the Study.....	2
1.2 ChatGPT’s Refinement Process.....	4
1.3 Key capabilities of ChatGPT.....	5
1.3.1 Fluency in Language Generation.....	5
1.3.2 Extensive Coverage of Multi-Domain Knowledge.....	8

1.3.3	Multilingual support of ChatGPT.....	9
1.3.4	The Power and Versatility of ChatGPT	11
1.4	Leveraging ChatGPT for Documentation Review	12
1.5	Applications of ChatGPT in Healthcare.....	13
1.5.1	Enhancing Patient Communication.....	14
1.5.2	Supporting Disease Diagnosis.....	15
1.5.3	Awareness and use in Pharmacy and Health Education.....	15
1.5.4	ChatGPT in Pharmacy Management.....	16
1.6	Challenges with ChatGPT in healthcare.....	17
1.6.1	Accuracy and reliability issues.....	18
1.6.2	Ethical Concerns and limitations with the use of ChatGPT in Healthcare...	18
1.7	Hallucination effect in ChatGPT.....	19
1.8	Rationale for the study.....	21
1.9	Aim and objectives	22

CHAPTER TWO:

METHODOLOGY.....23

2.1	Ethics Approval.....	24
2.2	Scope of the study.....	24
2.3	Study Design.....	24
2.4	Data Collection.....	25
2.5	Search Keywords.....	25
2.6	Inclusion and exclusion Criteria.....	25
2.7	Screening and Selection Process.....	26
2.8	Data Categorization.....	26
2.9	Limitations of Methodology.....	27

CHAPTER THREE: RESULTS.....28

3.1	Identified Literature	29
3.2	Summary	34

CHAPTER FOUR: DISCUSSION.....50

4.1	Overview of research findings.....	51
4.2	Mitigating the Occurrences of ChatGPT Hallucinations.....	60

4.3	Recommendation for Future Research	61
4.4	Limitations of this study.....	62
4.5	Conclusion.....	63
	References.....	64

LIST OF FIGURES

Figure 3.1: Prisma 2020 Flow Diagram for Article screening.....	30
Figure 3.2: Reported Areas of ChatGPT Applications	33
Figure 3.3: Medical specialties that reported application of ChatGPT	35
Figure 3.4: Reported Limitations with ChatGPT in Healthcare	45

LIST OF TABLES

Table 1: Applications of ChatGPT in various healthcare domains.....	32
Table 2: Summary of reports on ChatGPT Application in Cardiology.....	36
Table 3: Summary of reports on ChatGPT Application in Radiology.....	39
Table 4: Summary of reports on ChatGPT Application in Ophthalmology	42
Table 5: Summary of reports on ChatGPT Bias.....	46
Table 6: Summary of reports on ChatGPT generated False References.....	48

LIST OF APPENDICES

Appendix 1: Ethics Approval.....	82
Appendix 2: Summary of articles.....	84

LIST OF ABBREVIATIONS

- **AI** – Artificial Intelligence
- **EHR**- Electronic Health Record
- **GPT**- Generative Pre-Trained Transformer
- **HCPs** – Healthcare Professionals
- **LLM**- Large Language Model
- **NLP** – Natural Language Processing
- **PRISMA** – Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- **RLHF** – Reinforcement Learning from Human Feedback

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Artificial Intelligence (AI) has some extremely powerful tools that potentially transform a wide range of industries, including healthcare, education, finance, and many more, in a rapidly evolving environment. Large language models, like Open AI's ChatGPT, are undoubtedly at the forefront (Mu and He, 2024). Large language models have gained considerable attention for the capability to produce coherent, contextually relevant, and even human-like text, while also being able to engage in dynamic and conversational-style interactions. Since its release in November 2022, ChatGPT has proved to be useful in a wide range of contexts and has been critically acclaimed as an easy means of automating simple administrative tasks, offering customized support to users, enhancing learning activities, and supporting complex decisions (Camilleri, 2024;Younis et al, 2024).

An important turning point in the development of conversational artificial intelligence (AI) systems has been reached with the development of ChatGPT, representing a leap forward in both functionality and applicability. Developed on the GPT (Generative Pre-trained Transformer) architecture, ChatGPT exhibits exceptional capabilities in natural language understanding and generation. These advancements distinguish it from earlier AI models and have positioned it as a pivotal tool in numerous professional and academic contexts (Yiheng et al, 2023). By utilizing cutting-edge natural language processing (NLP) methods, ChatGPT is able to harness, interpret, and respond to queries from users, with a level of contextual awareness and precision that was previously unattainable (Haleem et al. 2024). The distinguishing feature of ChatGPT lies in its ability to maintain consistent relevance throughout extended conversations, which is highly valuable in professional settings where precise and clear communication is crucial (Partha Ray,

2023). Equipped with the prowess of powerful language generation, it is able to draft documents professionally, facilitate decision-making processes in real time, and reinforce workflows in different spheres such as healthcare, education, customer service and even technical support. This versatility underlines a transformative potential, especially in undertakings which require high-order linguistic competence and adaptability (Partha Ray, 2023).

The foundation of ChatGPT's design is the transformer model, a groundbreaking neural network architecture that has transformed the field of natural language processing (NLP). In addition to its foundational transformer architecture, recent iterations of ChatGPT incorporate reinforcement learning from human feedback (RLHF), a methodology designed to improve the alignment of the model's outputs with human values, preferences, and expectations. RLHF enables the model to refine its responses based on iterative feedback from human reviewers, ensuring that it delivers more accurate, relevant, and user-aligned outputs over time (Ouyang et al., 2022). This approach not only enhances ChatGPT's ability to handle diverse inquiries but also contributes to its overall reliability in high-stakes scenarios.

Further, the pre-training on wide datasets that ChatGPT has undergone provides it with a large knowledge base, underlining its ability to adapt to diverse domains and contexts. Coupled with fine-tuning mechanisms, this allows the model to be specialized in various applications: delivering medical information, analyzing legal cases, or facilitating creative brainstorming. Such features highlight the potential of the model for being a general-purpose AI assistant while also acting as an expert in a domain (Partha Ray, 2023; Zheyi et al, 2024). While the progress facilitated by ChatGPT is indeed impressive, it brings its toll of challenges that need to be taken

seriously and addressed with due care. Ethical issues regarding biased or misleading content, along with data privacy and security, remain significant concerns. It is only through further research and the instigation of robust regulatory frameworks that we can ensure such technologies will be deployed responsibly (Wang et al, 2023; Zhou et al, 2024).

1.2 ChatGPT's Refinement Process

The development of ChatGPT is carried out in a structured three-step process: supervised fine-tuning, reward modeling, and reinforcement learning. These all come together to develop the model's capability for performing complicated NLP tasks while minimizing unwanted output (Alawida et al, 2023).

The first stage involves a fine-tuning that is supervised, whereby it is exposed to high-quality and human-curated datasets so that a very strong foundational understanding of the pattern, context, and structure of the language can be established. During this phase, the AI trainers expose the model to well-structured responses for several prompts so that the model may learn how not to go off on a tangent when producing coherent and contextually relevant answers. This supervised learning process helps establish a baseline performance across a variety of tasks (Alawida et al, 2023).

With reward modeling, response quality would be enhanced through the evaluation of various outputs based on scores of preferences. Human reviewers would rank the responses of the model based on their accuracy, coherence, and relevance. From this ranking, the system develops a reward model to ensure that high-quality responses come first in ChatGPT to make the responses reliable and informative.

The last stage, reinforcement learning, refines the model's performance through continuous feedback loops. ChatGPT refines its decision-making with reinforcement learning techniques like Proximal Policy Optimization and reduces biases in order not to generate inappropriate or misleading content. Such iterative training enhances the adaptability of ChatGPT and enables it to work more effectively on a wide range of applications.

Due to this three-step refinement approach, ChatGPT is good at text generation, summarization, translation, code generation, and many other NLP tasks (Baido-anu and Owusu, 2023). This will keep the model robust, contextually aware, and aligned with human expectations; therefore, it will be very useful for users in different industries, such as research, education, healthcare, and business communication (Alawida et al, 2023; Ngoc Hai, 2023)

1.3 Key capabilities of ChatGPT

ChatGPT harnesses its vast training data, resources, aptitude, and creativity to demonstrate its ability to generate realistic and diverse text (Hamad et al, 2024). By leveraging deep analysis and understanding, it constructs semantically coherent responses that are both academically rigorous and methodologically sound. This efficiency has positioned ChatGPT as a leading AI paradigm in education, while it also plays a crucial role in healthcare, contributing to research, diagnostics, and patient support (Chow et al, 2023).

1.3.1 Fluency in Language Generation

ChatGPT can be considered a very highly improved model of artificial intelligence, wherein the capability of producing responses coherent and similar to human conversation is attained. It

employs state-of-the-art NLP techniques to understand user queries and produce long answers contextually relevant to the question asked. ChatGPT looks for patterns of language, sentence structure, and contextual signals to provide responses that meet the intent and expectations of the user and foster a smooth interaction (Barrot, 2023).

The key differentiator of ChatGPT is the continuity of the thread in conversations, hence creating natural-sounding and fluid dialogues. Quite often, users get conversations very similar to human ones where the model remembers the context, catches the right tone, and produces reflective responses on a wide array of topics. This increases user interaction manifold and makes ChatGPT very useful for personal assistants, customer support, content creation, and other professional needs (Bansal et al, 2024).

Algorithms allow ChatGPT to process complex questions and come up with well-structured and logical responses. While traditional search engines return a list of sources that the user has to sift through, ChatGPT synthesizes information into one coherent answer, streamlining the process of information retrieval (Devadas and Shilpa, 2023). Its ability to deliver human-like responses with high linguistic accuracy makes it a powerful asset in modern communication and AI-driven interactions (Lund and Wang, 2023).

Knowledge about science, history, cutting-edge technology, and even tailored counsel may be found on OpenAI's ChatGPT. This AI-powered tool interprets user queries with a high degree of accuracy and then processes them into insightful and well-structured responses on diverse subjects (Amos et al, 2024)

ChatGPT uses state-of-the-art NLP analysis and synthesis techniques upon reception of user queries. It facilitates the processing of large datasets to draw logical inferences that go a long way in enhancing overall user experience. It structures the responses in a coherent and contextually appropriate way, therefore providing users with precise information that precisely meets their requirements (Barrot, 2023).

The ability to adapt to genres and complexities enables this technology to be of importance to researchers, students, professionals, and general users in need of reliable information. ChatGPT gives well-reasoned explanations that contribute to informed decision-making and intellectual engagement regarding scientific principles, historical events or state-of-the-art technological advances (Fui-Hoon et al, 2023). The ease with which it lends smooth information retrieval, yet keeps the language conversational, further cements its status as a trusted AI assistant for the digital age (Karunaratne and Adesina, 2023).

Unlike the other search engines, which are classical and their responses are mostly inclusive of multiple links and summaries, ChatGPT synthesizes information into very comprehensive and correct answers, hence shortening the struggle of users across multiple sources of information (Barrot, 2023).

ChatGPT retains the special function of retaining and recalling memory of contexts within a single conversation and by this process, it may give follow-up responses relevant to that topic of conversation; thus, enabling one to have discussions that will be much more vibrant and much more personal. Whether casual or professional queries, assistance in academic ways, or whatever

the requirement tends to be, the continuity of responses of Chat GPT remains coherent, relevant, and consistent. (Barrot, 2023)

1.3.2 Extensive Coverage of Multi-Domain Knowledge

ChatGPT is able to answer questions on many aspects with great efficiency because of the vast data on which its algorithm is trained. Such a knowledge base allows the chatbot to process and understand even complex queries with high accuracy, hence becoming one of the most versatile tools for users in various domains (Haleem et al, 2023).

With its enhanced functions in NLP, ChatGPT can facilitate informed answers, ranging from state-of-the-art academic pursuits to the leading edge of present scientific and technological achievements, profound and complex analytic insights into key historical and even artistic areas. The application ChatGPT is prepared to provide significant arguments, contextual, and logically interim answers, whether these are explanations of rational scientific theory, an intuition of the inspiration behind recent engineering accomplishments, or consideration of the results of historic actions and visually pleasing movements (Dave et al, 2023).

The ability to synthesize information and present it in clear, understandable terms adds to its usability by researchers, educators, students and professionals. The AI chatbot not only helps in finding the information but also aids in intellectual exploration and critical thinking due to the well-rounded view it can provide on a number of complicated subjects. It transforms ChatGPT into a mighty tool for knowledge acquisition, academic inquiry, and interdisciplinary learning (Dave et al, 2023).

1.3.3 Multilingual support of ChatGPT

With the multilingual capability, ChatGPT has become more reachable to people from different linguistic backgrounds. This AI-powered advanced technology enables people to communicate in different languages, hence bridging the gap in communication and helping people overcome their language barriers (Li et al, 2023)

With support for multiple languages, ChatGPT gives users the ability to ask questions, find information, and converse in their own language. This makes interactions with the chatbot natural and intuitive for non-native speakers, which improves comprehension and ease of use. Besides enabling accessibility, this facility in many languages helps facilitate the process of knowledge sharing, and ChatGPT was found to perform well in detecting semantic ambiguity which becomes even more inclusive in nature (Ortega-Martin et al, 2023).

ChatGPT currently supports over 80 different languages,¹ and users can have access to educational resources, professional insight, and general information, unhindered by language constraints. In this respect, it makes ChatGPT an indispensable assistant for transnational business activities, international cooperation, or even inter-cultural communication, because all of these spheres of communication benefit greatly from effective multilingualism. The end result is that the multitask, multilingually trained capacity for response generation makes ChatGPT represent a leap toward a future where AI-based communications let people around the world communicate with technology in their own language which better conveys their thoughts in sync with their cultural contexts.

