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Review

ChatGPT in Pharmacy Practice: Disruptive or Destructive Innovation? A Scoping Review

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Abstract: ChatGPT has emerged as a promising tool for enhancing clinical practice. However, its implementation raises critical questions about its impact on this field. In this scoping review, we explored the utility of ChatGPT in pharmacy practice. A search was conducted in five databases up to 23 May 2024. Studies analyzing the use of ChatGPT with direct or potential applications in pharmacy practice were included. A total of 839 records were identified, of which 14 studies were included: six tested ChatGPT version 3.5, three tested version 4.0, three tested both versions, one used version 3.0, and one did not specify the version. Only half of the studies evaluated ChatGPT in real-world scenarios. A reasonable number of papers analyzed the use of ChatGPT in pharmacy practice, highlighting both benefits and limitations. The studies indicated that ChatGPT is not fully prepared for use in pharmacy practice due to significant limitations. However, there is great potential for its application in this context in the near future, following further improvements to the tool. Further exploration of its use in pharmacy practice is required, along with proposing its conscious and appropriate utilization.

Keywords: artificial intelligence; ChatGPT; pharmacy; pharmacy practice; pharmaceutical services

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1. Introduction

Artificial intelligence (AI) holds real promise for medicine and health, whether in scientific research, clinical practice, or education, but there are still major challenges to optimizing its use [1,2]. Among them, the use of AI-based natural language models (NLM) is increasing in healthcare-related contexts that have historically comprised human-to-human interaction, once using algorithms to understand and generate human-like conversations [3]. These models, such as Generative Pre-trained Transformer (GPT) or Bidirectional Encoder Representations from Transformers (BERT), have reached state-of-the-art performance over most computerized language processing tasks such as web search, automatic translation, automatic content generation, and question-answering [4].

On 30 November 2022, OpenAI released for public use the version of its AI-based large language model (LLM) for text generation, the ChatGPT [5]. This tool is based on GPT models and is trained to generate text similar to human-generated text from several hundred billion words of a vast crawl of websites and datasets, allowing the model to learn the nuances of natural language and generate coherent text [6]. ChatGPT can be used in multiple contexts, such as chatbots, virtual assistants, and customer services [7].

The use of chatbots with GPT models is useful in the healthcare field, helping to provide accurate information and answers to patients and healthcare professionals [3,8–10]. In addition, these chatbots can provide clinical and educational support, such as answering frequent basic questions, reviewing concepts, taking examinations for higher education students [9–12], as well as assisting researchers in scientific writing, supporting them in generating ideas, and improving the writing of their articles [9,10,13,14]. However, some

articles have warned against the use of this AI, highlighting that it can provide answers that are not clinically accurate or ethically appropriate [15,16], impair students' ability to think critically and make informed decisions [17], and pose risks to academic integrity and copyright infringement (plagiarism) [18,19].

In this article, we have focused on the potential use of ChatGPT in pharmacy practice. Pharmacy practice encompasses the "interpretation, evaluation, and implementation of medical orders; the dispensing of prescription drug orders; participation in drug and device selection; drug administration; drug regimen review; the practice of telepharmacy within and across state lines; drug or drug-related research; the provision of patient counseling; the provision of those acts or services necessary to provide pharmacist care in all areas of patient care, including primary care and collaborative pharmacy practice; and the responsibility for compounding and labeling of drugs and devices, proper and safe storage of drugs and devices, and maintenance of required records" [20]. Despite its limitations and potential biases, a published editorial suggested that ChatGPT could offer several benefits for pharmacy practice, such as answering clinical questions, informing pharmacists, and educating patients [21]. However, to date, there is no scoping review which synthesizes the findings of studies that investigated the utility of ChatGPT in the pharmacy practice. Thus, this scoping review aimed to explore the utility of ChatGPT in pharmacy practice. A synthesis of manuscripts describing its use is important for identifying future research opportunities and understanding the added value and implications for decision-making.

2. Methods

A scoping review was performed to provide structured and detailed findings on using ChatGPT in pharmacy practice. This review was conducted following the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement for Scoping Reviews (PRISMA-ScR) and the protocol was registered into the Open Science Framework platform (https://osf.io/f5bv7, accessed on 19 June 2024).

2.1. Databases and Search Strategy

A comprehensive search for relevant literature was conducted in the databases Medline (PubMed), Embase, Scopus, Web of Science, and LILACS (Latin American and Caribbean Health Sciences Literature) until 23 May 2024, without date restriction and regardless of the study design and language. In addition, a manual search was carried out on the references of the selected studies. The full strategies search for all databases can be found in Supplementary Table S1.

2.2. Study Selection

Eligible studies included original research that analyzed the use of ChatGPT by pharmacists within the context of pharmacy practice. Manuscripts that reported on ChatGPT through a descriptive approach, used other AI models, did not describe the use of ChatGPT, or excluded studies on the performance of ChatGPT in different fields of knowledge, were excluded. Preprints, reviews, comments, editorials, qualitative studies, chapters and books, and manuscripts that did not fit the review question were also excluded.

