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Harnessing Ai for Improved Pharmacovigilance: Drug Interaction Accuracy Comparison

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Abstract: Traditional drug interaction assets like Lexicomp serve as valuable equipment, but their obstacles remain. This have a look at explores the capacity of AI-powered language models, evaluating their accuracy in detecting drug-drug interactions in opposition to the hooked up benchmark of Lexicomp. We cognizance on three advanced models: ChatGPT, Gemini, and Claude. Utilizing a dataset of fifty set up drug-drug interactions compiled from Lexicomp, we evaluate each version's potential to successfully become aware of these interactions based totally on provided drug names. The measured percentage accuracy serves because the primary metric for comparison. This investigation objectives to evaluate the viability of AI-powered models as potential dietary supplements or even alternatives to standard resources in pharmacovigilance. The findings will shed light at the strengths and weaknesses of each version, highlighting their capacity advantages and barriers in the complicated area of drug protection. Ultimately, the have a look at contributes to the ongoing discourse on harnessing AI's strength to decorate medicinal drug safety and patient care.

***Index Terms*: Pharmacovigilance, Drug-Drug Interaction, Artificial Intelligence, Language Models, Accuracy Comparison.**

I. INTRODUCTION

1. Pharmacovigilance: Definition and Reasons for Underreporting

The phrase "Pharmacovigilance" became derived from the Greek literature "pharmakon" (manner drug) and the phrase "vigilare" (method maintain watch) in Latin. In 1961, the World Health Organization (WHO) has set up the pharmacovigilance (PV) application in reaction to the thalidomide disaster, for international drug tracking. PV is the science and sports relating to the detection, assessment, information, and prevention of unfavourable results of medicine or any other feasible drug-associated troubles (1).

Pharmacovigilance is the science and practice of monitoring the safety of medicines after they have been licensed for use. It aims to identify, assess, understand, and prevent adverse drug reactions (ADRs) & Drug-Drug Interactions (DDI's) in patients. This crucial process plays a vital role in patient safety, Public health and Drug development (2).

Here are some key reasons for underreporting:

Healthcare professional factors:

- Lack of awareness or knowledge: Not all healthcare professionals are adequately trained to identify and report DDIs and ADRs.
- Time constraints and workload: Busy schedules may discourage thorough reporting.
- Uncertainty about causality: Difficulty establishing a definite link between a drug and an adverse event.
- Systemic factors:
- Complex reporting systems: Cumbersome forms or reporting processes can deter healthcare professionals.
- Lack of feedback: Absence of acknowledgment or follow-up on reported DDIs and ADRs can discourage future reporting.
- Limited resources: Insufficient funding or infrastructure dedicated to pharmacovigilance activities.

There is major lack of communication between the patient and healthcare provider (3).

2. Artificial Intelligence in Pharmacy (4) (5)

Artificial intelligence (AI) is rapidly remodeling the panorama of pharmacy, promising a future of greater suitable medicine protection, optimized workflows, and personalised affected character care. One of the maximum impactful areas is drug discovery and improvement, in which

AI algorithms can study huge datasets of molecular structures and interactions to discover capacity drug applicants with extra tempo and accuracy compared to traditional techniques. This no longer most effective expedites the development manner however also will growth the fulfillment price of bringing safe and powerful medicines to market faster. AI's energy extends beyond discovery, gambling a important function in pharmacovigilance. By studying big volumes of affected person statistics and scientific information, AI can efficiently encounter and flag capacity damaging drug reactions (ADRs), which include previously unknown interactions. This proactive technique empowers healthcare specialists to intrude early, enhancing affected individual safety and stopping critical complications. Furthermore, AI is revolutionizing medicine adherence with the aid of the usage of leveraging chatbots and virtual assistants to provide patients with personalized remedy reminders, education, and useful resource. These AI-powered gadget cater to individual wishes and choices, helping sufferers recognize their medicinal tablets and adhere to their regimens, which ultimately leads to higher fitness consequences. Another exciting region of application is personalized medicine. AI algorithms can examine a affected individual's specific genetic makeup, medical records, and lifestyle factors to are looking forward to their reaction to unique medicinal pills. This tailor-made technique allows pharmacists and physicians to optimize treatment plans, minimizing potential aspect consequences and maximizing recovery benefits. However, moral troubles and capability biases inherent in AI models cannot be unnoticed. Ensuring transparency, fairness, and information privateness at the same time as mitigating bias in algorithms is critical for accountable and trustworthy implementation of AI in pharmacy. Additionally, human statistics will remain crucial in interpreting AI-generated insights and making important clinical selections.