This language support feature has improved the users' sense of use as well as facilitated cultural communication thereby helping to create a more diverse and inclusive global information

¹. <https://botpress.com/blog/list-of-languages-supported-by-chatgpt#how-many-languages-does-chatgpt-support>

ecology. Based on this, ChatGPT has the prospect to play a greater role in coordinating intelligent sessions and bring a new way of communication to users. By expanding its support to more languages, ChatGPT has increased its availability to more races and people with diverse languages, thereby eliminating language barriers. Users of ChatGPT can ask questions in different languages. This cross-language interaction can give users a richer and more personalized experience globally (Gill et al, 2023).

While ChatGPT was exposed to linguistic data, it has not been explicitly instructed on the respective linguistic structures, semantic content, or contextual variation, hence there is still a certain propensity for mistake or deviation from correct use (Basmov, 2023).

1.3.4 The Power and Versatility of ChatGPT

ChatGPT is enabled with a complex training called large-scale pre-training, which lets it gain knowledge from diverse sources. This involves exposing the model to extensive amounts of text-based data for training including books, academic papers, websites, and other reliable information repositories. Analysis and learning from this huge dataset enable ChatGPT to have strong foundational understanding of language, concepts, and context. (Walid Hariri, 2024).

Large-scale pre-training is one of the major benefits of such training, which works as the very reason for ChatGPT in performing a wide range of tasks. The model has been trained on such a wide variety of topics and styles that its responses are not only factually correct but also contextually appropriate. ChatGPT is quick to provide relevant and well structured information (Halaweh Mohanad, 2023). This wide training further makes ChatGPT robust and adaptable. This AI model can give logical reasoning and coherence for a variety of questions, hence

becoming an extremely versatile tool for casual users and professionals alike. Though still improving with each refinement, its core knowledge from large-scale pre-training makes it reliably consistent in managing complex queries (Shamus Sim, 2024)

The knowledge transferred by this model facilitates performance on other tasks beyond its original scope during the training stage, which proves how capable and adaptable it can be in several respects. The strengths of ChatGPT are, in summary: the generation of languages, coverage of multi-domain knowledge, versatility, multilingualism, context, and benefits brought about by large-scale pre-training. Features put together that make ChatGPT one of the most powerful and popular NLP models out there. (Gao Yixin, 2024).

1.4 Leveraging ChatGPT for Documentation Review

ChatGPT can be used for reviewing documentation, as this tool shows its effectiveness of gathering, processing, and summing up all types of information in the best way. Having specified a particular subject, it could text, pick up key ideas, and squeeze most of the vital details into one clear, simple summary. That is more helpful for those who have to analyze big reports, research papers, and other written works that they have no time to study thoroughly, as well as in analysing systematic reviews. (Sciurtti et al, 2024).

Equipped with the newest in NLP, ChatGPT is able to identify necessary insights, highlight important points, and then present that information in structured format. This feature shall be useful for researchers, students, and professionals intent on getting summarized content without losing critical information in the shortest time possible Sciurtti et al, 2024).

ChatGPT has the capability to find patterns, trends, and gaps in a document, which allows users to understand better the overall context of the material they are reviewing. While it does not replace human expertise, it serves as a powerful assistant that enhances efficiency and productivity by simplifying complex texts and making information more accessible (Harleem et al, 2023). ChatGPT has the ability to scan bulky volumes of written material with efficiency, extracting major ideas, opinions, and trends. This AI system will summarize long texts and help the researcher identify, with little effort, the relevant topics, emerging themes, and gaps in prior research. This capability can significantly streamline the literature review process, saving time and effort while improving the accessibility of critical information (Memarian and Doleck, 2023).

ChatGPT is able to assist researchers in highlighting the deficits in the research frameworks and indicating where more is needed. It gives short summaries of extensive studies and frees the scholar to develop the question and methodology of the research. While ChatGPT is able to create synthesized academic content, it does not guarantee that the citations will be comprehensive or entirely accurate. The model is based on responses already available but at times without checking if the sources are credible or not. It is very important for researchers to be cautious while using ChatGPT for academic purposes. References need to be cross-checked and data validated from established and reputable sources. Even with its powerful analytics, ChatGPT should be a support tool but not a source for academic research and literature reviews (Yan et al, 2023).

1.5 Applications of ChatGPT in Healthcare

A revolutionary age for the healthcare industry is being ushered in by the incorporation of AI, as demonstrated by ChatGPT and other similar technologies (Anas Alhur, 2024).

ChatGPT, a tool that lets health professionals perform clinical and investigative examinations more quickly and effectively, is an intriguing technology and the focus of the majority of research attention. Under the presumed scenario of ensuring medical quality, ChatGPT or other artificial intelligence technologies can be applied to medical systems. At the same time, it can help to carry out certain basic scientific research and clinical studies, or it can make insightful recommendations for researchers and practitioners. In the long run, the benefits of artificial intelligence in healthcare settings will improve the efficiency and accuracy required (Carrucio et al, 2024).

In healthcare, ChatGPT's applications have expanded rapidly, encompassing areas such as patient communication, clinical decision support, and research. It has been used to aid in consultations for cosmetic orthognathic surgery, support disease diagnosis, and assist in the preparation of medical and scientific articles (Huh, 2023).

Most recently, ChatGPT has drawn attention among physicians, mainly in emergency and critical care medicine where the possible uses include suggestions regarding medical decisions, analysis of clinical vignettes, differential diagnoses, optimization of documentation within an EHR system, and optimizing doctor-patient communication (Hwai et al, 2024).

ChatGPT-4 achieved an 80% accuracy rate on questions from the American College of Emergency Physicians' PEER prep In-Training Self-Test, excluding image analysis. Such accuracy is almost at human performance (Jarou et al, 2024).

ChatGPT has proven valuable in health education, providing students and professionals with an accessible tool for learning and skill enhancement (Sallam, 2023). These developments underscore ChatGPT's potential to reshape healthcare practices, improve patient outcomes, and redefine professional roles (Li and Guenier, 2024).

ChatGPT presents challenges that merit critical examination. Concerns about the model's accuracy, potential biases, data privacy, and ethical implications have emerged as significant barriers to its widespread adoption (Younis et al, 2024).

These issues highlight the need for a thorough exploration of ChatGPT's benefits and limitations to guide its safe and effective integration into professional settings.

1.5.1 Enhancing Patient Communication

ChatGPT has emerged as a powerful tool for bridging communication gaps between healthcare providers and patients. By simulating empathetic interactions, it has helped explain medical conditions, treatments, and follow-up procedures (Li and Guernier, 2024). The model's ability to generate clear, patient-friendly explanations has particularly proven valuable. Ensuring the accuracy of medical advice remains a concern, as incorrect information could jeopardize patient safety (Page et al, 2021).

1.5.2 Supporting Disease Diagnosis

AI-driven tools like ChatGPT are increasingly used to assist in diagnostic processes, offering preliminary assessments based on symptom descriptions (Singh et al, 2023). In radiology, for example, ChatGPT can aid in the interpretation of imaging results. Advanced AI systems have demonstrated impressive capabilities in identifying initial stages of various cancers - including those affecting the lungs, brain, and breast - through analysis of medical imaging data (Azizi et al, 2023).

1.5.3 Awareness and use in Pharmacy and Health Education

ChatGPT has emerged as an educational resource for healthcare students and professionals. Its ability to provide summaries, answer complex questions, and generate scenarios for problem-based learning has made it a valuable tool (Camilleri, 2023).

AI is revolutionizing pharmacy practice by assisting in the design of treatment plans, facilitating drug development, analyzing large volumes of healthcare data, and streamlining inventory management (Raza et al, 2022). Because of this popularity and wide adoption, there is interest in determining the role of ChatGPT in pharmacy practice and higher education (Gilson et al, 2023).

A study involving four hundred and forty-three undergraduate students in a Malaysian tertiary healthcare institute, investigated the knowledge, attitude and practice related to ChatGPT for academic purposes among university healthcare students, focusing on the frequency and purposes of use, satisfaction about its use revealed different levels of awareness about ChatGPT's

academic usefulness. Generally, the participants showed positive attitudes toward ChatGPT in academics despite concerns about accuracy, ethics, and dependency (Pallivathukal et al, 2024). There are varying levels of awareness among the health professionals, with some having satisfactory knowledge about the role of AI in health and others with limited knowledge. A study conducted in Pakistan established that the knowledge of physicians and pharmacists was found to be satisfactory, while nurses lacked even basic knowledge (Yousif et al, 2024).

A recent study investigated the perception of healthcare professionals in using ChatGPT in their practice and concluded that most healthcare workers (75.1%) were comfortable incorporating ChatGPT into their healthcare practice (Temsah et al, 2023).

Despite its potential, there has been limited research evaluating the use and impact of ChatGPT on pharmacy students and their education. A scoping review conducted in 2023 identified only seven studies focused on the integration of ChatGPT in pharmacy and health education, thereby highlighting the scarcity of publications on this topic (Jackson, 2023).

1.5.4 ChatGPT in Pharmacy Management.

ChatGPT has many applications in pharmacy, including but not limited to customer support, drug interaction checks, prescription verification, drug discovery, and others. It will improve the efficiency and precision of works in a pharmacy as well as enhancing patient counselling, reducing medication errors, optimizing inventory, and personalizing notifications. (Noman et al, 2024).

These will always have associated risks and concerns related to security, reliability, privacy, becoming too dependent on the AI, and not having the "human element of judgment".

Implementation of the GPT models, such as ChatGPT, responsibly-with human override-should continue into the near future. Its possible use in refining the accuracy, teaching practices of pharmacy students, improving patients' outcomes through patient care, increasing patient interaction, and enhancing the generativity that furthers the research into more complex analyses for scientific advancement is foreseen for the future (Noman et al, 2024).

1.6 Challenges with ChatGPT In healthcare

From a legal viewpoint, AI lacks any legal status as a human, and this consequently leaves the burden of responsibility and legal liability to a human being (Zhang and Zhang, 2023).

In most instances, the legal liability at the instance of harm to a patient can get complicated, and this leaves the questions to whether responsibility should fall upon the patient himself or herself, on the treating hospital, or the platform of OpenAI which oversees ChatGPT.

The lack of clarity in many respects is the reason for the heightened recommendation from researchers and policymakers for comprehensive legislation and legal guidelines that will explicitly spell out the attribution of responsibility about the use of artificial intelligence in health care (Changyu Wang, 2023).

1.6.1 Accuracy and reliability issues

Despite its potential, major obstacles were found to be doubts regarding the reliability and sources of the data that AI chatbots offered. While physicians and other professionals view ChatGPT as a promising tool in digital health's early adoption phase, it is essential to address issues related to accuracy, reliability, and medicolegal risks. Consequently, the current versions of ChatGPT and other chatbots should not be used for diagnostic or even treatment purposes without oversight from human experts because they are largely unreliable (Temsah et al, 2023).

1.6.2 Ethical Concerns and limitations with the use of ChatGPT in Healthcare

The growing adoption of AI in medicine brings several ethical challenges. Key concerns include a lack of transparency, limited understanding of the AI applications in use, and the risk of false or misleading outcomes (Rigby, 2019). Inaccurate diagnoses and irrational or unfair conclusions might result from AI systems, particularly older versions trained on biased data (Chen et al, 2019).

Howard et al. 2023 assessed the appropriateness, consistency, safety, and antimicrobial stewardship implications of the advice from ChatGPT against eight simulated infection scenarios. In the findings, ChatGPT proved a capable tool at natural language processing, providing responses which were clear, grammatically correct, and well-structured, often including a summary of the scenario, management options, and disclaimers, as might be found on patient information websites. However, where complex cases were involved, ChatGPT, though excellent at summarizing scenarios, seemed to struggle to differentiate between important

versus unimportant details in distinguishing key clinical factors and more subtle important insights were often lost.

Safety concerns arose when ChatGPT identified inconsistent antimicrobial contraindications, missed critical patient safety red flags, and entered into failure modes whereby dangerous advice was provided despite prompts and at times even in disregard for its own recommendations. Although most responses included disclaimers advising specialist consultation, patient safety was at danger due to ChatGPT's significant shortcomings in situational awareness, inference, and consistency (Antoine et al, 2025).

Without access to specific medical databases or specialized training in clinical advice, ChatGPT showed intriguing responses that seemed to indicate sufficient training data but emphasized limitations to its implementation in clinical practice (Howard et al, 2023).

1.7 Hallucination effect in ChatGPT

It would be expected that Large Language Models generate content that is accurate and verifiable, with no form of fabrication and false content included. The foundation and mechanism with which these language models work breed hallucinations that are inevitable and intrinsic in this model output (Banergee et al, 2024). The token generation for LLM is intrinsically prone to proposing believable but incorrect information simply because the pattern learned from its training data tends to predict what the next token can be. GPT-4's parent organization, OpenAI, on their website itself lists hallucinations as one of the key limitations for LLMs-a fact that speaks to how cognizant industry professionals are of this critical problem.²

2 OpenAI OpenAI: GPT-4.(<https://openai.com/research/gpt-4>), Accessed: January 2, 2025

ChatGPT's hallucination effect is an interesting but worrisome phenomenon that draws attention to the limitations of artificial intelligence in natural language processing, especially as applied in the field of healthcare (Mesko and Eric, 2023). ChatGPT, despite its remarkable potential, has hallucination as one of its most well-known shortcomings. This is its tendency to provide information that is inaccurate, deceptive, or absurd but looks true. Hallucination is a basic barrier in the development of AI and has significant implications for the dependability and credibility of content produced by AI (Jerome Godard, 2023).