The manuscripts retrieved from the databases were allocated to the Rayyan QCRI web program [22] to exclude duplicate files (Phase 1), analyze the titles and abstracts of the articles (Phase 2), and analyze complete articles whose abstracts were previously selected (Phase 3). Two reviewers (T.M.L and M.B.V) independently reviewed the titles and abstracts of all studies identified by the searches and discussed any discrepancies arising from consensus. When it was not possible to obtain the full text, the corresponding authors were contacted via email or through the ResearchGate platform (www.researchgate.net, accessed on 10 July 2024).

2.3. Data Extraction and Analysis

The data were collected in a pre-formatted spreadsheet in Microsoft Excel®, including author; year; country; publication type (according to how it was indexed); study design (as described by authors); version/date of use of ChatGPT; context; objectives; the method used; outcome measures; main findings; and limitations. Two independent reviewers (M.B.V and T.M.L) extracted data, and disagreements were resolved by consensus. We also used Elicit (https://elicit.org/, accessed on 20 July 2024) and Scispace (https://scispace.com/, accessed on 20 July 2024) online tools to complement this process. A narrative and tabular synthesis of the results were provided according to the characteristics of the studies. The original ideas and concepts of the included studies were respected.

3. Results

The electronic search identified 839 potentially relevant records. After removing duplicates and reviewing the titles and abstracts, 54 articles were selected for full-text examination. Three studies were not retrieved, and no relevant studies were identified in the reference lists of the included studies. Of these, 14 studies met the inclusion criteria for review [23–36]. Figure 1 shows a flowchart of the literature search.

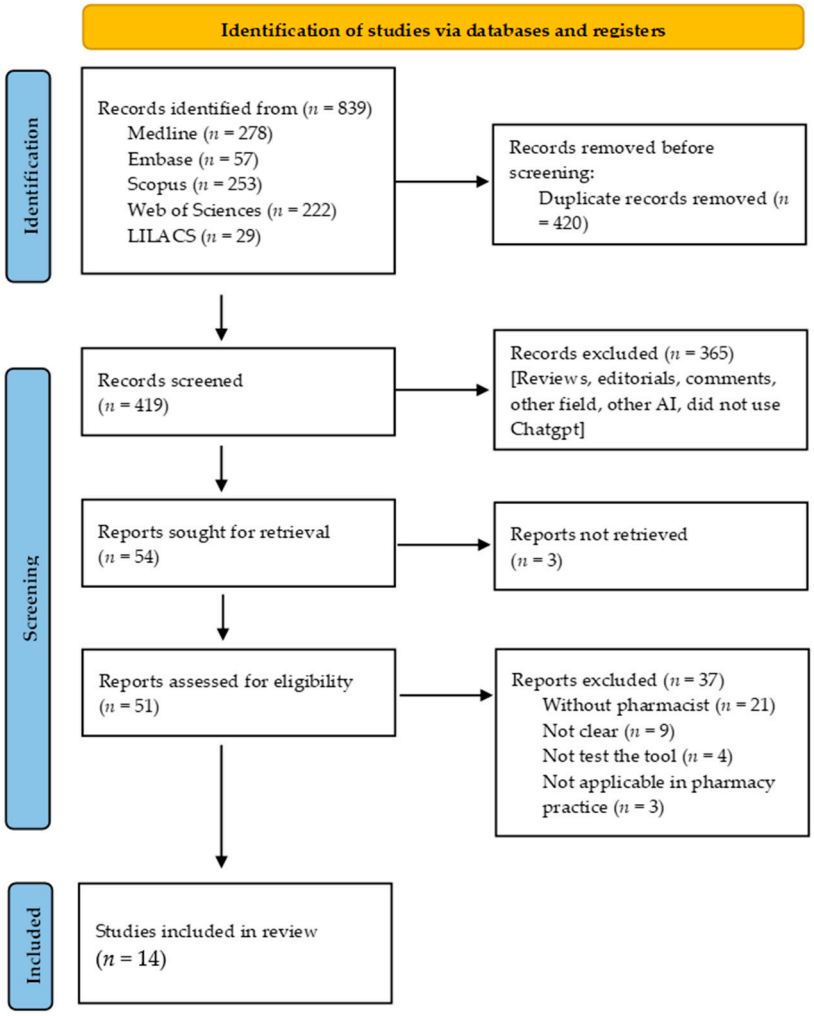

Figure 1. Study selection flowchart through literature search.

3.1. Characteristics of the Included Studies

The characteristics of the fourteen studies included in this review are summarized in Table 1. All studies were published in English and reported between 2023 and 2024. Studies were conducted in Asia (n = 6) [23–25,28,29,34], North America (n = 4) [26,32,33,35], and

Europe (n = 4) [27,30,31,36]. Thirteen studies [23–25,27–36] were published as original articles (also called research articles and original research) and one as a brief report [26]. Study designs were classified as comparative studies (n = 5) [23,26,29,34,35], followed by cross-sectional studies (n = 3) [28,30,36]. Two studies did not specify the study design [32,33]. Six studies [24,28,29,32,34,36] used ChatGPT version 3.5, three studies [27,30,33] used version 4.0, and three studies [23,25,35] used both versions. One study used an older version [31], and another study did not describe the version used [26]. Four studies [30,31,34,35] tested ChatGPT in the drug information context, followed by clinical pharmacy questions [27,32] and medication consultation [28,29]. All contexts are illustrated in Figure 2.