3. Chat GPT, Google Gemini and Claude, major AI platforms,

In the bustling world of big language models (LLMs), three names presently dominate the headlines: ChatGPT, Google Gemini, and Claude. While they proportion the capability to system and generate human-like textual content, each possesses precise strengths and weaknesses, catering to unique wishes.

ChatGPT: Developed by using OpenAI, ChatGPT boasts brilliant context awareness and adaptability. It excels at crafting creative text formats like poems, scripts, and even musical portions. Its strong don't forget of previous interactions allows for coherent and tasty dialogues. However, worries linger regarding occasional actual inaccuracies and capability biases reflecting its schooling records.

Google Gemini: Built by means of Google, Gemini shines in its astounding performance and information retention. Powered via the MoE (Mixture of Experts) structure, it excels at authentic language responsibilities like summarizing complicated topics and answering tricky questions. Its huge context window permits it to do not forget and reference information across lengthy conversations, making it perfect for facts-pushed interactions. However, issues exist concerning its innovative abilities compared to competitors.

Claude: Anthropic's Claude positions itself as the "safe and moral" opportunity. It prioritizes genuine accuracy and independent responses, making it suitable for touchy subjects or obligations requiring real precision. Additionally, it gives unique features like document attachments and the potential to quote sources, improving its transparency and research cost. However, its creative and stylistic abilities continue to be below improvement in comparison to competitors.

Table 1 Strength and Weakness Of Various AI Platform

Feature	ChatGPT	Google Gemini	Claude
Developer	OpenAI	Google	Anthropic
Strengths	Creative text formats, context awareness, adaptability	Efficiency, knowledge retention, factual tasks	Factual accuracy, unbiased responses, file attachments, source citations
Weaknesses	Potential factual inaccuracies, biases	Less creative compared to rivals	Underdeveloped creative capabilities
Ideal for	Creative writing, storytelling	Information access, analysis	Sensitive topics, research tasks

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II. RESEARCH METHODOLOGY

This study aims to compare the accuracy of three AI-powered language models (ChatGPT, Google Gemini, and Claude) in detecting drug-drug interactions (DDIs) against the established benchmark of Lexicomp.

a. Data Collection

We will source a dataset of 50 well-established Drug-Drug Interactions DDIs from Lexicomp, ensuring a diverse range of drug combinations and interaction severities.

Each DDI will be represented by a pair of drug names (drug A and drug B).

b. Evaluation Process

Model Input: Each model will be presented with a pair of drug names from the DDI dataset, without any additional information or context.

Model Response: Each model will be asked to answer the following question: "Is there a potential interaction between drug A and drug B?"

c. Interaction Classification: Each model's response will be categorized as:

True Positive (TP): Correctly identifies an existing DDI.

True Negative (TN): Correctly identifies the absence of a DDI.

False Positive (FP): Identifies a DDI when none exists.

False Negative (FN): Fails to identify an existing DDI.

d. Performance Metrics: We will calculate the following performance metrics for each model:

Accuracy: Proportion of correctly classified DDIs = (TP + TN) / Total cases

Precision: Proportion of true positives among all positive predictions = (TP / (TP + FP))

Recall: Proportion of DDIs correctly identified = (TP / (TP + FN))

F1-score: Harmonic mean of precision and recall, balancing their contribution.

e. Calculation Formulas

Accuracy: Accuracy Percentage = ((TP + TN) / Total cases) *100

Precision: Precision Percentage = (TP / (TP + FP)) *100

d. Ethical Considerations

This study will not involve human subjects or patient data. The selected DDIs are publicly available in Lexicomp. We will ensure responsible use of the AI models, avoiding potential biases and adhering to ethical guidelines for AI research.

III. RESULTS AND DISCUSSION

50 set of Data was taken from Lexicomp and were analysed using three AI platform

a. Chat GPT.

True Positive (TP)	43
True Negative (TN)	3
False Positive (FP)	1
False Negative (FN)	3