The use of ChatGPT in writing academic papers presents a significant challenge to academic integrity. As much as the AI demonstrates remarkable ability to generate well-structured scientific essays with appropriate academic tone and format, the output usually contains fact and fiction data, citations, and research findings (Alkaissi and McFarlane, 2023).

A recent study examining the occurrence of AI-generated hallucinations in research proposals by ChatGPT revealed that out of 178 cited references, 69 lacked a DOI, and 28 were determined to be nonexistent (Althaluri et al, 2023). This blending of fact and falsehood is particularly deceptive, as the fabricated components bear the same appearance of confidence and professional sheen as the real information, confusing readers about what is real and what is artificial (Althaluri et al, 2023).

From a liability perspective, whether clinicians understand how AI works or why it generated a particular recommendation is irrelevant (Haupt and Mason, 2023). It is the care being provided above or within accepted standards that remains relevant. The bad advice coming out of AI is no

different from the flawed information professionals have always propagated and used to cause harm, as in both instances these are filtered through the professionals' judgment. Therefore, the existing legal frameworks can indeed hold healthcare professionals responsible for their advice, regardless of its origin. In other words, clinicians will remain accountable for the consequences. Therefore, they should not put any more faith in GPT than in other medical tools until those are properly validated. Clinicians may use LLMs to perform routine tasks or generate novel ideas. Whatever the case, it is critically important that they carefully review and validate the LLM output to safeguard patients and themselves (Haupt and Mason, 2023).

To guarantee the moral application of AI chatbots in patient care, legislators and healthcare professionals must set rules, procedures, and oversight systems (Chakraborty et al, 2024).

1.8 Rationale for the Study

The integration of ChatGPT into healthcare and education represents a pivotal shift in the adoption of AI tools. Its versatility offers unique opportunities to enhance productivity, streamline workflows, and expand access to knowledge. However, these advancements come with challenges that must be addressed to ensure equitable and ethical use. This study seeks to explore the awareness, utilization, and challenges associated with ChatGPT, with a specific focus on healthcare professionals and pharmacy students.

Given the increasing reliance on AI technologies in sensitive fields, understanding users' perceptions and experiences with ChatGPT is crucial. By examining its application in clinical and academic contexts, this research aims to identify gaps, address misconceptions, and provide actionable recommendations to optimize its implementation.

1.9 Aim and objective

This study aims to understand the awareness, use, opportunities, and limitations associated with ChatGPT in healthcare and pharmacy education.

CHAPTER TWO
METHODOLOGY

2.1 Ethics Approval

The study was registered with the Faculty Research Ethics Committee (FREC) of the Faculty of Medicine and Surgery, and approval was granted with the approval number MED 2024-00501.

(Appendix 1)

2.2 Scope of the Study

This research focuses on healthcare professionals and pharmacy students, examining their engagement with ChatGPT since its launch. The study encompasses a systematic literature review of relevant articles published between November 2022 and November 2024, adhering to PRISMA 2020 guidelines. By addressing both clinical and educational contexts, the research provides a comprehensive view of ChatGPT's utility and limitations.

2.3 Study Design

This study adopted a systematic literature review approach to examine the challenges associated with using ChatGPT in healthcare and pharmacy education. The review ensured a structured and rigorous examination of existing literature, enabling the identification of patterns, insights, and gaps. The study was conducted in accordance with the PRISMA 2020 guidelines, which provides a standardized framework for selecting and analyzing relevant studies. This design ensured that the process is transparent, reproducible, and methodologically sound, allowing for the synthesis of high-quality data from diverse sources (Page et al, 2021).

2.4 Data Collection

To gather relevant literature, a structured search was performed across five major academic databases: PubMed, GoogleScholar, Scopus, ProQuest, and ResearchGate.

These digital databases were chosen for their extensive collections of peer-reviewed articles, grey literature, and interdisciplinary studies. The search strategy focused on studies published between November 2022 and November 2024, ensuring the inclusion of the most recent research on ChatGPT.

2.5 Search Keywords

Keywords were employed to retrieve articles relevant to the research question. These were:

ChatGPT, Awareness, Challenges, Limitations, Use, Healthcare professionals, Pharmacy Education.

The search was iterative, with adjustments made to keywords to ensure a comprehensive and precise dataset to focus specifically on ChatGPT and how it is engaged in healthcare practice and education.

2.6 Inclusion and Exclusion Criteria

Articles published in English and addressing ChatGPT's applications, challenges, or limitations in healthcare and pharmacy education were included. Both original research and review articles were considered, as well as case studies, editorials, and opinion pieces that provided valuable qualitative insights. Duplicate articles were excluded, along with those unrelated to healthcare or

education or focused on AI tools other than ChatGPT. By applying these criteria, the study ensured a robust and focused literature set for systematic review.

2.7 Screening and Selection Process

The screening process involved three stages: a review of title and abstract, evaluation of the whole text, and data extraction. During the title and abstract review, articles that were clearly irrelevant were eliminated. Full-text evaluation allowed for a deeper assessment of the remaining studies to ensure they addressed the research objectives. Key data such as study aims, findings, and conclusions were systematically extracted and organized. A PRISMA flowchart was included in the findings to visually represent the search and selection process, detailing the number of articles retrieved, duplicates removed, and final studies reviewed.

2.8 Data Categorization

The full texts of the selected articles were thoroughly reviewed and categorized based on the applications of ChatGPT in different healthcare practice areas. This research identified four key categories which includes: ChatGPT in healthcare, ChatGPT as a patient-assisted tool, ChatGPT in pharmacy and health education as well as articles that focussed on the limitations and ethical concerns of ChatGPT. The proportion of articles focusing on each area was calculated as a percentage of the total number of articles included in the study.

2.9 Limitations of Methodology

Despite its structured approach, the methodology had limitations. The reliance on published literature excluded recent findings not yet peer-reviewed. Similarly, focusing only on English-language publications limited perspectives from non-English-speaking regions, potentially skewing the results. Furthermore, database-specific indexing practices introduced bias, as some relevant articles were not captured in the chosen datasets. These limitations were acknowledged to contextualize the findings and highlight areas for future research.

CHAPTER THREE

RESULTS

3.1 Identified Literature

Figure 3.1 indicates the study selection procedure. The initial database search captured a total of 337 papers across the 5 electronic databases. While a total of 101 duplicate articles were identified and removed, this was followed by the application of the inclusion and exclusion criteria, which saw a further removal of 129 articles. At the end of the article screening, 107 articles met the eligibility requirements and were included in the final paper (Figure 3.1).

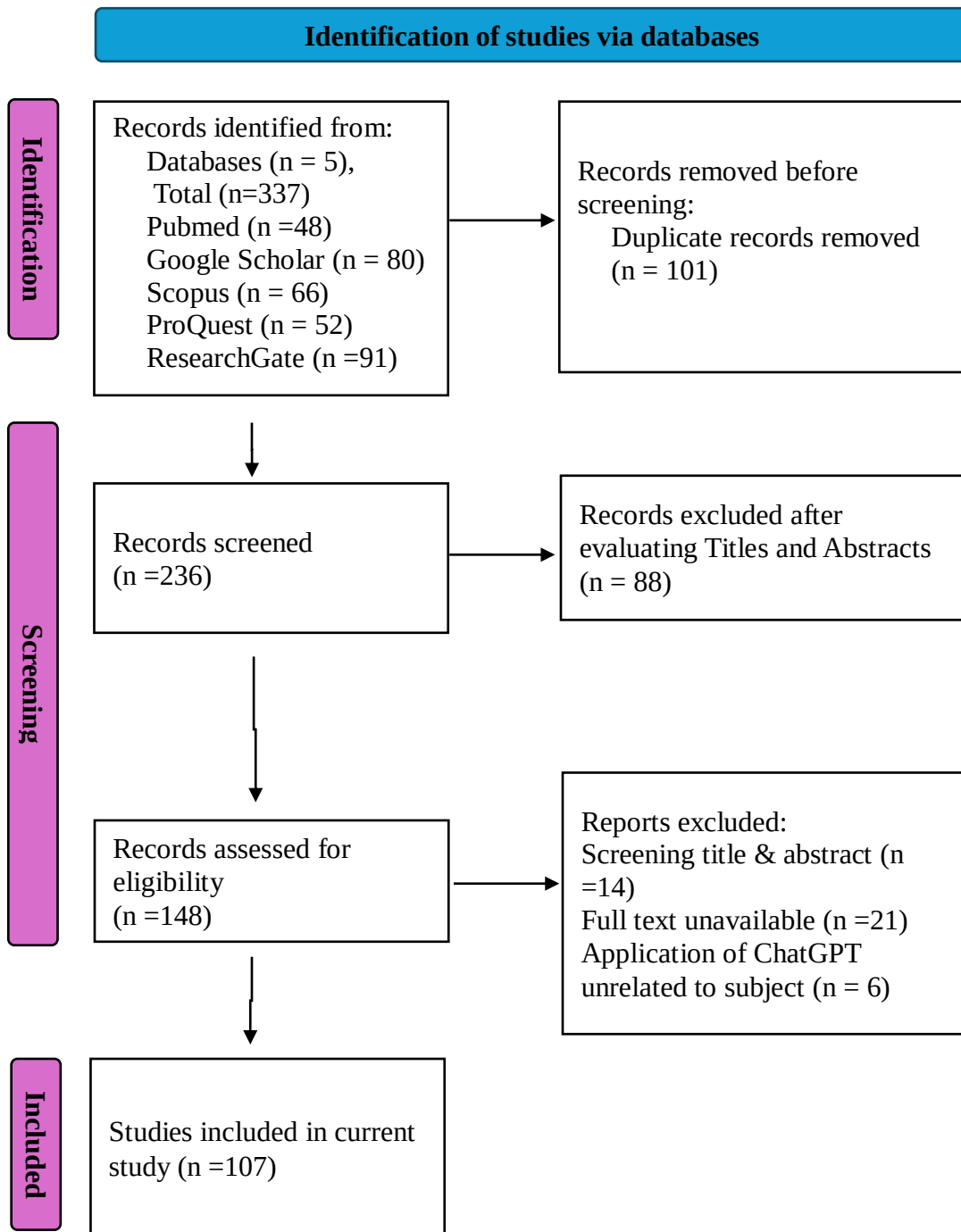


Figure 3.1: PRISMA 2020 flow diagram for article screening

Table 1 summarizes the number of research articles exploring ChatGPT's applications across various settings, providing insight into current research trends on AI's potential. Showing that the highest number of articles were related to direct patient care (N=43), while reports on the limitations of ChatGPT in healthcare was the next most reported (N=23). Other areas were less reported as shown in the table.

Figure 3.2 visually represents this distribution with a bar chart, highlighting ChatGPT's role in different areas of healthcare practice and education.

Table 1: Applications of ChatGPT in various healthcare domains (N=107)

Category	Number of Articles	Description
ChatGPT in Direct Patient Care Therapy	43	ChatGPT assists in diagnosis, medication management, treatment recommendations, and patient monitoring.
ChatGPT Limitations and Ethical Concerns	23	Research addresses issues such as data privacy, AI bias, misinformation, inconsistencies and over-reliance on ChatGPT and AI-generated content.
ChatGPT as a Patient-Assisted Tool	19	ChatGPT acts as a digital resource for health education, symptom tracking, medication adherence, and lifestyle recommendations.
ChatGPT as a Teaching Aid in Pharmacy and Medical Education	11	ChatGPT supports personalized learning, case-based discussions, exam preparation, and interactive problem-solving exercises.
ChatGPT in Other Areas of Healthcare	11	ChatGPT contributes to healthcare administration, clinical documentation, medical research, and policy-making.

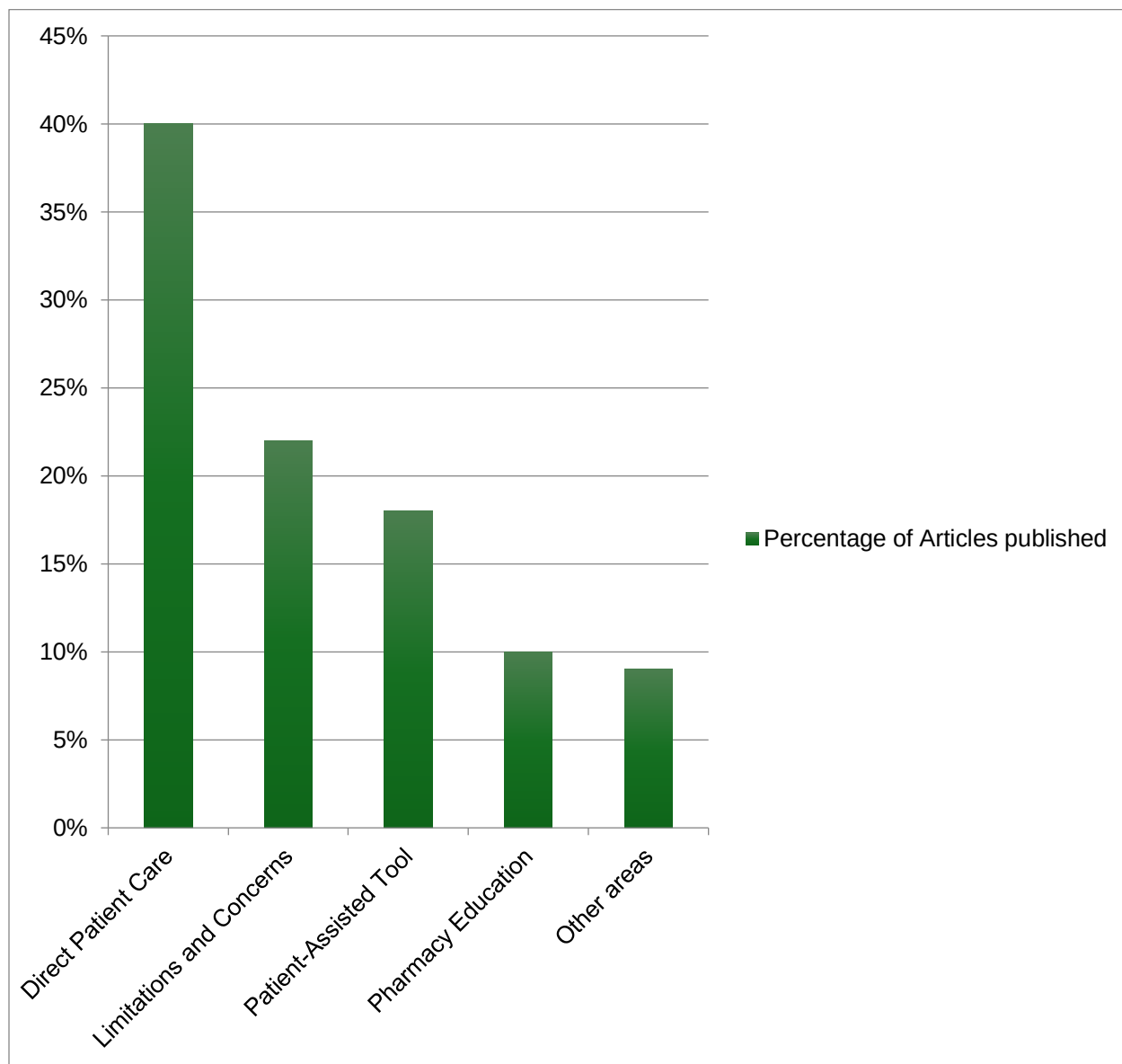


Figure 3.2: Reported Areas of ChatGPT Application

3.2 Summary

The analysis revealed distinct patterns in ChatGPT's application in direct patient care.