Table 1. Characteristics of the included studies.

Author, Year	Country	Publication Type	Study Design	Version/Date of Use of ChatGPT	Context
Al-Ashwal et al., 2023 [23]	Yemen, Iraq, Jordan, and Malaysia	Original research	Analytical comparative study	ChatGPT-3.5 and ChatGPT-4.0/May 2023	Drug–drug interactions
Al-Dujaili et al., 2023 [24]	Iraq and Lebanon	Research article	Preliminary analysis	ChatGPT-3.5/February and March 2023	Pharmacotherapy cases
Bazzari and Bazzari, 2024 [25]	Jordan	Original article	Observational	ChatGPT-3.5 and ChatGPT-4.0/December 2023	Telepharmacy
Covington et al., 2024 [26]	United States	Brief report	Comparative study	NR/NR	Patient Education
Fournier et al., 2024 [27]	Swiderland	Original article	Retrospective observational study	ChatGPT-4.0/March 2023	Clinical pharmacy questions
Hsu et al., 2023 [28]	Taiwan	Original paper	Prospective cross-sectional study	ChatGPT-3.5/February 2023	Medication consultation
Huang et al., 2023 [29]	China	Original article	Comparative study	ChatGPT-3.5/March 2023	Medication consultation
Montastruc et al., 2023 [30]	France	Research	Cross-sectional study	ChatGPT-4.0/NR	Drug information
Morath et al., 2023 [31]	Germany	Original research	Exploratory real-world analysis	ChatGPT-3/January 2023	Drug information
Munir et al., 2024 [32]	United States	Original Research article	NR	ChatGPT-3.5/February to April 2023	Clinical pharmacy questions
Roosan et al., 2024 [33]	United States	Research	NR	ChatGPT 4.0/NR	Medication therapy management
Salama, 2024 [34]	Jordan	Research article	Comparative study	ChatGPT-3.5/September 2023	Drug information
Sheikh et al., 2024 [35]	United States	Original Research article	Comparative study	ChatGPT-3.5 and ChatGPT-4/March to May 2023	Drug information
van Nuland et al., 2024 [36]	Netherlands	Research	Retrospective cross-sectional study	ChatGPT-3.5/NR	Dose modification in patients with renal impairment

NR (not reported).

Figure 2. Word cloud of contexts in which ChatGPT was tested. It was generated using the Word Clouds tool (available at https://www.wordclouds.com/, accessed on 10 August 2024).

3.2. Main Results of the Included Studies

Table 2 shows the objectives, methods and measured variables, main findings, and limitations of the fourteen studies included. The studies verified the utility of ChatGPT in: identifying drug interactions compared to recognized databases [23]; managing pharmacotherapy cases [24]; acting as a pharmacist in a service of telepharmacy [25]; creating patient education materials [26]; responding to questions asked to a pharmacist [27,28,34] or asked by pharmacists to other services [30]; resolving drug-related and pharmacy-based questions [31,32]; performing prescription review, patient medication education, adverse drug reaction recognition and causality assessment, and drug counseling [29]; optimizing medication therapy management [33]; providing drug safety information of non-prescription medications and supplements used by individuals with kidney disease [35]; intervening in the drug dose for hospitalized patients with renal dysfunction [36]. Only half of the studies evaluated ChatGPT in real-world scenarios [27–31,34,36].

Studies used several methods and measured variables to analyze ChatGPT. The studies that compared ChatGPT 4.0 with version 3.5 showed that version 4.0 has superior performance for pharmacy practice [23,25,35]. Moreover, some studies showed positive results with ChatGPT use: it was capable of generating clinically relevant pharmaceutical information [24]; ChatGPT maintained excellent accuracy in medication counseling [29]; ChatGPT answered 100% of the questions on pharmacy calculation correctly [32]; and ChatGPT successfully identified drug interactions, provided therapy recommendations, and formulated a general management plan in 100% of patient cases [33].

However, the studies also highlighted important limitations related to its use: a lack of a patient-centered and individualized approach that a human pharmacist would provide [25]; the variable accuracy scores prevent the routine use of ChatGPT to produce medication-related patient education materials at this time [26]; ChatGPT did not provide better answers than those recorded by the pharmacists, especially for prescription-related questions [27]; ChatGPT did not perform well on questions about drug–herb interactions and those related to the hospital setting [28]; ChatGPT was weak in prescription review, patient medication education, and adverse drug reaction recognition and causality assessments [29]; ChatGPT showed a lower accuracy in questions regarding drug causality [30]; ChatGPT answered the majority of real-world drug-related questions wrong or partly wrong [31]; ChatGPT scored low in drug information enhanced prompt and patient case categories [32]; ChatGPT exhibited a lower percentage of correct answers for drug–drug interactions, adverse drug effects, and for drug dosage [34]; ChatGPT did not show good concordance with Micromedex when used as drug information sources for medication safety of non-prescription medications and supplements in individuals with kidney disease [35]; and ChatGPT's performance in clinical rule-guided dose interventions for hospitalized patients with renal dysfunction was poor [36]. Studies also addressed ethical concerns and privacy issues with sharing patient information with ChatGPT [25,27].