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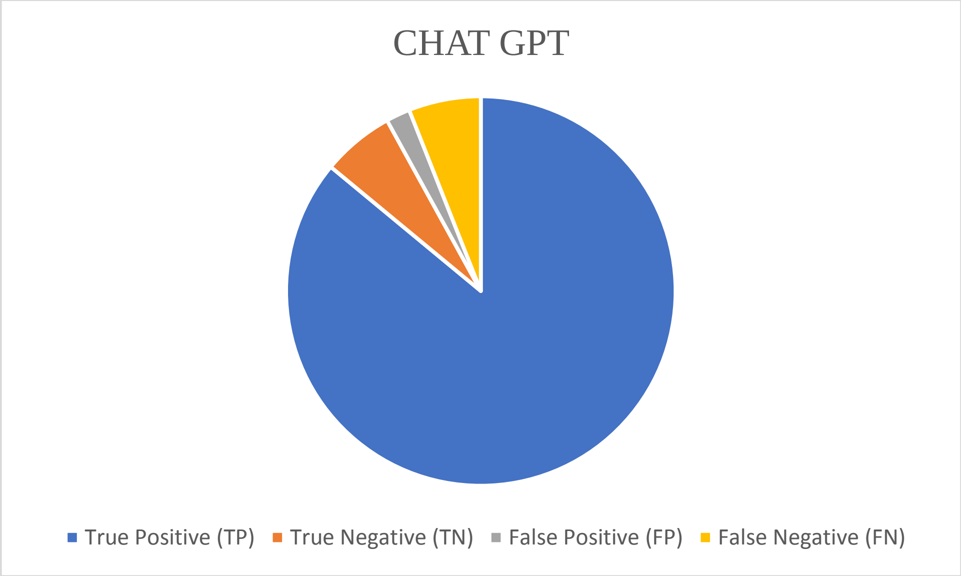
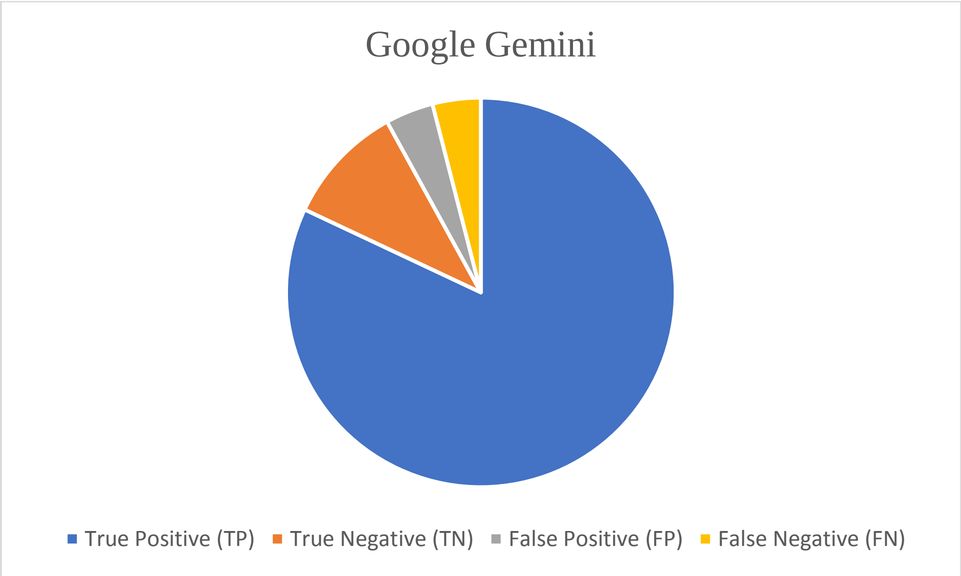


Accuracy Percentage = ((43+ 3)/ 50) * 100 = 92%
Precision Percentage = (43/ (43 +1) *100 = 97%

b. Google Gemini

True Positive (TP)	41
True Negative (TN)	5
False Positive (FP)	2
False Negative (FN)	2



Accuracy Percentage = ((41+ 5)/ 50) * 100 = 92%
Precision Percentage = (41/ (41+2) *100 = 95.3%

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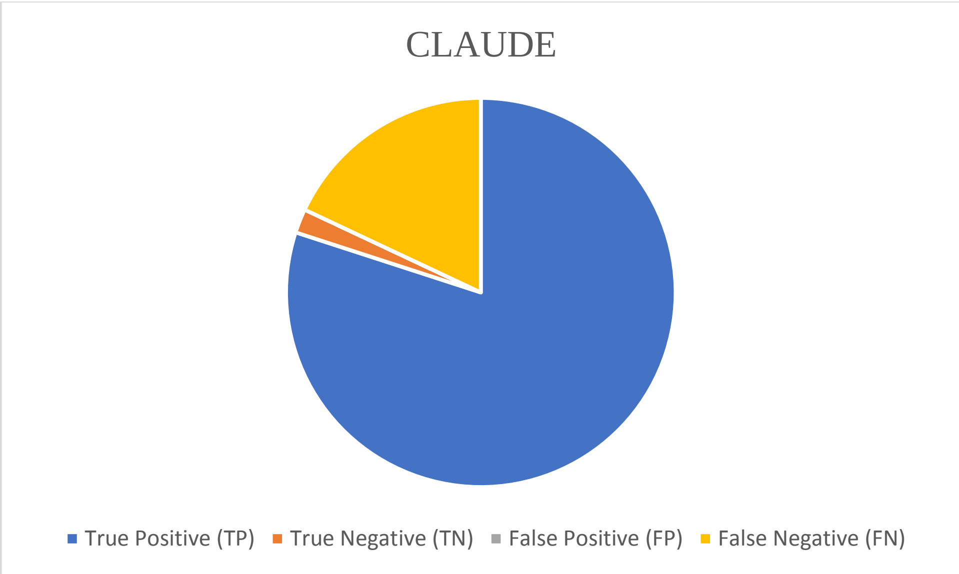
c. Claude