Figure 3.3 shows a representation of various specialties in medicine that reported the use of ChatGPT in their operations. Cardiology had the highest number of reports (N=11), followed closely by Radiology (N=9) and Ophthalmology (N=8).

Table 2 shows the summary of the articles that highlighted ChatGPT's use in cardiology, and table 3 shows its application in radiology while table 3 is a summary of articles that reported ChatGPT's use ophthalmology.

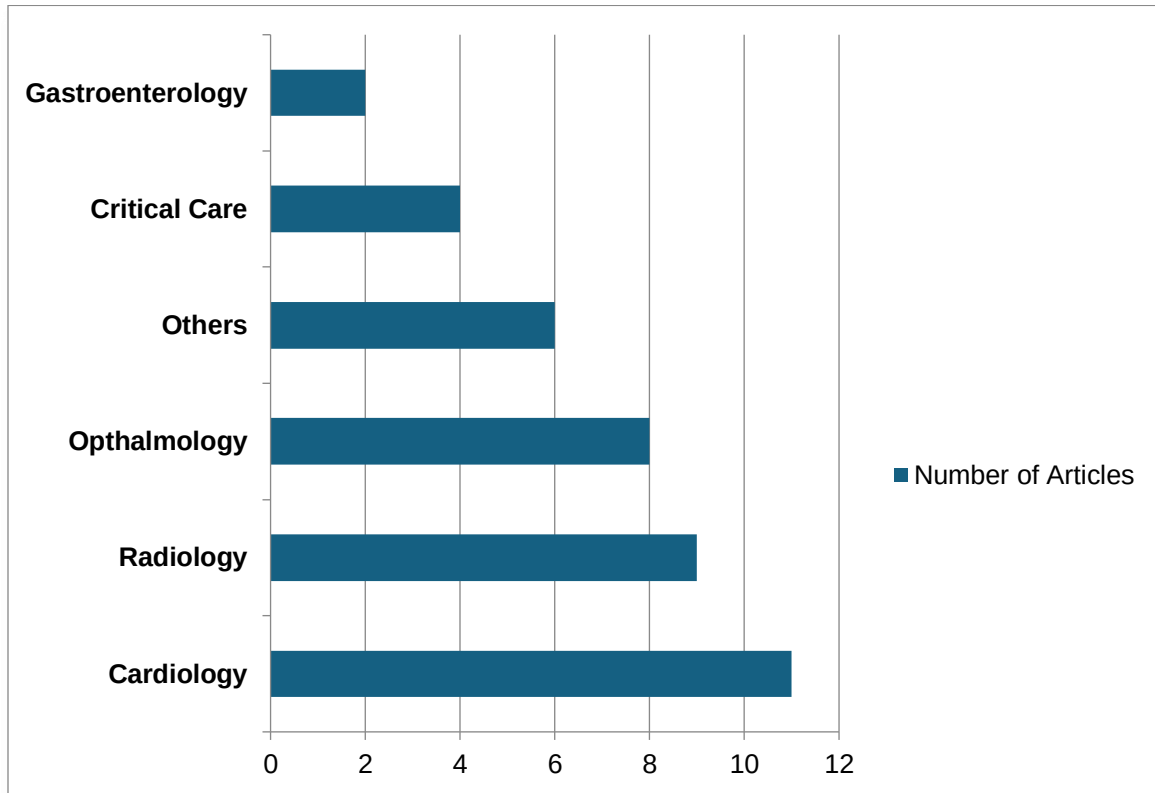


Figure 3.3: Medical specialties that reported application of ChatGPT (N=43)

Table 2: Summary of reports on ChatGPT application in Cardiology (N=11)

Location	Aim of the Study	Findings	Recommendation	Reference
USA	This paper looks at the many ways that ChatGPT can improve clinical decision-making, including symptom analysis, risk assessment, and cardiovascular problem differential diagnosis.	ChatGPT has the potential to significantly enhance treatment results, raise the standard of care, and promote innovative research.	To improve ChatGPT's therapeutic value while minimizing risks by refining training data, developing specialized models, advancing AI technology, and implementing regulations.	Leon et al, 2024
Denmark	To evaluate and methodically investigate ChatGPT's capacity to appropriately advise patients on four cardiovascular disease-related themes when they are prompted.	The articles reviewed were fairly evenly distributed across discussing how ChatGPT could be used for medical publishing, in clinical practice and for education of medical personnel and/or patients.	It is recommended to explore and optimize ChatGPT's potential in medical publishing, clinical practice, and medical education while ensuring accuracy, ethical use, and regulatory compliance.	Lautrup et al, 2023
USA	Assessing the suitability of AI model responses to basic, essential questions about CVD prevention.	Findings revealed that AI model responses to 21 out of 25 questions (84%) were considered appropriate within the research context.	The study should be revisited with a more structured grading system to assess specific aspects of the responses, including accuracy and readability.	Sarraj et al, 2023
USA	This study aims to explore whether ChatGPT-4 can improve heart failure patient education materials to meet the AMA's recommended	ChatGPT-4 made a notable improvement in the readability of heart failure patient education materials, making them easier to	It is recommended to use the model as a supplementary resource alongside care from licensed healthcare professionals for heart failure patients, as it may enhance health literacy	King et al, 2024

	reading level, while ensuring they remain accurate and comprehensive.	understand.	and potentially improve patient outcomes.	
USA	This systematic review and pooled analysis aims to assess how accurately ChatGPT 3.5 and 4 can answer simple questions across various cardiovascular medicine fields.	ChatGPT showed consistently high accuracy in responding to cardiovascular-related queries, with no notable differences between model versions or years.	To consider using online chat-based large language models (LLMs) as an informational tool in cardiology, based on these promising results.	Kassab et al, 2024
Netherlands	The aim of this study is to explore the potential of generative AI, utilizing advanced machine learning algorithms, to diagnose heart disease and recommend patient-specific management options.	ChatGPT can improve patient outcomes, boost physician efficiency, and reduce administrative tasks, allowing more time for care.	It is recommended that all healthcare providers be involved and stay informed about generative AI to ensure its optimal use and mitigate potential risks and challenges in its implementation.	Gala and Makaryus, 2023
Singapore	To evaluate the quality of ChatGPT in providing medical information about the coronary angiogram, a common cardiology procedure.	The findings indicate that ChatGPT's answers were generally comprehensive and systematic, covering most of the major information fields required.	It's important for healthcare professionals to understand both the strengths and limitations of AI models. While ChatGPT can be a helpful tool for providing patients with information, it should never replace the personalized care and advice that healthcare providers offer.	Koh et al, 2023

Israel	The aim of this study is to assess the diagnostic accuracy of ChatGPT-4, with image evaluation capabilities, in interpreting ECGs with confounding factors and compare its performance to that of physicians.	When analyzing ECGs with confounding variables, ChatGPT-4 frequently missed or misidentified atrial fibrillation (AF).	Its performance did not outperform that of medical professionals, despite its potential as a helpful tool for ECG interpretation. This highlights the ongoing significance of human skill in complex diagnosis.	Avidan et al, 2024
USA	This systematic review explores the current research on how ChatGPT could be applied in the field of cardiology.	ChatGPT shows promise in improving patient education, assisting clinicians in delivering care, and contributing to the development of future research in cardiology.	More research is needed to explore how ChatGPT can be applied in cardiology and to address the ethical concerns around using it for providing medical advice.	Sharma et al, 2024
USA	This study assesses how well ChatGPT-4o, performs on the Adult Clinical Cardiology Self-Assessment Program.	The model interpreted medical images with context, but its accuracy varies and it struggles with image interpretation without context.	It is recommended to use large language models with caution in medical education and clinical decision-making, especially for interpreting ECGs, due to their current limitations and inconsistent performance.	Malik et al, 2025
Canada	To evaluate the accuracy of ChatGPT-4 in interpreting multimodal images, including echocardiograms, angiograms, X-rays, for paediatric cardiology knowledge assessment.	The findings show that the chatbot performed significantly better when provided with an electrocardiogram image compared to when it was not given the image.	More research is needed to evaluate ChatGPT's clinical reasoning skills and its development in paediatric cardiology to understand its potential for clinical and academic use.	Gritti et al, 2024

Table 3: Summary of reports on ChatGPT Application in Radiology (N=9)

Location	Aim of the Study	Findings	Recommendation	Reference
Saudi Arabia	To assess the wide application of ChatGPT in various areas of healthcare.	ChatGPT has wide application in disease diagnosis and management, cellular imaging, radiology and more.	ChatGPT has potential for diverse medical applications and is recommended as a resource for academics, researchers and HCPS.	Younis et al, 2024
USA	To determine the usefulness of ChatGPT in decision making in radiology	ChatGPT demonstrated moderate accuracy in identifying suitable imaging steps for breast cancer screening and assessing breast pain.	ChatGPT for radiologic decision-making is practical and can enhance clinical workflows while promoting the efficient use of radiology services.	Rao et al, 2023
Germany	Assessing the potential of ChatGPT to simplify and summarize radiology reports.	ChatGPT was found to generate patient-focused information, promote patient-centered care, and optimize healthcare cost-effectiveness.	The study demonstrated ChatGPT's ability to simplify radiology reports, though its limitations should be taken into account and addressed.	Jeblik et al, 2022
Thailand	To evaluate Thai medical students' perceptions on AI and its use in radiography.	93.6% of the students strongly supported the inclusion of AI training in medical school curricula and acknowledged its importance for their careers.	TO incorporate AI and ChatGPT in the training of radiology students.	Angkurawaranon et al, 2024
Canada	To evaluate the potential of ChatGPT in structured	Studies highlight optimism about ChatGPT's potential to assist radiologists	It is recommended to integrate AI-driven techniques into radiology while	Sacoransky et al, 2024

	radiology reporting, examining its capabilities, limitations, and impact compared to traditional AI-driven image analysis.	but raise concerns about data privacy, reliability, medical errors, and insufficient medical-specific training.	ensuring ongoing research, development, and ethical oversight.	
Turkey	To explore the integration of AI as a tool in radiology workflows to improve efficiency, accuracy, and patient care.	According to research, ChatGPT may accelerate a number of radiology workflow processes, including scheduling, check-in, patient registration, and reporting.	It is recommended to address the limitations of ChatGPT, including potential algorithmic bias and ethical concerns, to enhance its effectiveness and reliability.	Mese et al, 2023
India	To evaluate how well ChatGPT-3.5 can simplify radiology reports for professionals and patients.	The findings show that ChatGPT successfully simplified radiology reports by eliminating technical jargon, while still maintaining key diagnostic information.	To incorporate the free version of ChatGPT-3.5 into radiology practices to simplify reports, improving accessibility and enhancing communication which can support informed decision-making.	Sarangi et al, 2023
Ireland	The aim of our study was to evaluate ChatGPT's accuracy and limitations in answering basic and specialized MRI-related questions.	ChatGPT performed well on simple MRI questions (over 85% accuracy) but showed variable accuracy (40% to 66.7%) on complex, specialized	It is recommended to use ChatGPT for simple MRI questions, but with caution for complex ones. A balanced approach should be taken, combining AI with expert oversight in medical education and	Lee and Lee, 2024

		multiple-choice questions.	decision-making.	
USA	To explore the ability LLMs to predict the most appropriate neuroradiologic imaging modality based on specific clinical presentations.	The findings revealed that ChatGPT and Glass AI scored 1.75 and 1.83, respectively, with no significant difference between them. The neuroradiologist, however, scored 2.19, significantly outperforming both LLMs.	ChatGPT showed similar performance to GlassAI, with potential for improvement through medical text training, but it still lagged behind experienced neuroradiologists, indicating a need for further development.	Johnson et al, 2023

Table 4: Summary of reports on ChatGPT Application in Ophthalmology (N=8)