Table 2. Objectives, methods and measured variables, main findings, and limitations of the included studies.

Author, Year	Objectives	Method Used	Measured Variables	Main Findings	Limitations
Al-Ashwal et al., 2023 [23]	To compare ChatGPT-3.5, ChatGPT-4, Bing AI, and Bard performance in predicting DDI.	Two clinical DDI databases (Micromedex and Drugs.com) were used as standards. Five medications from two drug classes (SGLT2 inhibitors and macrolides) were selected.	Accuracy, specificity (disregard clinically irrelevant interactions), sensitivity (identify clinically important interactions), negative predictive value (likelihood of an ignored DDI being clinically insignificant), and positive predictive value (the chance that a detected DDI was indeed of clinical significance).	Microsoft Bing AI had the highest specificity (0.769) and accuracy (0.788) compared to ChatGPT-3.5, ChatGPT-4, and Bard. ChatGPT-3.5 had the lowest specificity (0.372) and accuracy (0.469) among the AI tools. All programs improved overall performance when the reference tool switched to a free DDI source, but ChatGPT-3.5 still had the lowest specificity (0.392) and accuracy (0.525). ChatGPT-4 improved the accuracy over ChatGPT-3.5 but still lagged behind Bing AI.	Comparisons were made with two conventional clinical tools (Micromedex and Drugs.com) for DDI and two drug classes (SGLT2 inhibitors and macrolides), which may vary significantly based on the tools chosen as standards and the drug classes included. The study focused on theoretical analysis and simulations, which may only partially represent real-world clinical scenarios where various other variables can influence outcomes. The rapid evolution of AI technology means that the performance of the AI systems evaluated in the study might change significantly with future updates and versions.
Al-Dujaili et al., 2023 [24]	To evaluate the accuracy and consistency of ChatGPT's responses to pharmacotherapy cases over multiple time points.	Twenty pharmacotherapy cases (48 questions total), were entered into ChatGPT at 3 time points (weeks 1, 3, and 5). Twenty clinical pharmacy experts from around the world were consulted on the same 20 cases.	The accuracy and consistency of ChatGPT's responses in managing pharmacotherapy cases were assessed using inter rater reliability and test–retest reliability. The percent agreement between ChatGPT's responses and those of clinical pharmacy experts worldwide was evaluated.	ChatGPT was able to generate clinically relevant pharmaceutical information, but its accuracy and consistency varied over time: 70.83% (week 1), 79.2% (week 3), and 75% (week 5). Clinical pharmacy experts showed considerable variation in accuracy, with the highest average accuracy in Europe, followed by North America, and Asia. The agreement between clinical pharmacy experts and ChatGPT increased over time (79.2%, 87.5%, 83.3% at different weeks).	ChatGPT generates irrelevant pharmacokinetic calculations and a lack of clinical reasoning. Potential bias in participant selection due to lack of specific inclusion criteria for clinical pharmacy experts. Need for further research with larger samples. Need for longitudinal studies with longer observation periods to provide a more comprehensive understanding.
Bazzari& Bazzari, 2024 [25]	To explore and assess the potential application of ChatGPT-3.5 and ChatGPT-4 in telepharmacy.	ChatGPT was instructed to act as a pharmacist over the phone and answer all upcoming patient questions, presented through a set of 20 life-like scenario questions. The authors developed these 20 assessment questions to address various aspects of patient medication counseling services.	The accuracy, precision, and clarity of ChatGPT's responses to assessment questions were evaluated using a 4-point Likert-like scale.	ChatGPT demonstrated the ability to role-play as a pharmacist, understand case details, and provide appropriate responses to drug-related questions. ChatGPT 4.0 showed superior performance, higher consistency, and the ability to report reliable information sources compared to ChatGPT 3.5.	Potential inaccuracies or unclarities in ChatGPT's responses, especially for complex or specialized cases. Lack of a patient-centered, individualized approach that a human pharmacist would provide. Limitation on the number of inquiries ChatGPT 0 can handle. Provision of incorrect feedback by ChatGPT 4.0. Potential ethical concerns around storing and analyzing patient information to address the feedback issue.
Covington et al., 2024 [26]	To evaluate the utility of ChatGPT as a source of medication-related patient education.	PEMs were obtained from ChatGPT and LexiComp for 8 common medications. PEMs were extracted, blinded, and assessed by 2 independent investigators. A 7-item accuracy checklist was generated by expert consensus, with LexiComp PEMs serving as the control.	Comparison of PEMs generated by ChatGPT and LexiComp using the PEMAT-P, which assesses the understandability and actionability of the instructions for patients. Comparison of literacy components (Flesch reading ease, Flesch Kincaid grade level, percent passive sentences, word count) and accuracy of the ChatGPT-generated PEMs.	ChatGPT-generated PEMs had similar understandability, but higher reading levels compared to the evidence-based resource. The average accuracy score for ChatGPT PEMs was 61%, with varying scores across medications (ranging from 29% to 86%). ChatGPT-generated materials had lower word counts and passive sentences, which could potentially benefit patients.	The reliance on expert consensus to create an accuracy checklist, which may introduce subjectivity and potential bias in the evaluation process. The use of a single database standard, which may not capture all aspects of patient education content. The small sample size of PEMs. The assessment of only a single prompt within ChatGPT.

