

# The promise and challenges of ChatGPT in community pharmacy: A comparative analysis of response accuracy

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## Abstract

This study evaluates ChatGPT, an AI-based language model, in addressing common pharmacist inquiries in community pharmacies. The assessment encompasses Drug-Drug Interactions, Adverse Drug Effects, Drug Dosage, and Alternative Therapies, each comprising 20 questions, totaling 80 questions. Responses from ChatGPT were compared against standard answers, generating textual and chart scores. Textual score was computed by relating correct answers to the total questions within each category, while chart score involved the total correct answers multiplied by the chart-type questions. ChatGPT exhibited distinct performance rates: 30% for Drug-Drug Interactions, 65% for Adverse Drug Effects, 35% for Drug Dosage, and an impressive 85% for Alternative Therapies. While Alternative Therapies displayed high accuracy, challenges arose in accurately addressing Drug Dosage and Drug-Drug Interactions. Conclusion: The study underscores the complexity of pharmacy-related inquiries and the necessity for AI model enhancement. Despite promising accuracy in certain categories, like Alternative Therapies, improvements are crucial for Drug Dosage and Drug-Drug Interactions. The findings emphasize the need for ongoing AI model development to optimize integration into community pharmacy settings.

## Keywords

ChatGPT, community pharmacy, healthcare, effectiveness and technology

## Introduction

In recent years, the integration of artificial intelligence (AI) and natural language processing (NLP) technologies has revolutionized various sectors, including healthcare (Das et al. 2021). Community pharmacy, as a vital component of the healthcare system, is not exempt from the transformative impact of these innovations. Chatbots, powered by advanced AI models like Chat GPT (Generative Pre-trained Transformer), have emerged as a promising tool in the community pharmacy landscape (Nelson et al. 2020). The purpose of this research paper is to elucidate the sig-

nificance of employing Chat GPT in community pharmacies and how this technology can profoundly enhance patient engagement, streamline information dissemination, and ultimately improve healthcare outcomes (George and Elrashid 2023). The advent of Chat GPT represents a significant leap forward in the field of AI-powered conversational agents. Chat GPT utilizes deep learning and NLP techniques to generate human-like text and engage in meaningful dialogues. It learns from vast amounts of text data, enabling it to comprehend and generate responses that mimic human conversation (Raza et al. 2022). In the context of community pharmacy, integrating Chat GPT

into existing systems can revolutionize patient-pharmacist interactions, providing efficient and personalized services to individuals seeking pharmaceutical guidance and support. Community pharmacies play a pivotal role in public health by providing essential healthcare services, including medication dispensing, medication therapy management, health screenings, and patient counseling (Howorko 2009). However, pharmacies are often bustling with activity, and pharmacists may find it challenging to devote extensive time to each patient. This is where Chat GPT can make a substantial difference (Huang et al. 2023; Zhu et al. 2023). By automating routine inquiries and providing accurate, tailored responses, Chat GPT can help alleviate the burden on pharmacists and allow them to focus on more complex and specialized patient needs. Moreover, the adoption of technology, such as Chat GPT, aligns with the modernization of healthcare services. (Flynn 2019). This not only enhances patient satisfaction but also ensures that patients are well-informed about their medications, conditions, and overall health. Another crucial aspect of employing Chat GPT in community pharmacy is its potential to enhance medication adherence. Non-adherence to prescribed medications remains a significant concern in healthcare, leading to compromised treatment outcomes and increased healthcare costs. Chat GPT can be programmed to send medication reminders, provide instructions on proper usage, and offer support in overcoming adherence challenges. By personalizing these reminders and tailoring them to each patient's unique needs, Chat GPT can significantly contribute to improving medication adherence rates. In conclusion, the integration of Chat GPT in community pharmacies represents a transformative step towards enhancing patient engagement and optimizing healthcare services. This technology has the potential to streamline communication, increase efficiency, improve medication adherence, and ultimately elevate the standard of care provided by community pharmacies. As healthcare continues to evolve in the digital age, embracing innovative technologies like Chat GPT is imperative for community pharmacies to remain at the forefront of patient-centered care (Stasevych and Zvarych 2023).