Location	Aim of the Study	Findings	Recommendation	Reference
Thailand	To examine in depth how chatbots are used in ophthalmology.	Chatbots teach patients about eye health essentials while addressing common questions and correcting misconceptions about eye care.	Efficient use requires the development of certain guidelines and standards for chatbots employed in ophthalmology.	Ittarat et al, 2023
Canada	Evaluating ChatGPT's capability to respond to a variety of multiple-choice questions (MCQs) in ophthalmology.	ChatGPT currently performs at the skill level of a typical first-year ophthalmology resident.	While there is potential for ChatGPT's use in ophthalmology, its applications must be approached with caution and careful consideration.	Antaki et al, 2023
UK	Assessment of ChatGPT and other LLMs' accuracy in generating responses for ocular emergencies compared to the UK's NHS 111 online system.	When compared to NHS 111 responses, LLMs' overall accuracy in this trial was good. Ninety-three percent of all LLM responses had a score of ≥ 1 , which is considered "Good."	In the digital age, LLMs have the potential to improve patient care and accessibility to healthcare, hence their adoption is recommended.	Khan and Gunasekera, 2025
Singapore	Analyzing ChatGPT's use in clinical duties, including as ophthalmology exams.	The study found that ChatGPT-4.0 outperformed ChatGPT-3.5 in ophthalmology exams and excelled in generating discharge notes, assessing diagnoses, and answering basic medical questions.	The creation of uniform evaluation frameworks, picture data interpretation, comparative analysis of LLMs, and API integration should be the top priorities of future research.	Wong et al, 2023

USA	This study evaluated ChatGPT's ability to generate ophthalmic discharge summaries and operative notes.	ChatGPT can include specific medications, follow-up instructions, consultation details, and location in discharge summaries when given appropriate prompts.	ChatGPT performed well in generating ophthalmic discharge summaries and operative notes. Enhancing its training and incorporating human verification could significantly improve healthcare outcomes.	Singh et al, 2023
Spain	To assess ChatGPT's responses to common questions from ophthalmology patients.	ChatGPT has the potential to serve as a complementary tool, improving health literacy and reducing the informational load on healthcare professionals.	To implement ChatGPT as a supplemental tool in patient education, helping to improve health literacy and reduce the strain on healthcare professionals	Ruiz-Nunez et al, 2024
Iran	This review summarizes recent research on the use of ChatGPT, an AI-powered chatbot, in ophthalmology, while also addressing its limitations and ethical considerations.	ChatGPT has demonstrated fair to good accuracy, with its latest version showing improved performance in offering ophthalmic recommendations for various disorders.	ChatGPT shows promise in enhancing ophthalmic healthcare education and research, potentially easing workload burdens, but its limitations require it to function alongside human expert oversight.	Bitra et al, 2024
Israel	Evaluating ChatGPT's diagnostic precision in ophthalmology.	ChatGPT demonstrated lower diagnostic accuracy in ophthalmology cases compared to residents and attending clinicians.	ChatGPT had significantly lower diagnostic capabilities in ophthalmology, professional oversight is required.	Shemer et al, 2024

Figure 3.4 is a pie chart that represents publications examining ChatGPT's limitations and ethical concerns in healthcare and research (N=23).

Articles highlighting the Bias of ChatGPT in formed the largest proportion (N=8), followed by those articles that reported on false references in scientific research citations (N=6).

The summary of these reports showing on ChatGPT bias and false references generated by ChatGPT have been shown in tables 5 and 6 respectively.

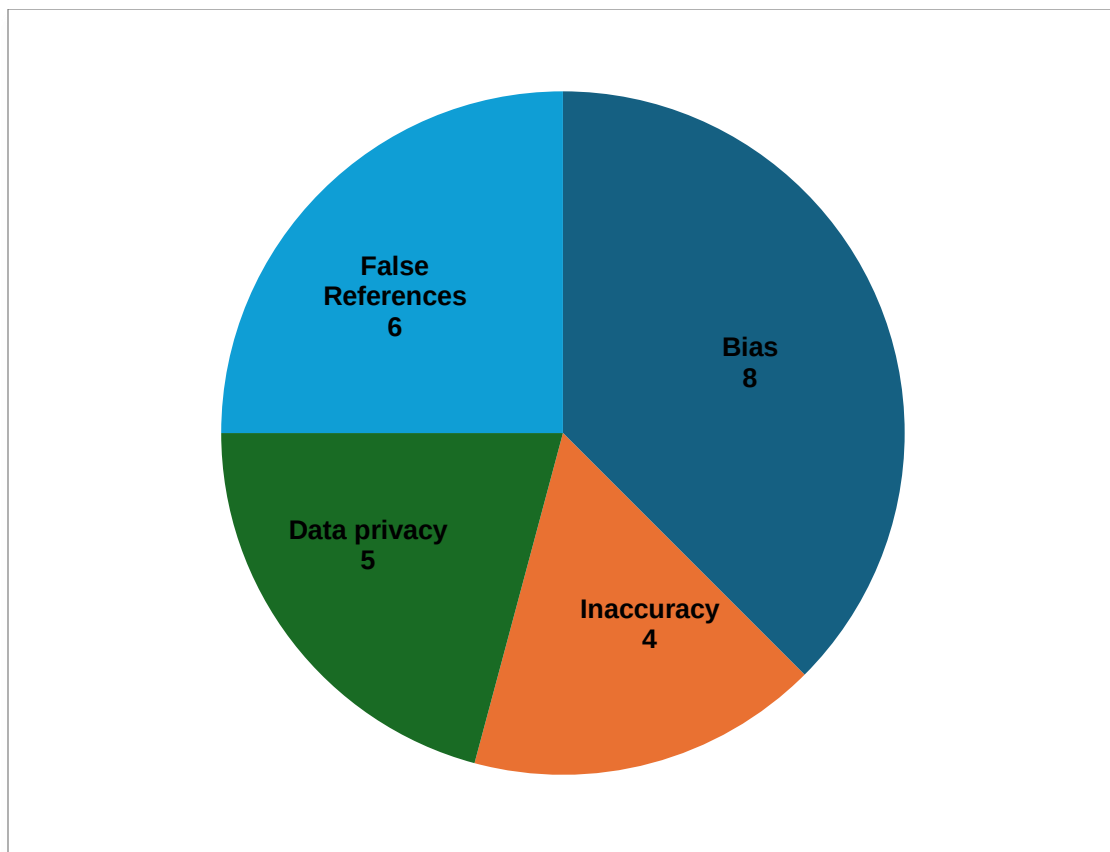


Figure 3.4: Reported Limitations with ChatGPT in Healthcare (N-23)

Table 5: Summary of reports on ChatGPT Bias (N=8)

Location	Aim of the Study	Findings	Recommendation	Reference
USA	To investigate how clinical judgments are impacted by biases that arise in medical artificial intelligence (AI).	Results show that these biases have the potential to change clinical results and affect outcomes.	We advise the use of broad and varied data sets, advanced statistical techniques to eliminate biases, and unambiguous reporting guidelines.	Cross et al, 2024
South Korea	This study examines the drawbacks of ChatGPT, such as lack of human judgment, data quality issues, bias and ethical challenges.	ChatGPT lacked the broader perspective of responses to queries which can pose significant challenges.	Additional research is necessary to explore the use of AI chatbots in medical and health education, incorporating a wider variety of questions and more advanced chatbot versions.	Alam et al, 2024
USA	Evaluating the future of medical writing in the era of ChatGPT	The findings indicate that Chat GPT improved efficiency in medical writing	Suboptimal understanding of the medical field, ethical concerns, risk of bias, legal issues, and various limitations of ChatGPT should be carefully considered.	Biswas som, 2023
USA	To examines the moral and legal issues surrounding the application of AI in healthcare.	There are various irregularities and bias associated with the responses chatGPT provides in real medical scenarios.	There is need for careful assessment and verification before to applying AI in actual medical situations.	Miao et al, 2023
USA	To educate stakeholders on the impact of AI bias on healthcare inequities.	Bias impacts and pose a reasonable threat to disease and overall health outcomes.	An expanded Total Product Lifecycle (TPLC) framework for healthcare AI that identifies the sources and effects of bias and proposes strategies for mitigation.	Abramoff et al, 2023

Turkey	To raise awareness of the significance of proactively recognizing and correcting AI bias within the medical imaging community.	The review showed that a number of biases could jeopardize AI in medical imaging and have a negative impact on patient outcomes.	Raising public knowledge of biases in its various forms could aid in the creation of more efficient regulatory structures.	Kocak et al, 2025
USA	To analyse sentiment and bias in HIV-related generated information by ChatGPT across various racial/ethnic lines.	According to the study, ChatGPT's linguistic and readability metrics are largely independent of insurance type and race/ethnicity.	To validate these findings and evaluate their ramifications, more research is required.	Hanna et al, 2023
USA	To assess how a large language model (LLM) generative AI system affects healthcare bias and physician decision-making accuracy.	The findings demonstrated that, with AI support, doctors are willing to modify their first clinical judgments, and that this significantly increased clinical decision-making accuracy.	ChatGPT and other have AI tools play a significant role in clinical decision-making.	Goh et al 2023

Table 6: Summary of reports on ChatGPT generated False References (N=6)

Location	Aim of the Study	Findings	Recommendation	Reference
Poland	This study compared ChatGPT-4 and Gemini Advanced's capacity to choose reliable sources on frequently discussed otorhinolaryngology issues.	Both chatbots had low reference-finding performance; however ChatGPT-4 was more accurate (29–45%) than Gemini Advanced (10–17%).	There is need to develop capacity of the Chatbots to generate factual references.	Jedrzejczak et al, 2024
USA	Evaluating the challenges that must be resolved before implementing ChatGPT in pharmacy practice settings.	ChatGPT generated misleading prompts and fictional answers.	It is recommended to put necessary regulatory oversight before deployment in healthcare.	Munir et al, 2024
Turkey	Examining AI risks in medicine and proposing policies for risk reduction and benefit optimization.	AI has the potential to transform healthcare, but it also poses significant risks, including healthcare disparities, misdiagnoses, and unsuitable treatments.	These include developing continuous education and auditing mechanisms, putting in place a participatory society-in-the-loop management approach, and raising AI literacy.	Ilikhan et al, 2024
UK	Assessing the usefulness of ChatGPT as a tool for researchers.	Reliance on ChatGPT for research poses risks such as the potential for incorrect or nonsensical answers, and the possibility of plagiarism.	ChatGPT does not meet the criteria to be listed as an author. Authors should be transparent about their use of ChatGPT and take responsibility for the content it generates.	Sallam Malik, 2023
India	To harness ChatGPT potential in healthcare and scientific writing.	ChatGPT has drawbacks, such as producing erroneous references and difficulty with critical thinking tasks, which calls for strict cross-verification.	In order to create domain-specific tools, standards, and laws and to responsibly utilize AI's potential, cooperation between AI developers, researchers, educators, and politicians is essential.	Jeyaraman et al, 2023

Greece	To summarize the potential applications and implications of ChatGPT in Education, Clinical Practice and Research.	Rational concerns on the originality and of research and academic integrity.	Increased vigilance and formulation of ethical framework to harvest the potential of ChatGPT	Kapsali et al, 2024
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CHAPTER FOUR

DISCUSSION

4.1 Overview of research findings

The results from the systematic literature review provide insights into the diverse applications and limitations of ChatGPT in healthcare practice and education. With 107 eligible articles categorized into five key application areas, this study underscores ChatGPT's awareness and potential while addressing critical challenges. The findings are discussed, with emphasis on the implications, challenges, and recommendations for integrating ChatGPT into healthcare systems.

ChatGPT's role in direct patient care emerged as the most studied category, accounting for 40% of the articles reviewed. Out of the 41 articles in this category, the reports of ChatGPT's application in cardiology ranked highest with eleven articles followed closely by radiology and ophthalmology specialties.

ChatGPT through its capacity to evaluate risk variables, analyze patient-reported symptoms, and support differential diagnoses using vast medical knowledge databases, shows promise for transforming clinical decision-making and diagnostics in cardiovascular medicine (Leon et al, 2024). Its real-time data collecting and emergency decision-making skills help speed up treatment regimens and improve diagnostic accuracy (Chlorogianis et al, 2023). Cardiovascular magnetic resonance (CMR), electrocardiography (ECG), and echocardiography are among the important cardiovascular diagnostic techniques that ChatGPT has shown a significant potential to improve diagnostic procedures. ChatGPT has been used to improve the interpretation and diagnostic precision of echocardiogram findings (Kusunose, 2023).

There are significant risks associated with using ChatGPT for cardiovascular diagnosis. A case report described how reliance on ChatGPT's inaccurate assessment resulted in a

delayed diagnosis of a transient ischemic stroke (Saenger et al, 2024). Suboptimal accuracy in adhering to the American Heart Association's Advanced Cardiovascular Life Support Guidelines for bradycardia and cardiac arrest was revealed in a study on ChatGPT's performance in complex clinical scenarios (Pham et al, 2024). These results demonstrate the need for enhancements to provide consistent and trustworthy ChatGPT guidance in clinical situations.

An exploratory study performed on the appropriateness of responses generated by AI models concerning basic cardiovascular-preventive questions using the ChatGPT-3.5 model showed that chatGPT produced appropriate responses in 21 out of 25 questions, as decided upon by the preventive cardiologists themselves. This further highlights the potential of generative AI to provide appropriate and helpful information for cardiovascular disease prevention, adding to clinical practice in the management and risk assessment of patients. (Sarrajy et al, 2023). Similarly, study has shown that ChatGPT can enhance the diagnosis of heart failure by utilizing its natural language processing and machine learning skills to analyze a wide range of patient data (Harskamp and De Clercq, 2024).