Table 2. *Cont.*

Author, Year	Objectives	Method Used	Measured Variables	Main Findings	Limitations
Fournier et al., 2024 [27]	To assess ChatGPT's capacity to correctly respond to clinical pharmacy questions asked in a tertiary University Hospital.	The last 100 questions recorded in the institutional clinical pharmacy database, covering various categories such as logistics, documentation, prescriptions, drug administration, monitoring, extravasation, and other aspects, were selected. Two blinded clinical pharmacists assessed the correctness, completeness, and clarity of the AI-generated answers, classifying them as entirely correct, incomplete, no answer, or incorrect, while a third pharmacist intervened in cases of disagreement.	Hit percentage.	ChatGPT demonstrated a mixed performance in answering clinical pharmacy questions, with a global correct answer rate of 44.9%. The performance varied depending on the type of question, with ChatGPT performing better on logistical issues (57.1% correct) but worse on prescription-related questions (30% correct). ChatGPT did not provide better answers than those recorded by the pharmacists, as confirmed by the evaluation panel.	Small sample size (100 questions) from a single clinical pharmacy unit. Questions are limited to those documented in the database. Potential subjective biases or inconsistencies in the assessment by the panel of 3 blinded clinical pharmacists. Use of an older version of ChatGPT which may not reflect the most current or advanced version. Lack of exploration of the potential ethical or legal implications of using AI models in clinical practice.
Hsu et al., 2023 [28]	To evaluate the suitability of ChatGPT for answering real-world medication consultation questions in pharmaceutical services and to analyze the accuracy of its responses to drug–herb interaction questions, assessing its potential for use in medication education and consultation.	The test questions were divided into 2 groups: (1) 80 open-ended medication consultation questions (40 selected from the general public and 40 from healthcare professionals) and (2) 8 questions on drug–herb interactions. An assistant submitted the questions to ChatGPT and recorded the responses. Two experienced pharmacists independently reviewed the ChatGPT responses, and a third pharmacist was consulted to resolve any discrepancies.	Appropriateness rate.	The appropriateness rate for ChatGPT's responses to real-world medication consultation questions was 64%. The appropriateness rate was higher for public questions compared to those from hospital settings (61% vs. 39%; chi-square test, $p = 0.01$). ChatGPT exhibited an appropriateness rate of 50% in its responses regarding drug–herb interactions.	All questions and responses generated by ChatGPT were in Chinese. The responses in English may be more accurate than those in Chinese due to a larger data pool for the English language. The study used GPT-3.5, while a newer model, GPT-4, has been shown to produce fewer hallucinations. Some questions required background information, which may have led to less accurate ChatGPT responses.
Huang et al., 2023 [29]	To evaluate the performance of ChatGPT in the following key domains of clinical pharmacy practice in the real-world: prescription review, patient medication education, ADR recognition, ADR causality assessment, and medication counseling.	Questions and answers were collected from real clinical cases and clinical pharmacist competency assessments. All questions and answers were translated from Chinese to English using ChatGPT. Five clinical pharmacists independently rated the answers on a scale of 0 (completely incorrect) to 10 (completely correct). The mean scores of the answers provided by ChatGPT and clinical pharmacists were compared using a Student's *t*-test.	Accuracy.	ChatGPT was excellent accuracy in medication counseling (ChatGPT: 8.77 vs. clinical pharmacist: 9.50, $p = 0.0791$) and weak in prescription review (5.23 vs. 9.90, $p = 0.0089$), patient medication education (6.20 vs. 9.07, $p = 0.0032$), ADR recognition (5.07 vs. 9.70, $p = 0.0483$), and ADR causality assessment (4.03 vs. 9.73, $p = 0.023$).	The limited number of questions and prompts may not fully capture ChatGPT's capabilities and limitations. ChatGPT's understanding of medical terminology and concepts may be limited due to its restricted exposure to a medical training set and the absence of knowledge updates beyond 2021, leading to potential misinterpretations in the Chinese-English translation.
Montastruc et al., 2023 [30]	To evaluate the quality of answers provided by the OpenAI chatbot (GPT 4.0) in answering questions from a drug information service database.	Fifty questions related to information on medication and proper use and drug causality were selected from those submitted to a pharmacovigilance center by healthcare professionals (including community and hospital pharmacists) or patients. The responses generated by ChatGPT 4.0 were then compared to those provided by specialists in pharmacovigilance, considered the gold standard.	The chatbot's responses were rated on a Likert scale from 0 to 10, where 10 represented the same level of accuracy as that provided by a pharmacovigilance specialist. This scale was used to assess the quality of information, with scores ranging from 0 (unacceptable) to 10 (very good). Scores of 1–2 were considered very poor, 3–4 poor, 5–6 acceptable, 7–8 good, and 9–10 very good.	Median (IQR) rating of the 50 questions was 4.8 (3–7.3). Median (IQR) of answers regarding drug causality was 3.7 (3–6.3). Median (IQR) of answers regarding the information on medication and proper use was 5 (3.2–8.3). Chatbot answers were globally not acceptable with lower accuracy in questions regarding drug causality.	The representativeness of the sample regarding the queries received in the drug information service over a longer period is limited due to the small number of questions used. A blinded evaluation was not possible as answers written by the chatbot were too obvious. The specialist responses were considered the gold standard, and evaluators might be prone to subjective bias, by thinking that the chatbot cannot be as effective as a pharmacologist.