In this study, we aim to evaluate the efficacy of ChatGPT in providing accurate responses to a diverse range of inquiries commonly encountered by pharmacists in community pharmacy settings.

## Methods

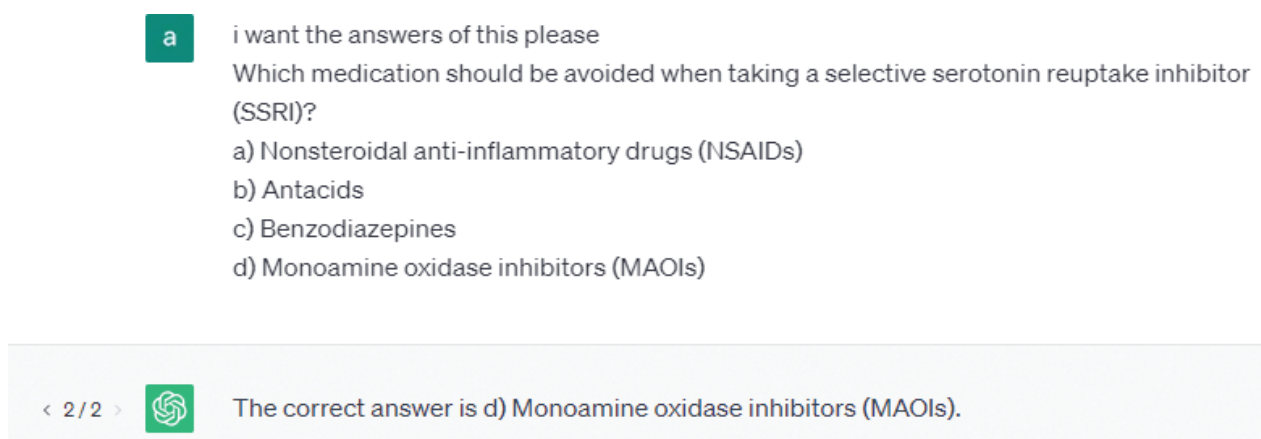
### Study design

The inquiry into four distinct categories—Drug-Drug Interactions, Adverse Drug Effects, Drug Dosage, and Alternative Therapies—involved the manual input of questions into ChatGPT, as depicted in Fig. 1. Real-world clinical cases and assessments of clinical pharmacist competency provided the pool of questions and corresponding answers. The responses generated by ChatGPT were obtained by inputting identical questions into the 'New Chat' box of ChatGPT Mar 23 Version. For reference, answers were aligned with the German guideline of drug information and categorized based on the sources used. To ensure reliability, the reproducibility of ChatGPT's responses was analyzed by repeating the input of three questions at various timepoints (day 1, day 2, week 2, week 3).

**Step 2** involved consolidating each question along with its corresponding response into a singular entry. **Step 3** expanded the dataset by obtaining 20 questions from each category through collaboration with pharmacists in community pharmacies. This process helped establish a standardized question format.

To evaluate performance, the answers generated by ChatGPT were compared against standard responses, and scores were tallied. Textual scores were determined by dividing the total number of questions in each category by the score (ranging from 0 to 100 points) and then multiplying the result by the number of accurate responses. Chart scores were computed by multiplying the total count of correct answers by the quantity of chart-type questions within each category.

The mean score for each stage surpassed 60 points, meeting the stipulated passing threshold (a score of 60 points or higher) for both stages. The model test utilizing ChatGPT 3.5 was conducted from September 12 to 15, 2023.



**Figure 1.** Templet of questions posed.

## Study analysis

The relevant data for this study were collected and analyzed as percentages by using Microsoft Excel (Microsoft, Redmond, WA, USA).