The application of LLMs in radiology is by its usefulness in aiding diagnosis. By evaluating imaging data alongside the patient's medical history, ChatGPT could propose possible diagnoses, differential diagnoses, and suitable treatment options (Kottlors et al, 2023). Given this potential, LLMs could serve as intelligent assistants for radiologists, supporting them in interpreting medical images and offering initial assessments to aid in decision-making (Akinci D'Antonoli et al, 2024). Furthermore, they have been highly useful in addressing radiology-related queries, such as explaining specific imaging findings, clarifying radiological procedures, and providing general insights into various imaging techniques (Bhayana et al, 2023).

ChatGPT can be an interactive platform for the patients to access ophthalmology information that is quite accurate and current (Rasmussen et al, 2023). ChatGPT can also educate the patient on the importance of regular eye checks and the other systemic parameters or life style modification such as protection from UV radiation, address frequently asked questions, debunk myths and misconceptions, and clarify doubts related to eye health (Ittarat, et al, 2023).

ChatGPT's ability to diagnose and provide management recommendations for uveitis was assessed, and while its performance was slightly below that of ophthalmologists specializing in uveitis, it demonstrated consistency in its management plans (Carabali et al, 2024). The results indicate that large language models (LLMs) like ChatGPT could potentially complement clinical expertise in specialized medical fields by offering reliable diagnostic and therapeutic guidance (Carabali et al, 2023).

Similarly, findings from a comparative study to evaluate GPT-4's diagnostic accuracy in glaucoma and retina management compared to fellowship-trained ophthalmologists, showed that GPT-4 either matched or surpassed the specialists, thereby highlighting its strong potential for clinical decision-making with competitive accuracy and thoroughness scores (Huang et al, 2024).

ChatGPT's resourcefulness in patient care has also been reported in other specialties such as rheumatology (Vincenzo et al, 2023) and in nephrology where research findings showed that it played an important role in supporting healthcare professionals during pre- and post-kidney transplant care and long-term medication management, which was important for graft survival and prevention of complications in the kidney transplant recipients (Garcia-Valencia et al, 2023).

A study using the GPT-3.5-Turbo version of ChatGPT simulated patient information generated for 20 orthopedic and trauma surgical procedures. It indicates that ChatGPT mentioned an average of 47% of relevant keywords across procedures. This goes to prove the suboptimal quality of information being provided in the field of orthopedics and trauma surgery (Kasapovic et al, 2024).

Similarly, another study which assessed the use of ChatGPT and other AI models in the prognosis of depression found that the predictions of ChatGPT-4 matched those of Psychiatrists and other mental health specialists (Elyoseph et al, 2024).

Research carried out recently indicates that ChatGPT could help prevent healthcare worker burnout and save clinicians' time by assisting with administrative paperwork, such as insurance preauthorization requests, patient discharge documentation, and other medical administrative tasks (Temsah et al, 2023; Patel, 2023). A study by Ayers et al, 2023 has shown that the application of ChatGPT in a clinical setting can have massive benefits in handling Electronic Health Records (EHRs) and patient messages. Indeed, their results indicated that clinicians could save a considerable amount of time when managing patient messages in the ambulatory EHR system by leveraging ChatGPT to draft responses on their behalf. This, in turn, reduces the administrative workload and thus allows the healthcare provider to focus more on the direct care of the patient, hence improving the overall efficiency of the medical practice. Remarkably, the study discovered that the public was happier with the chatbot's responses than with those generated by actual medical professionals (Ayers et al, 2023).

The effectiveness of ChatGPT in responding to factual knowledge questions about clinical pharmacy was also investigated in a recent study carried out in a clinical pharmacy context. The study revealed that the accuracy, concordance and quality of substantiation of the responses of ChatGPT to the clinical questions 79%, 95% and 73% respectively as against the Clinical Pharmacist's accuracy rating of 66%. This further buttresses the claim that with further improvements, ChatGPT could serve as a valuable resource to Pharmacists (Nuland et al, 2024).

The potential of ChatGPT of LLMs, especially ChatGPT-4.0, for delivering responses to HBV-related questions was highlighted in a study conducted in China, where patients received 93.3% accuracy in chatGPT's response to queries (Wang et al, 2024). The researcher maintained that while LLMs may be an adjunctive informational tool for patients and physicians to improve outcomes, it should not replace personalized treatment recommendations from physicians in the management of hepatitis B infections (Li et al, 2025). Another evaluation of ChatGPT's outputs revealed notable potential of ChatGPT to provide plausible medical information regarding common questions addressed by patients with inflammatory bowel diseases, to their gastroenterologists. However, the study also highlighted significant limitations, including challenges in providing detailed and up-to-date information and occasional inaccuracies. Further research and improvements are necessary, with a focus on aligning its responses with authoritative medical evidence from reliable databases (Gravina et al, 2024).

Despite the wide application of ChatGPT as revealed in this study, ethical concerns and limitations of ChatGPT accounted for the second-largest share (22%) of the publications

analyzed in this study. A total of 23 articles highlighted the limitations with the implementation of chatGPT in healthcare and medical research. The reported major concern was the risk of bias (N=8), which was closely followed by the false citations generated by ChatGPT (N=6).

These limitations pose a significant barrier to the integration of ChatGPT into healthcare as misinformation, biases in AI-generated responses, and medicolegal implications ultimately question the trustworthiness of AI chatbots application in healthcare (Huh, 2023).

While ChatGPT holds immense potential to transform medical practice, a valid question remains if it is being applied in the most effective and appropriate way. Most importantly, developing critical thinking skills among all stakeholders will help in making informed decisions, better management of patients, and the integration of AI technologies like ChatGPT into responsible medical practice (Kapsali et al, 2023). There are also doubts introduced regarding LLM applicability, in that a probably AI-based application can offer nothing but a catalog of preset answers and knowledge, without allowing the healthcare professionals to develop their critical ability, assess a wide range of clinical dilemmas, and tailor their practice in order to fit the needs of each single patient (Kapsali et al, 2024).

Munir et al, 2024, in a study revealed that ChatGPT has limited effectiveness in answering pharmacy-related questions. While it performed better on calculation and multiple-choice questions, it struggled with drug information and patient case questions, often providing misleading or fabricated answers and citations.

The use of ChatGPT in research and scientific writing is constrained by several challenges, including bias, plagiarism, and a lack of originality, which can undermine the credibility of

academic work. Additionally, the chatbot may generate inaccurate content and incorrect citations, raising concerns about the reliability and validity of the information it provides. These limitations highlight the need for careful human oversight when using AI tools in scholarly writing and research (Sallam, 2023).

LLMs have been found to carry risks due to biases in their training data and their tendency to produce "hallucinations," meaning misleading or factually inaccurate information (Joshua et al, 2023).

The use of ChatGPT as a patient-assisted tool formed approximately 18% of the reviewed articles captured in this study. Applications of ChatGPT in this area include providing health education, answering common patient queries, and supporting self-management of chronic conditions. ChatGPT's ability to simulate conversational interactions makes it an effective virtual assistant for patients, particularly those managing conditions like diabetes or hypertension (Fatani, 2023).

Despite these advantages, ethical concerns related to patient data privacy and the potential for misinformation must be addressed. ChatGPT's reliance on pre-existing data without real-time updates may also predispose it to produce outdated or inaccurate responses (Huh, 2023). Therefore, integrating robust validation mechanisms and ensuring compliance with data protection regulations are crucial.

In Pharmacy and Medical education, ChatGPT's potential as an educationally resourceful tool was reported in 10% of the articles reviewed in this study. Its ability to assist pharmacy and medical students by explaining complex topics, generating case-based scenarios, and providing personalized learning experiences is well-documented (Wang et al, 2023). This

aligns with modern pedagogical approaches that emphasize interactive and self-directed learning.

Medical educators, therefore, have to keep pace with technology through its rapidly evolving nature and thereby consider implications with respect to the use of ChatGPT in curriculum design, assessment methodologies, and teaching approaches. Long-term research and evaluation are needed, with a view toward the maximum possible incorporation of AI-powered learning tools within medical education (Hyunsu Lee, 2023).

The findings from a study at the University of Puerto Rico shows that participants' who took courses on Artificial Intelligence and Machine Learning Applied to Health Disparities Research (AIML + HDR), showed that knowledge and attitudes towards ChatGPT and AI in general have significantly improved, highlighting how well the course has worked to increase comprehension and cultivate favorable attitudes toward AI. The results also show a lack of hands-on experience with AI technologies, underscoring the need for better integration in the classroom and how important it is to teach medical practitioners about AI in order to facilitate its beneficial integration into medical practices (Heredia et al, 2024).

A recent data on the use of ChatGPT by pharmacy students during their Advanced Pharmacy Practice Experience rotations in New York-USA, suggest a potential benefit in improving educational outcomes regarding entrustable professional activities during APPEs. The tool seems to enhance knowledge for the student, their capabilities for collecting and presenting information, critical thinking skills, and written and verbal communication. In the light of these important skills and considering the potential benefits

of ChatGPT, it would be of interest to consider incorporation of ChatGPT and other AI technologies into students' learning activities in order to support and foster such benefits (Goldman et al, 2024).

Another study examining PharmD students' perceptions of integrating ChatGPT into clinical training found that 64% recognized its potential benefits for various clinical tasks. Some students used it for evaluating drug-drug interactions and developing care plans. However, concerns were raised about over-reliance, accuracy, and ethical implications. The study emphasized the importance of collaborative decision-making between humans and ChatGPT, recommending that the technology should complement healthcare professionals' expertise and be used strategically to address human limitations (Zawiah et al, 2023).

Futhermore, ChatGPT offers significant advantages to medical students by enhancing their learning experience and skill development. It supports students, particularly those from non-English speaking backgrounds, in improving their language proficiency and communication skills, which are essential for clinical practice. ChatGPT assists students in improving their subjective representation of medical knowledge by offering feedback on language usage and writing style. It serves as a benchmark for knowledge comparison in small group assessments, enabling students to identify and address gaps in understanding. Additionally, ChatGPT can replicate patient interactions, enabling students to practice gathering medical histories and recording symptoms. These features make ChatGPT an essential tool for enhancing critical thinking, problem-solving, and communication skills in medical training (Seetharaman, 2023).

However, the dependence on ChatGPT as a sole source of knowledge raises concerns about the development of critical thinking skills among students. While it can supplement traditional teaching methods, critical thinking, educators must ensure that students engage in active problem-solving and not solely rely on AI-generated content. Structured integration into curricula with defined boundaries for use is recommended (Rossela et al, 2024).

4.2 Mitigating the occurrences of ChatGPT Hallucinations

Since hallucinations can arise at different stages of an LLM's development and their definition may vary, addressing them in healthcare requires a multifaceted approach (Ahmad et al, 2023).

One of the most important ways to reduce hallucinations is to incorporate human expertise into the creation and implementation of large language models. To improve accuracy and dependability, the Human-In-The-Loop (HITL) technique includes domain experts at different phases of model development and operation (Wu et al, 2021).

Ahmed et al. (2023) suggested LLMs have a human in the loop where every output given from an LLM should have supervision from a human. Though that might be an indicated requisite in special situations having critical importance within medical settings, even then not one but hundreds of outputs produced at run-time by several single humans. The options can be other ways through which LLM flags output that it may not be sure and bounces them to human judgment. These various inputs by humans may also be sources for extra training data that improves the model. Lastly, the feedback can come from added user

feedback after a response generated on the LLM. As an example, ChatGPT has that thumbs up and thumbs down options for responses generated from users.

In another research, Manakul et al, 2023, revealed that the regularization and application of certain penalties inside the loss function are considered some of the traditional machine learning methods for trying to reduce the problem of hallucination in LLMs. Algorithms of regularization prevent over-fitting because they penalize over-reliance on specific patterns in the training data to encourage more generalized and balanced outputs. It would also add some penalty terms to the loss, which would encourage the model toward simpler and hence more generalizable solutions instead of highly complicated or merely memorized patterns that can only contribute to eventual hallucination. These methods put together enhance a model's generalizations toward a bigger range of contexts and reduce the possibility of generating harmful misinformation. With such algorithmic improvements, LLMs can be made more reliable and trustworthy, with the guarantee that their responses remain appropriate to the context in which they are deployed (Manakul et al, 2023).

4.3 Recommendations for Future Research

The findings from this review highlight the transformative potential of ChatGPT in healthcare. However, its effective integration requires addressing existing limitations and ensuring ethical use. Future research on ChatGPT in healthcare should prioritize improving the model's accuracy and reliability by enhancing context-specific and evidence-based recommendations. This includes developing comprehensive training programs to equip healthcare professionals and students with the skills to use AI tools effectively and

responsibly. Additionally, researchers should focus on establishing robust regulatory frameworks that ensure the safe and ethical implementation of AI in healthcare settings. Simultaneously, there is a critical need to explore novel applications of ChatGPT, particularly in emerging areas like telemedicine and mental health support, to fully understand and leverage its potential in advancing healthcare delivery and patient care.

4.4 Limitations of this Study

The PRISMA Guideline for a systematic review specifies that the screening of research articles that should be considered for inclusion in the study must be carried out independently by a minimum of two researchers. And in situations where there are conflicting opinions about the inclusion or exclusion of a paper, a meeting should be scheduled to properly review the researcher's opinions and a final decision is taken on the inclusion or exclusion of the articles under review. In this study, screening and review of the articles were carried out solely by the author which is a loophole for a potential bias.

The study's methodology potentially introduced bias by selecting only published English-language publications and open-source journals published between 2022-2024. This may have inadvertently omitted valuable international perspectives and insights about ChatGPT's capabilities and limitations published in websites, news, textbooks and other forms of print media, or in a different language. This selective approach could result in an incomplete understanding of the AI tool's performance and potential across diverse research contexts.