Table 2. *Cont.*

Author, Year	Objectives	Method Used	Measured Variables	Main Findings	Limitations
Morath et al., 2023 [31]	To investigate the performance and risk associated with ChatGPT to answer real-world drug-related questions.	A sample of 50 drug-related questions was collected. A panel of 6 senior hospital pharmacists evaluated the answers. Answers were also researched according to the German guidelines for drug information. The reproducibility of ChatGPT's answers was tested by entering 3 questions repeatedly at different time points (day 1, day 2, week 2, week 3).	Content (correct, incomplete, false), patient management (possible, insufficient, not possible), and risk (no risk, low risk, high risk).	Only 13 out of 50 answers provided by ChatGPT had correct content and enough information to initiate patient management with no risk of harm. Most answers were either false (38%) or had partly correct content (36%), and no references were provided. There was a high risk of patient harm in 26% of the cases, and a low risk in 28% of the cases. The answers provided by ChatGPT were not reproducible, with only 3 out of 12 repeated answers being identical.	Lack of reproducibility, as ChatGPT's answers varied when the same questions were asked at different time points.
Munir et al., 2024 [32]	To evaluate and provide insight into the potential of ChatGPT as a tool for answering practice-based, clinical questions and the challenges that need to be addressed before implementation in pharmacy practice settings.	A total of 32 pharmacy-based questions (6 standard drug information questions, 6 enhanced prompt drug information questions, 5 patient case questions, 5 calculations questions, and 10 top 200 drugs) were prompted to ChatGPT. Questions were collected from 2 colleges of pharmacy. For three types of questions (top 200 drugs, patient case, and pharmacy calculations), ChatGPT's responses were judged as correct or incorrect based on the answer key provided by the institution that supplied the questions. For both versions of the drug information questions, each response was individually evaluated by the pharmacist investigators on the research team using criteria they established. Each member assessed the responses for accuracy and source identification on a Likert scale with the categories: unacceptable, needs improvement, satisfactory progress, and meets expectations. Responses rated as unacceptable and needs improvement were considered "incorrect," while those rated as satisfactory progress and meets expectations were considered "correct".	Appropriateness (percentage of correct answers).	ChatGPT scored 100% in pharmacy calculation, 83% in drug information, and 80% in the top 200 drugs categories. However, ChatGPT scored lower in drug information enhanced prompt (33%) and patient case (20%) categories. ChatGPT has limited success as a tool to answer pharmacy-based questions.	Small sample size of questions and utilization of ChatGPT at a few single points in time in 2023. The study does not take into account pharmacists' perspectives on using ChatGPT in practice, nor was it conducted in a clinical practice setting.
Roosan et al., 2024 [33]	To investigate ChatGPT's ability to identify potential DDI, provide personalized medication recommendations, and monitor and manage patient medications and counseling.	Clinical patient cases (n = 39) were searched through various sources (e.g., internet, pharmacy case textbooks, and cases used in pharmacy school courses) and were classified into levels of complexity (simple, complex, very complex) by two clinical pharmacists. Each patient case was added into ChatGPT to evaluate the responses. Responses provided by ChatGPT were compared to actual answers for patient cases and were assessed based on 3 criteria: the ability to identify DDIs, precision in recommending alternatives, and appropriateness in devising management plans. This was also carried out by two clinical pharmacists.	Accuracy.	ChatGPT was able to answer all cases for simple and complex cases correctly. ChatGPT successfully identified DDI in 39/39 (100%) patient cases; provided therapy recommendations in 39/39 (100%) patient cases; and formulated a general management plan in 39/39 (100%) patient cases; but it did not recommend specific dosages. Results suggest it can assist pharmacists in formulating management plans.	The study used a relatively small number of patient cases, which were sourced from available resources. The study only evaluated ChatGPT's ability to identify DDI, recommend alternative medication therapy, and formulate management plans but not assessed patient-specific considerations. The study did not consider clinicians' perspectives on using AI in their practice.