The correlation between perceived benefits and concerns was evaluated using Spearman's rho correlation due to the data's non-normal distribution.

## Results

In this study, we have expanded the scope by introducing four categories, encompassing a grand total of 80 questions, with each category comprising 20 multiple-choice questions, offering respondents a wider array of options to choose from (A, B, C, or D). Fig. 3 showed the percentage of correct answers.

The results were shown in Table 1. In first category (category a) about drug - drug interaction, the correct answers were 6 out of 20 with correct rate 30%. The second category B, the adverse effects show that the correct answers was 17 with success rate 65%. In the third category (category C) the results shows that the success rate was only 35%. In the last category D, the chat GPT has the high success rate with 85% (Fig. 2 shows templet about alternative therapy).

**Table 1.** Overview of ChatGPT's performance.

Category	Number of questions	Number of correct questions	% of correct questions
Drug -Drug interactions	20	6	30%
Adverse drug effects	20	13	65%
Drug dosing	20	7	35%
Alternative therapy	20	17	85%

a

patient has penicillin allergy , what is the alternative therapy we can give it to him



If a patient has a documented penicillin allergy, alternative therapies can be considered depending on the specific condition being treated. Here are some commonly used alternatives to penicillin:

1. **Cephalosporins:** Cephalosporins are a class of antibiotics that are structurally related to penicillins but have a different side chain. Many people with penicillin allergies can safely tolerate cephalosporins. However, if the penicillin allergy is severe or anaphylactic, caution is still advised.
2. **Macrolides:** Macrolide antibiotics, such as erythromycin, clarithromycin, and azithromycin, are often used as alternatives to penicillin for various infections. They have a different chemical structure and are generally considered safe for individuals with penicillin allergies.
3. **Clindamycin:** Clindamycin is an antibiotic that can be an alternative for certain infections when a patient is allergic to penicillin. It is commonly used for skin and soft tissue infections, dental infections, and some respiratory tract infections.

**Figure 2.** Templet about alternative therapy questions.

Table 2 displays the correlation between acknowledged advantages of ChatGPT and noted apprehensions. The Spearman's rho correlation coefficient is 0.255 ( $p < 0.001$ ), indicating a statistically significant, albeit weak, positive correlation between the perceived benefits and concerns of ChatGPT. The significance level is  $p < 0.001$ .

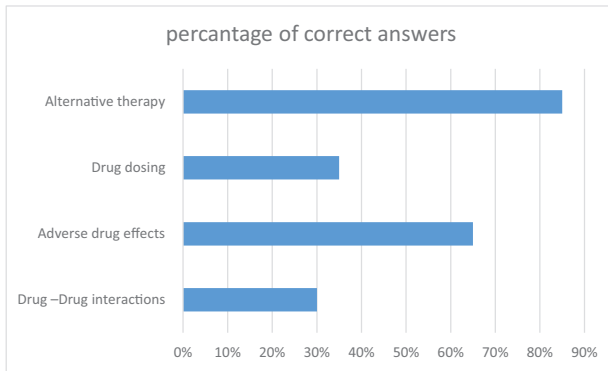
**Table 2.** Correlation between perceived benefits and concerns.

		Perceived benefits	Perceived concerns
Spearman's rho	Perceived benefits	Correlation coefficient	0.98
		p value	0.35
	Perceived concerns	Correlation coefficient	0.35
		p value	<0.001*

\*Correlation is significant at the 0.05 significance level.