4.5 Conclusion

The findings from this research underscore the multifaceted applications of ChatGPT in healthcare, from direct patient care and educational support to research and administrative tasks. While its potential is undeniable, definite policy framework that clearly addresses and dictate the extent to which clinicians and healthcare professionals depend on the output of ChatGPT must be put in place so as to protect both the healthcare professionals and the patients from grave consequences that arise owing to the limitations and inefficiencies of the chatbot.

The ethical concerns of academics and institutions of learning also need to be considered and addressed, as it concerns the safe and effective use of ChatGPT by students and researchers.

With continued advancements and a collaborative approach, ChatGPT holds great promise to serve as a valuable tool towards enhancing healthcare delivery and education.

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APPENDIX 1

The status of your REDP form (MED-2024-00501) has been updated to Acknowledged

1 message

form.urec@um.edu.mt <form.urec@um.edu.mt>
To: peter.iji.23@um.edu.mt

16 December 2024 at 14:13

Dear Peter Agbike Iji,

Please note that the status of your REDP form (MED-2024-00501) has been set to *Acknowledged*.

This status change was accompanied by the following explanation/justification: *Dear applicant, Your research ethics application has been received. This does not mean that your application has FREC ethical approval and may be subject to an audit review. The FREC number generated by submission for records only cannot be used as proof of ethical approval. As indicated in the Research Ethics Review Procedures, submissions which have no self-assessment issues are kept for record and audit purposes only, so research may commence. Kindly note that FREC will not issue any form of approval as the responsibility for the self-assessment part lies exclusively with the researcher. Please note that SCPD generally requires review. If you have any questions or doubts or require any further clarification you can contact the MED FREC secretary. Regards, MED FREC*

You can keep track of your applications by visiting: <https://www.um.edu.mt/research/ethics/redp-form/frontEnd/>.

*****This email has been automatically generated by URECA. Please do not reply. If you wish to communicate with your F/REC please use the respective email address.*****

APPENDIX 2

**A Summary of all the articles (107) included in this study showing the aim, findings
and recommendations from the research**

Research Focus	Location	Aim of the Study	Findings	Recommendation	References (DOI)
CHATGPT IN THERAPEUTICS AND HEALTHCARE PRACTICE	Saudi Arabia	To assess the knowledge, attitude and intended practices of HCPs towards ChatGPT.	Majority of the HCPs (76.7%) believed ChatGPT could positively impact the future of healthcare systems.	ChatGPT should not be used for diagnostic or treatment purposes without human expert oversight.	Temsah et al, 2023
	Korea	To assess the reliability of ChatGPT responses in disease diagnosis and treatment.	ChatGPT accurately diagnosed seven out of 10 case reports.	Users of ChatGPT ought to possess sufficient knowledge and skills to determine validity of its responses.	Huh, 2023
	Saudi Arabia	To assess the wide application of ChatGPT in various areas of healthcare.	ChatGPT has wide application in disease diagnosis and management, cellular imaging, radiology and more.	ChatGPT has potential for diverse medical applications and is recommended as a resource for academics, researchers and HCPS	Younis et al, 2024
	United Kingdom	Assessing the prognosis of depression by various AI models.	ChatGPT-4 showed predictions similar to those of the mental health specialists, comparable to other AI models.	Continued validation and assessment of ChatGPT and other AI models used in clinical contexts.	Elyoseph et al, 2024
	USA	To examine the knowledge and attitudes of Hispanic healthcare workers on AI.	The results show limited practical exposure of Hispanic HCPs to AI.	Recommends future investigations aimed at implementing AI in healthcare.	Negron et al, 2024
	China	To examine the benefits, drawbacks, moral dilemmas, potential future developments, and real-world uses of ChatGPT and artificial	Potential uses of ChatGPT in the medical domain include helping clinicians with clinical and laboratory	Policy frameworks to check potential copyright violations, medical-legal issues to ensure transparency in content produced by artificial intelligence.	Xu et al, 2024

		intelligence (AI) in the medical and healthcare fields.	diagnosis as well as identifying possible research subjects.		
	Germany	To assess the quality of medical information provided by the ChatGPT on commonly performed orthopedic and trauma surgical procedures.	The results show that the quality of information currently offered by ChatGPT in the orthopedics and trauma surgery fields is not at its best.	To increase the precision and dependability of medical information, AI sources and algorithms must be further developed and improved.	Kasapovic et al, 2024
	UK	Assessment of ChatGPT and other LLMs' accuracy in generating responses for ocular emergencies compared to the UK's NHS 111 online system.	When compared to NHS 111 responses, LLMs' overall accuracy in this trial was good. Ninety-three percent of all LLM responses had a score of ≥ 1 , which is considered "Good."	In the digital age, LLMs have the potential to improve patient care and accessibility to healthcare, hence their adoption is recommended.	Khan and Gunasekera, 2025
	Singapore	Analyzing ChatGPT's use in clinical duties, including as ophthalmology exams.	The study found that ChatGPT-4.0 outperformed ChatGPT-3.5 in ophthalmology exams and excelled in generating discharge notes, assessing diagnoses, and answering basic medical questions.	The creation of uniform evaluation frameworks, picture data interpretation, comparative analysis of LLMs, and API integration should be the top priorities of future research.	Wong et al, 2023

	USA	This study evaluated ChatGPT's ability to generate ophthalmic discharge summaries and operative notes.	ChatGPT can include specific medications, follow-up instructions, consultation details, and location in discharge summaries when given appropriate prompts.	ChatGPT performed well in generating ophthalmic discharge summaries and operative notes. Enhancing its training and incorporating human verification could significantly improve healthcare outcomes.	Singh et al, 2023
	Spain	To assess ChatGPT's responses to common questions from ophthalmology patients.	The research suggests that ChatGPT has the potential to serve as a complementary tool, improving health literacy and reducing the informational load on healthcare professionals.	To implement ChatGPT as a supplemental tool in patient education, helping to improve health literacy and reduce the strain on healthcare professionals	Nunez et al, 2024
	Iran	This review summarizes recent research on the use of ChatGPT, an AI-powered chatbot, in ophthalmology, while also addressing its limitations and ethical considerations.	ChatGPT has demonstrated fair to good accuracy, with its latest version showing improved performance in offering ophthalmic recommendations for various disorders.	ChatGPT shows promise in enhancing ophthalmic healthcare education and research, potentially easing workload burdens, but its limitations require it to function alongside human expert oversight.	Bitra et al, 2024
	Israel	Evaluating ChatGPT's diagnostic precision in ophthalmology.	ChatGPT demonstrated lower diagnostic accuracy in ophthalmology cases compared to residents and attendings, both with patient history alone and with	ChatGPT demonstrated significantly lower diagnostic capabilities in ophthalmology making it unsuitable as a replacement for medical professionals.	Shemar et al, 2024

			added clinical examination findings.		
	Taiwan	To understand the use of ChatGPT in emergency medicine and critical care.	ChatGPT has the potential to improve patient care management by supporting clinical decision-making and drug selection in critical care.	Research and regulations must be adopted to ensure ethical use of ChatGPT in critical and emergency care settings.	Hwai et al, 2024
	Thailand	To examine in depth how chatbots are used in ophthalmology.	Chatbots teach patients about eye health essentials while addressing common questions and correcting misconceptions about eye care.	Efficient use requires the development of certain guidelines and standards for chatbots employed in ophthalmology.	Ittarat et al, 2023
	USA	To determine the usefulness of ChatGPT in decision making in radiology	ChatGPT demonstrated moderate accuracy in identifying suitable imaging steps for breast cancer screening and assessing breast pain.	Leveraging ChatGPT for radiologic decision-making is practical and may enhance clinical workflows while promoting the efficient use of radiology services.	Rao et al, 2023
	Canada	Evaluating ChatGPT's capability to respond to a variety of multiple-choice questions (MCQs) in ophthalmology.	ChatGPT currently performs at the skill level of a typical first-year ophthalmology resident.	While there is potential for ChatGPT's use in ophthalmology, its applications must be approached with caution and careful consideration.	Antaki et al, 2023
	Germany	Assessing the potential of ChatGPT to simplify and summarize radiology reports.	ChatGPT was found to generate patient-focused information, promote patient-centered care, and optimize	The study demonstrated ChatGPT's ability to simplify radiology reports, though its limitations should be taken into account and addressed.	Jeblick et al 2022

			healthcare cost-effectiveness.		
	Lebanon	To assess ChatGPT's precision and reliability in handling pharmacotherapy scenarios at multiple assessment points.	The analysis indicated that ChatGPT can produce clinically relevant pharmaceutical information, though its accuracy and consistency may vary.	Clinical pharmacy decision-making requires precise and consistent medical information, as it has a direct impact on patient safety.	Al-Dujaili et al, 2023
	Jordan	To evaluate pharmacists' knowledge of and usage of ChatGPT in their professional practice.	Participants acknowledged ChatGPT's benefits in pharmacy, with 69.9% supporting its use for educational materials and 66.9% identifying it as a machine learning algorithm.	While ChatGPT shows potential in healthcare and pharmaceutical practice, its use should be strictly governed by evidence-based regulations.	Hammour et al, 2023
	Brazil	Examining the applicability of ChatGPT in pharmacy practice.	The studies revealed that ChatGPT is not yet fully equipped for implementation in pharmacy practice due to notable limitations.	Further investigation into ChatGPT's role in pharmacy practice is necessary, alongside recommendations for its mindful and appropriate application.	Lima et al, 2024
	USA	Seeks to assess the current uses of ChatGPT in rheumatology, with an emphasis on their potential to enhance disease detection, diagnosis, and patient care.	ChatGPT demonstrated substantial potential to advance rheumatology by enhancing diagnostic precision and tailoring patient care.	Additional research is required to expand the application of these technologies to rarer and more intricate clinical conditions.	Irfan and Yaqoob, 2023
	UK	The use of ChatGPT in discharge note writing	ChatGPT proved efficient in saving physicians	Some patient-specific information has to be manually checked by a human physician, underscoring the need for	Patel and Lam, 2023

			ample time by generating near accurate discharge notes after inputting some some patient information.	human oversight.	
	China	To assess the effectiveness of ChatGPT in key areas of clinical pharmacy practice.	ChatGPT excelled in retrieval, integration, and dialogue but lacked medicine-specific datasets and struggled with advanced reasoning and complex instructions.	ChatGPT's ability to tackle complex problems requires further enhancement and development.	Huang et al, 2023
	USA	Evaluating ChatGPT as a tool for addressing practice-based clinical questions in pharmacy practice environments.	The study shows that ChatGPT performs well in calculations and multiple-choice questions but struggles with drug information and patient case queries, often providing inaccurate or fabricated answers and citations.	The study recommends extensive refining of ChatGPT before deployment in healthcare.	Munir et al, 2024
	Saudi Arabia	Examining healthcare professionals' initial impressions and firsthand experiences with ChatGPT in Pediatric Intensive Care Units (PICUs)	ChatGPT showed its engaging interface and its potential to simplify tasks and deliver quick information.	Participants valued ChatGPT's interface and efficiency but raised concerns about its medical accuracy, data freshness, and ethical implications	Temsah et al, 2024
	USA	This study aims to explore whether ChatGPT-4 can improve heart failure patient	ChatGPT-4 made a notable improvement in the readability of	It is recommended to use the model as a supplementary resource alongside care from licensed healthcare professionals for heart failure	King et al, 2024

		education materials to meet the AMA's recommended reading level, while ensuring they remain accurate and comprehensive.	heart failure patient education materials, making them easier to understand.	patients, as it may enhance health literacy and potentially improve patient outcomes.	
	USA	This systematic review and pooled analysis aims to assess how accurately ChatGPT 3.5 and 4 can answer simple questions across various cardiovascular medicine fields.	ChatGPT showed consistently high accuracy in responding to cardiovascular-related queries, with no notable differences between model versions or years.	It is recommended to consider using online chat-based large language models (LLMs) as an informational tool in cardiology, based on these promising results.	Albert Andrew, 2025
	Netherlands	The aim of this study is to explore the potential of generative AI, utilizing advanced machine learning algorithms, to diagnose heart disease and recommend patient-specific management options.	ChatGPT can improve patient outcomes, boost physician efficiency, and reduce administrative tasks, allowing more time for care.	It is recommended that all healthcare providers be involved and stay informed about generative AI to ensure its optimal use and mitigate potential risks and challenges in its implementation.	Gala and Makaryus, 2023
	Singapore	The aim of this study is to evaluate the quality of ChatGPT in providing medical information about the coronary angiogram, a common cardiology procedure.	The findings indicate that ChatGPT's answers were generally comprehensive and systematic, covering most of the major information fields required.	It's important for healthcare professionals to understand both the strengths and limitations of AI models. While ChatGPT can be a helpful tool for providing patients with information, it should never replace the personalized care and advice that healthcare providers offer.	Koh et al, 2023
	USA	Assessing the suitability of AI model responses to basic, essential questions about CVD prevention.	Findings revealed that AI model responses to 21 out of 25 questions	The study should be revisited with a more structured grading system to assess specific aspects of the responses, including accuracy and readability.	Sarraj et al, 2023