Table 2. *Cont.*

Author, Year	Objectives	Method Used	Measured Variables	Main Findings	Limitations
Salama, 2024 [34]	To evaluate the efficacy of ChatGPT in providing accurate responses to a diverse range of inquiries commonly encountered by pharmacists in community pharmacy settings.	The assessment included DDI, adverse drug effects, drug dosage, and alternative therapies, with each category consisting of 20 questions, totaling 80 questions. Real-world clinical cases and evaluations of clinical pharmacist competency served as the basis for the questions and corresponding answers.	Performance (percentage of correct answers).	ChatGPT exhibited distinct correct answer rates: 30% for DDI, 65% for adverse drug effects, 35% for drug dosage, and 85% for alternative therapies.	The study focused on a specific version of ChatGPT (ChatGPT 3.5), limiting the generalizability of the results to other AI models or versions. The evaluation of ChatGPT's performance was based on a predefined set of questions, which may not fully represent the wide range of inquiries pharmacists encounter in real-world practice. The study did not examine how user demographics or experience levels might influence ChatGPT's effectiveness.
Sheikh et al., 2024 [35]	To evaluate the accuracy of ChatGPT in assessing the safety of commonly used non-prescription medications and supplements in individuals with kidney disease.	The authors compared ChatGPT's outputs with the safety categorization provided by the Micromedex database. Additionally, the findings were confirmed by experienced pharmacists. Medications and supplements commonly used by the general population and those of particular interest or concern for individuals with kidney disease (e.g., OTC pain medications, common cold preparations, gastrointestinal upset remedies, topical treatments for skin conditions, and a broad range of dietary supplements) were included (n = 124).	Overall concordance percentage.	The overall concordance percentage between Micromedex and ChatGPT-3.5 and ChatGPT-4 was 64.5% and 81.4%, respectively. ChatGPT-3.5 and ChatGPT-4 can not be currently recommended as reliable drug information sources for medication safety of non-prescription medications and supplements in individuals with kidney disease.	Prescription medications commonly used by patients with kidney disease were not evaluated. The study used only one drug information source (Micromedex) to compare with ChatGPT. The study assessed ChatGPT's performance using a particular query format, which might have influenced the model's performance. The study exclusively examined ChatGPT's ability to assess medication safety, overlooking other crucial aspects like dosing recommendations, potential drug interactions, and contraindications. The study did not include direct clinical validation or evaluate the impact of ChatGPT's recommendations on patient outcomes. The study did not address the challenges and barriers to the implementation of ChatGPT in clinical practice.
van Nuland et al., 2024 [36]	To evaluate the performance of ChatGPT in clinical rule-guided dose interventions in hospitalized patients with renal impairment.	CDSS alerts related to renal dysfunction (using the eGFR calculated according to the CKD-EPI formula) were extracted from the EHR over a two-week period and then presented to ChatGPT and an expert panel. The alerts were provided both with and without patient variables. To assess performance, the recommended medication interventions were compared by an independent hospital pharmacist.	Accuracy (1—dose advice by ChatGPT is correct and identical to the dose advice given by the expert panel; 2—dose advice is correct but different from the expert panel; 3—dose advice by ChatGPT is incorrect).	For alerts presented without patient variables, ChatGPT provided "correct and identical" responses for 19.9% of the alerts, "correct and different" responses for 26.7%, and "incorrect" responses for 53.4%. For alerts that included patient variables, ChatGPT provided "correct and identical" responses for 16.7% of the alerts, "correct and different" responses for 16.0%, and "incorrect" responses for 67.3%. ChatGPT demonstrated inadequate performance in clinical rule-guided dose interventions for hospitalized patients with renal dysfunction. As a result, its current capabilities make it unsuitable for automatic integration into the EHR for managing CDSS alerts related to renal dysfunction.	ChatGPT's response was transformed from alerts into dosing advice and compared to the expert panel's advice, which may have led to the loss of concordance between the rationale behind the answers. The authors did not ask follow-up questions when ChatGPT's answer was incomplete but headed in the right direction, while this might have increased accuracy in answers. Since ChatGPT can continuously learn and update, the study findings may evolve over time, meaning results could differ in the future.

Abbreviations: ADR (adverse drug reaction), AI (artificial intelligence), CDSS (clinical decision support systems), DDI (drug–drug interactions), eGFR (estimated glomerular filtration rate), EHR (electronic health record), IQR (interquartile range), OTC (over-the-counter), PEM (Patient education material), PEMAT-P (Patient Education Materials Assessment Tool-printable), SGLT2 (Sodium-glucose cotransporter-2).

The main limitations reported by the studies included were: theoretical analyses that do not necessarily represent real-world scenarios [23,32,33,35], small sample sizes [24,26,27,29–34],

comparison made with few databases [23,26,35], variable answers in different time points [24,31]. Additionally, since the tool is continually updated, the study results may no longer reflect the current performance of the tool at the time of reading the articles [23,36].