## Discussion

The research paper presents a comprehensive assessment of ChatGPT's effectiveness in providing accurate responses to diverse inquiries commonly encountered by pharmacists in community pharmacy settings. The study employed a well-structured methodology, categorizing questions into five distinct groups, each consisting of twenty questions, to evaluate ChatGPT's performance. These categories encompassed fundamental aspects of pharmacy practice, including drug-drug interactions, adverse drug effects, drug dosage, and alternative therapies. The study's results indicate varying performance levels of ChatGPT across these categories. Let us delve deeper



**Figure 3.** Percentage of correct answers.

into these findings and discuss their implications. **Drug-Drug Interactions (Category A):** Within this category, ChatGPT demonstrated a correct response rate of 30%. While this performance appears relatively low, it is essential to recognize the intricacy of drug-drug interactions and the challenges associated with providing precise responses (Ranchon et al. 2023). Many drug interactions are nuanced and context-dependent, posing difficulties even for human pharmacists attempting to offer accurate answers without a comprehensive understanding of the patient's medical history (Donepudi 2018). Enhancing ChatGPT's grasp of drug interactions is imperative to augment its success rate in this category (Biswas 2023). **Adverse Drug Effects (Category B):** The results for Category B reveal a higher success rate of 65%, suggesting that ChatGPT excels in identifying and describing adverse drug effects (Sharma et al. 2021). Adverse drug reactions constitute a critical aspect of pharmacists' duties, and an AI tool proficient in providing accurate information in this area can prove immensely beneficial. Nonetheless, further research and refinement of the model could enhance its performance even further. **Drug Dosage (Category C):** Category C presented the lowest success rate, at only 35%. Drug dosage calculations represent a complex task requiring precise and context-specific information (Al Meslamani 2023). The diminished success rate in this category may be attributed to the complexities involved in determining appropriate dosages based on a patient's individual characteristics, medical history, and other factors. Developing more sophisticated algorithms or integrating real-time patient data might assist in improving the model's performance in this domain. **Alternative Therapies (Category D):** The study revealed an impressive success rate of 85% in Category D, which focuses on alternative therapies. This outcome is encouraging given the growing interest in and adoption of alternative therapies by patients. An AI tool capable of providing reliable information about these therapies can be invaluable for pharmacists when addressing patients' inquiries (Cain et al. 2023). However, it is imperative to ensure that ChatGPT's responses are evidence-based and not misleading or potentially harmful. While the study provides

valuable insights into ChatGPT's performance in a pharmacy context, it also has some limitations that warrant acknowledgment. Firstly, the study concentrated on a specific version of ChatGPT (ChatGPT 3.5), and thus, the results may not be generalizable to other AI models or versions. Additionally, the evaluation of ChatGPT's performance was based on a predefined set of questions, which may not fully encapsulate the broad spectrum of inquiries pharmacists encounter in real-world practice. Furthermore, the study did not explore the potential impact of user demographics or experience levels on ChatGPT's effectiveness, which could be an intriguing avenue for future research. **Practical Implications and Future Directions:** Despite the limitations, the study's findings hold practical implications for the integration of AI tools like ChatGPT in community pharmacy settings (Ho et al. 2023). ChatGPT's relatively high success rates in specific categories, such as adverse drug effects and alternative therapies, suggest its potential as a valuable resource for pharmacists, enhancing their decision-making processes and providing accurate information to patients (Ramesh et al. 2021). To further refine ChatGPT's performance in areas with lower success rates, such as drug dosage and drug-drug interactions, several strategies can be considered. Augmenting the dataset with more diverse and context-rich examples may aid the model in better understanding the complexities of these topics (Morath et al. 2023). Additionally, integrating real-time patient data, such as medical history and drug profiles, could enhance response accuracy. It is crucial to emphasize that AI tools like ChatGPT should not be viewed as replacements for human pharmacists but rather as supportive tools to amplify their capabilities. As AI technology continues to advance, ensuring the validation, evidence-based nature, and ethical deployment of AI models in healthcare settings is of paramount importance.

## Conclusion

In conclusion, this research paper provides valuable insights into the use of ChatGPT in a community pharmacy context. The study's findings shed light on the AI model's strengths and weaknesses in addressing different categories of inquiries. By understanding these results and their implications, researchers and healthcare professionals can work together to further refine AI models, ensuring they become reliable and valuable assets in delivering patient-centered care.

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