			(84%) were considered appropriate within the research context.		
CHATGPT AS PATIENT-ASSISTED TOOL	China	To determine ChatGPT's potential to deliver personalized medical consultation assistance to Chronic Hepatitis B Patients	74.5% of ChatGPT's responses were found to be comprehensive with 93.3% accuracy rate.	Inadequacy in emotional management of ChatGPT requires training of the chatbot in specific language and patient's emotional management strategies.	Wang et al, 2024
	Saudi Arabia	To evaluate how the Saudi public views artificial intelligence (AI) in healthcare	Of the participants, 84.1% were aware of artificial intelligence (AI), and 61.1% thought it was a useful tool for medical practitioners.	Suggestions for effective integration and application of medical AI while preserving patient safety should be presented to the health management community.	Syed et al, 2024
	UK	To provide information about the use of ChatGPT in health communication.	ChatGPT was found to be giving erroneous and insufficient health information.	To incorporate real patients insight into ChatGPT infrastructure across diverse linguistic and cultural spheres.	Min Li, 2024
	Germany	To examines how ChatGPT might help patients with neuro-oncological diseases and their emotional and cognitive loads.	According to the theory, patients may take a more active role in their treatment decisions if they are better informed by LLMs (ChatGPT).	Incorporating LLMs into neuro-oncology necessitates using AI tools sparingly while managing ethical issues, such as protecting patient data and obtaining informed consent.	McLean et al, 2024
	Italy	This review assessed ChatGPT's ability to give medical information about queries that patients with IBD	The analysis of ChatGPT's outputs revealed some intriguing potential, but it also had	It is necessary to conduct additional research and improve ChatGPT, potentially bringing its results into line with the best available medical data from reputable sources.	Gravina et al, 2024

		frequently ask their gastroenterologists.	serious drawbacks, including the inability to update and detail information and the occasional inaccuracy.		
	USA	Comparing ChatGPT's responses to human responses when answering questions on genetics.	ChatGPT was found to provide quick and accurate responses, along with easily accessible information, for patients with genetic diseases.	The value of ChatGPT will grow in both research and clinical environments with proper regulation and upgrades.	Duong and Solomon, 2023
	USA	Assessing ChatGPT's responses to questions about cirrhosis and hepatocellular carcinoma.	ChatGPT was found to have enhanced health literacy leading to improved patient outcomes.	ChatGPT could be a valuable supplement for patients alongside standard care, and future studies on its utility are recommended.	Yeo et al, 2023
	India	To explore the history, uses, main challenges, and potential future developments of ChatGPT.	Findings reveal that ChatGPT though with some ethical concerns has garnered significant attention from academia, research, and industry in a remarkably short period.	Addressing these ethical challenges will enhance its performance, utility, and user experience, improving its effectiveness in various applications.	Partha Pratim Ray, 2023
	India	To highlight the key factors enabling ChatGPT to enhance customer and patient support.	ChatGPT transformed customer and patient service with its capacity to manage multiple requests and providing swift and	With constant improvement, and development, ChatGPT has potential to revolutionize customer and patient service.	Haleem et al, 2024

			accurate responses to client inquiries.		
	South Korea	To emphasize the potential use of ChatGPT in clinical practice, virtual assistance and patient communication.	ChatGPT serves as a viable source for prompt information and patient guidance.	Reliability and correctness of the information provided must be enhanced to prevent misleading or false information sharing.	Alam, 2024
CHATGPT IN PHARMACY AND HEALTH EDUCATION	UAE	To present a favorable argument in favour of ChatGPT incorporation into education	Reported increased utilization of ChatGPT in education by students and educators alike.	The development of dedicated academia chatbot (ChatGPT-Academia) with regulations and tailored features to support students and educators.	Halaweh Mohanad, 2023
	Malaysia	Assess the use of ChatGPT by undergraduate health students in Malaysia.	Positive attitudes towards the use of ChatGPT by healthcare students in their academics.	Creation of guidelines for implementing interactive chatbots in healthcare education.	Pallivathukal, et al, 2024
	USA	To evaluate the impact of ChatGPT on Pharmacy student's achievement on educational outcomes.	82% of the students acknowledged that ChatGPT helped them find and analyse information on medication.	The incorporation of ChatGPT into student learning activities is beneficial for an overall learning experience.	Goldman et al, 2024
	Thailand	To evaluate Thai medical students' perceptions on AI and its use in radiography.	93.6% of the students strongly supported the inclusion of AI training in medical school curricula and acknowledged its importance for their careers.	TO incorporate AI and ChatGPT in the training of radiology students.	Angkurawaranon et al, 2024
	Germany	Examining medical schools' biomedical ethical obligations when integrating AI applications into	(AI) in medicine is linked to new ethical obligations and concerns.	Creation of institutional policies for medical instructors and students on the moral use of AI.	Busch et al, 2023

		medical education.			
	Kosovo	This qualitative study examines how Kosovoan faculty members include ChatGPT, a type of artificial intelligence, into their lesson and lecture design.	ChatGPT is a useful tool for expediting time-consuming teaching duties.	Cooperation among educators to exchange best practices and continual training to increase understanding of ChatGPT's uses and ethical implications.	Kurti and Sylva, 2024
	Cyprus	To evaluate ChatGPT's use in dental education at the undergraduate level	students who used ChatGPT for their learning assignments fared noticeably higher on the knowledge test.	Teachers should consider incorporating ChatGPT into their lesson plans as well as perform awareness campaigns to inform teachers and students about ChatGPT's limitations and promote responsible use.	Kavadella et al, 2024
	Saudi Arabia	To evaluate healthcare students' attitudes, beliefs, perceptions, and perceived barriers around ChatGPT.	The majority of healthcare students are aware of ChatGPT, have favorable opinions of it, and believe it could improve education and productivity.	Future research should focus on improving the moral and effective use of AI tools, and ChatGPT in the classroom is essential.	Alharbi et al, 2024
	USA	To highlight the potential in the use of the (ChatGPT) tool to assist the documentation process in nursing education.	ChatGPT still lacks the specificity necessary for nursing diagnoses, which frequently leads to inaccurate responses.	A significant amount of human critical thinking and fact-checking is still necessary when using ChatGPT in nursing education.	Gosak et al, 2024
	USA	To assess the perceptions of healthcare students on frequency of ChatGPT's use, perceived risks, and ethical	Despite extensive use, 42% of students were unaware of ChatGPT and its use in healthcare.	It is necessary for medical educators to investigate the integration of chatbots into undergraduate health care education programs.	Ojeda et al, 2024

		concerns.			
	Algeria	A comprehensive analysis of earlier studies on ChatGPT's use in the healthcare and education industries.	ChatGPT was found to be useful in different areas of healthcare as well as medical education.	Encouraging the ethical and responsible use of ChatGPT technology, improving stakeholder training, and revising sector-specific standards.	Hamad et al, 2024
CHATGPT LIMITATIONS AND ETHICAL CONCERNS	Saudi Arabia	To identify potential barriers to AI Chatbot adoption among HCPs.	Credibility and source of information provided by ChatGPT is the main barriers to its adoption.	To ensure the dependability and trustworthiness of AI Chatbots.	Temsah et al, 2023
	Greece	To summarize the potential applications and consequential implications of ChatGPT in Education, Clinical Practice and Research.	Rational concerns on the originality and of research and academic integrity.	Increased vigilance and formulation of ethical framework to harvest the potential of ChatGPT	Kapsali et al, 2024
	Turkey	Examining AI risks in medicine and proposing policies for risk reduction and benefit optimization.	While AI has the potential to revolutionize healthcare, it also carries significant risks that may contribute to healthcare inequities, misdiagnoses, and inappropriate treatments.	These include developing continuous education and auditing mechanisms, putting in place a participatory society-in-the-loop management approach, and raising AI literacy.	Ilikhan et al, 2024
	USA	To investigate how clinical judgments are impacted by biases that arise in medical artificial intelligence (AI).	Results show that these biases have the potential to change clinical results and affect outcomes.	We advise the use of broad and varied data sets, advanced statistical techniques to eliminate biases, and unambiguous reporting guidelines.	Cross et al, 2024
	USA	To educate stakeholders on the potential impact of AI bias on healthcare outcomes and equip them with	Bias impacts and pose a reasonable threat to disease and overall health outcomes.	An expanded Total Product Lifecycle (TPLC) framework for healthcare AI that identifies the sources and effects of bias and proposes strategies for mitigation.	Abramoff et al, 2023

		strategies to identify and mitigate inequities.			
	USA	The purpose of this study is to investigate if ChatGPT chatbots offer trustworthy advice on quitting smoking.	The research revealed that the Chatbot though with certain misinformations , offered reliable information on strategies for quitting smoking, and also recommended seeking professional service.	The instructions for the LLM chatbot can be changed to make up for these informational flaws.	Abroms et al, 2025
	TURKEY	To raise awareness of the significance of proactively recognizing and correcting AI bias within the medical imaging community.	The review showed that a number of biases could jeopardize AI in medical imaging and have a negative impact on patient outcomes.	Raising public knowledge of biases in its various forms could aid in the creation of more efficient regulatory structures.	Kocak et al, 2024
	India	To harness ChatGPT potential in healthcare and scientific writing.	ChatGPT has drawbacks, such as producing erroneous references and difficulty with critical thinking tasks, which calls for strict cross-verification.	In order to create domain-specific tools, standards, and laws and to responsibly utilize AI's potential, cooperation between AI developers, researchers, educators, and politicians is essential.	Jeyaraman et al, 2023
	Saudi Arabia	This study examines the attitudes, opinions, perceptions, and perceived challenges of healthcare students at King	The findings reveal that most healthcare students are familiar with ChatGPT, view it positively, and	Future studies should focus on improving the ethical and effective use of AI tools like ChatGPT in academic settings.	Alharbi et al, 2024

		Saud University, Riyadh, Saudi Arabia, toward ChatGPT.	believe it can boost productivity and enhance education.		
	South Korea	This study examines the drawbacks of ChatGPT, such as lack of human judgment, data quality issues, accountability concerns, overreliance risks, and medico-legal and ethical challenges.	ChatGPT lacked the broader perspective of responses to queries which can pose significant challenges	Additional research is necessary to explore the use of AI chatbots in medical and health education, incorporating a wider variety of questions and more advanced chatbot versions.	Alam et al, 2024
OTHER AREAS OF CHATGPT APPLICATION	South Korea	Assessment of the ChatGPT's performance in national licensing examinations for medical, pharmacy, dentistry, and nursing.	In health licensing examinations, ChatGPT models demonstrated proficiency in the following order: pharmacy, medicine, dentistry, and nursing.	Further research is needed to investigate the use of AI chatbots in medical and health education, incorporating diverse questions and more advanced chatbot versions.	Jin et al, 2024
	Iraq	Assesing the usefulnessness of ChatGPT in healthcare delivery services in remote and under-served regions.	Implementing ChatGPT in rural healthcare reduces the challenges related to restricted accessibilities to medicines and resources.	The resourcefulness of ChatGPT does not replace the need for human professionals in rural healthcare settings.	Ahmed et al, 2023
	Saudi Arabia	This review examines how ChatGPT is transforming medical research, improving patient care and treatment regimens, and addressing complex health science issues.	ChatGPT is at the forefront of delivering individualized mental health care and enhancing the management of chronic conditions.	To fully realize AI's promise in improving healthcare, the evaluation highlights the need for smooth integration, interoperability, and the preservation of AI systems' accuracy and dependability.	Anas Alhur, 2024
	USA	Assessing the	ChatGPT can	ChatGPT has the potential to	Sharma and Thakur,

		potential use of ChatGPT in drug discovery.	assist in identifying and validating new drug targets, designing new drugs, optimizing drug properties, assessing toxicity, and generating drug-related reports.	be a powerful and promising tool in drug discovery, but its associated ethical concerns must be addressed.	2024
	Netherlands	A guide for the transparent use of ChatGPT in scientific writing.	ChatGPT assists researchers and students to carry out scientific writings.	It is essential to provide adequate information about the use of ChatGPT, along with proper accreditation and verification of its usage.	Aczel and Wagenmakers, 2024
	Ireland	Evaluating ChatGPT's effectiveness for academic writing in biomedicine.	ChatGPT was found to generate original, precise, and accurate responses with a systematic approach.	While ChatGPT can aid in enhancing academic writing skills, there is need to support the advocacy for universal design in learning, and promote the proper use of ChatGPT under academic mentoring.	Kumar Arun, 2023
	UK	Assessing the usefulness of ChatGPT as a tool for researchers	Reliance on ChatGPT for research poses risks such as the potential for incorrect or nonsensical answers, limited knowledge up to the year 2021, absence of legal personality, and the possibility of plagiarism.	ChatGPT does not meet the ICMJE 4 criteria and therefore cannot be listed as an author. Authors should be transparent about their use of ChatGPT and take responsibility for the content it generates.	Chris Zielinski, 2023
	USA	Evaluating the future of medical writing in the era of ChatGPT	The findings indicate that Chat GPT improved efficiency in medical writing	Suboptimal understanding of the medical field, ethical concerns, risk of bias, legal issues, and various limitations of ChatGPT should be carefully considered.	Som Biswas, 2023
	USA	Evaluating	The findings	While ChatGPT has the	Lund and Wang, 2023

		ChatGPT's impact in academia	reveal that ChatGPT is useful for literature reviews, can assist in data analysis, and aid in translation.	potential to advance academia, it is important to consider how to use it responsibly and ethically.	
	USA	Evaluating the output of a conversation with ChatGPT regarding the use of rapamycin.	ChatGPT provided an accurate summary of rapamycin's side effects and emphasized the importance of consulting a healthcare provider based on the specific situation.	A demonstration of ChatGPT's potential to generate complex content, though human professional oversight must always be maintained.	Alex Zhavoronkov, 2022
	Korea	Comparing ChatGPT's performance on a parasitology exam with that of Korean medical students.	ChatGPT's performance was lower compared to medical students, with plausible explanations for incorrect answers including hallucination.	ChatGPT's performance is expected to improve with continued training and upgrades, and healthcare educators and students are encouraged to incorporate this tool into the educational process.	Sun Huh, 2023