4. Discussion

To the best of our knowledge, this is the first scoping review to discuss the use of ChatGPT in pharmacy practice. Fourteen relevant studies were identified on this question. ChatGPT was tested in various contexts, including drug information, medication consultation, clinical pharmacy questions, pharmacotherapy cases, drug–drug interactions, telepharmacy, patient education, dose modification, and medication therapy management. However, only half of the studies evaluated ChatGPT's performance in real-world scenarios. Researchers must be engaged in designing future studies with real-world data. Moreover, studies used various methods and measured variables to analyze ChatGPT, making them quite heterogeneous and producing different results. Methodological standardization is important to enable more reliable comparisons between studies. Finally, the studies showed that ChatGPT is not fully prepared for use in pharmacy practice as this AI still has important limitations; however, there is great potential for its use in this context in the near future after improvements to this tool.

A preview study sought to summarize studies on the use of ChatGPT in pharmaceutical services [37]. Although this is a narrative review and presents methodological flaws, the findings were similar to our study, showing that ChatGPT is a promising tool which can assist pharmacists with certain tasks, but it provides inaccurate and uncertain information, highlighting that the tool cannot replace professional pharmacists.

Three studies used both versions (3.5 and 4.0) of ChatGPT in their analysis, highlighting the superiority of version 4.0. Overall, ChatGPT-4.0 has a more current knowledge base due to a later data cut-off and benefits from more frequent updates and improvements compared to ChatGPT-3.5 (updated until September 2021) [7]. However, the recent version is paid, which could be a limiting factor for its use in daily practice. Pharmacists can benefit from similar AI models, such as Google Gemini and Microsoft Copilot, as they have more up-to-date databases than ChatGPT-3.5. Moreover, new studies should be performed to elucidate the differences between the versions of ChatGPT.

Drug information sources assist pharmacists in improving patient safety, minimizing drug-related issues to the patient, and rational use of drugs by both physician and patient [38]. Four studies tested the ChatGPT in this field. Although ChatGPT has the potential to deliver drug information, its current performance is unreliable, with a significant risk of patient harm due to inaccurate or incomplete content. In addition, two studies explore the potential of ChatGPT in answering clinical pharmacy questions. Both studies underscore the importance of continuous updates and refinements to improve the accuracy and safety of AI tools in clinical practice. On the other hand, two studies evaluated the performance of ChatGPT in medication consultation questions, suggesting that ChatGPT has the potential to be a valuable tool. Then, users should be cautious with the outputs generated by ChatGPT and use them carefully.

Surprisingly, only one study included in this review explored the use of ChatGPT to predict and explain drug–drug interactions. Compared with other AI models, ChatGPT had lower specificity and accuracy to provide this information for pharmacists. These findings were similar to those presented in another study that assessed ChatGPT's ability to detect drug interactions using a simulated patient. ChatGPT is a partially effective tool for explaining common drug–drug interactions, with about 50% of the correct answers being inconclusive, emphasizing that further improvement is required for potential use by patients [39]. Pharmacists should use ChatGPT cautiously and compare their responses generated with other consolidated tools, such as Micromedex [40] and UptoDate [41].

Moreover, one study tested the ChatGPT for patient education involving pharmacists with promising results. It is known that patient education provided by pharmacists brings benefits, promoting autonomy, empowerment, and self-management [42]. The

use of ChatGPT in patient education has demonstrated potential across various medical fields, including dermatology [43], ophthalmology [44], and general medical education [45], although there are concerns about the accuracy and potential bias of the information generated by ChatGPT as well as ethical concerns such as privacy issues. Future studies should focus on improving the capabilities of ChatGPT to assist the pharmacist in generating patient education.

Before applying it in pharmacy practice, it is very important to test the ChatGPT in real-world scenarios, as a barrier to its use is the uncertainty of how it behaves in clinical practice [46]. Future studies should further explore real-world scenarios, as well as utilize larger sample sizes, compare ChatGPT to a broader range of data sources, conduct longitudinal evaluations to assess ChatGPT's accuracy over time, and standardize methodologies for evaluating the tool.

This scoping review has some limitations. Although a comprehensive literature search was used, some studies may have been missed because they were not indexed in the searched databases, published on the websites, or published in non-Roman characters. In addition, the number of publications regarding ChatGPT in the healthcare field is rapidly increasing within a brief timeframe. It is worth noting that some studies of interest that emerged after the set search period may not have been included.

5. Conclusions

ChatGPT has shown potential as a tool in pharmacy practice. However, certain concerns have been noted during its application. Whether ChatGPT represents a disruptive or destructive innovation depends on how it is integrated into pharmacy workflows. If used thoughtfully and ethically, it could be a disruptive innovation, positively transforming practices by improving efficiency and decision-making. On the other hand, if misused or relied upon excessively without proper oversight, it could lead to destructive outcomes. Further research is encouraged to gain a deeper understanding of the use of ChatGPT in real-world scenarios as well as to promote conscientious, appropriate, and ethical utilization.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/scipharm92040058/s1, Table S1: Electronic databases search strategy.

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