True Positive (TP)	40
True Negative (TN)	1
False Positive (FP)	0
False Negative (FN)	9



Accuracy Percentage = ((40+ 1)/ 50) * 100 = 84%
Accuracy Percentage = (40/ (40+) 0*100 = 100%

Examining three AI models, this have a look at highlights their ability to support drug interaction detection, with models like ChatGPT and Gemini exceeding 90% accuracy. However, the restricted statistics, actual-world complexity, and absence of interpretability call for in addition studies and responsible development. AI may be a precious tool, but human information remains crucial for secure and moral integration into pharmacovigilance.

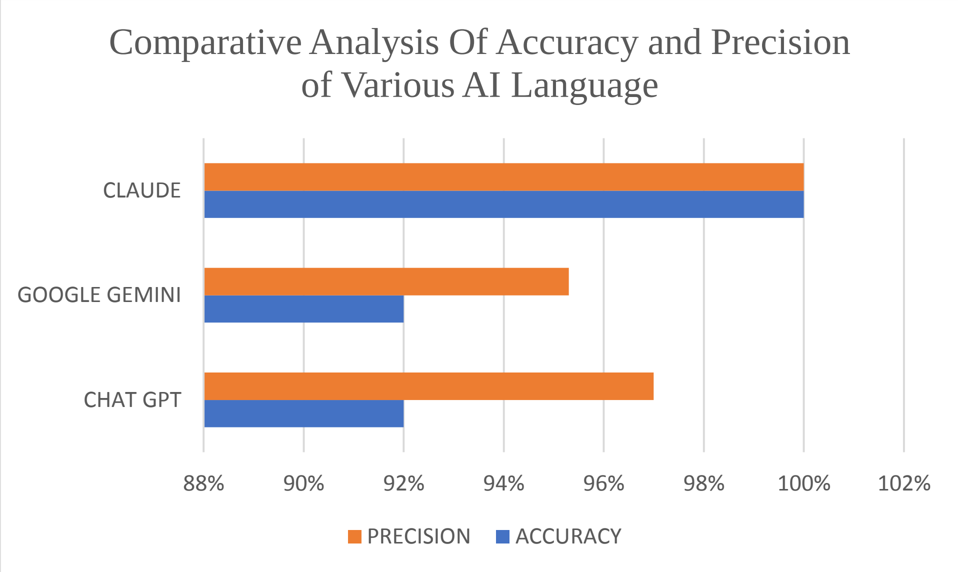
IV. CONLUSION

Take a look at explored the potential of three AI fashions (ChatGPT, Google Gemini, and Claude) for detecting drug-drug interactions (DDIs) compared to the established benchmark of Lexicomp.

Across 50 analysed interactions, ChatGPT and Google Gemini verified brilliant accuracy exceeding 90%, suggesting their capability to aid pharmacovigilance efforts. Both fashions displayed high precision, successfully figuring out maximum actual interactions. While Gemini had slightly lower precision than ChatGPT, it done a better actual bad price, indicating higher potential to discover secure drug combos.

Claude, despite an ideal precision score, fell quick in standard accuracy (84%) because of a excessive range of fake negatives (overlooked interactions). This highlights the significance of balancing precision and take into account for powerful DDI detection.

Overall, the findings recommend that AI fashions, mainly ChatGPT and Google Gemini, offer promising ability for assisting with DDI detection. However, obstacles remain, and several key factors warrant similarly attention:



Limited data: This has analysed only 50 DDIs, and overall performance can also range with large and more diverse datasets.
Real-international complexity: Actual drug interactions may be motivated by using man or woman factors not captured on this evaluation.
Interpretability: Understanding how AI models attain their conclusions is critical for believe and accountable implementation.
Further research is vital to address these limitations and explore the generalizability of the findings. Additionally, human knowledge stays essential for deciphering AI outputs and making vital clinical selections.
It is crucial to emphasize that AI fashions need to not update current pharmacovigilance practices, but rather function complementary gear to enhance safety and performance. As AI era maintains to evolve, accountable improvement and ethical concerns can be important to ensure its secure and beneficial integration into healthcare practices.

REFERENCES

[1]. Murali, K., Kaur, S., Prakash, A., & Medhi, B. (2019). Artificial intelligence in pharmacovigilance: Practical utility. Indian journal of pharmacology, 51(6), 373–376. https://doi.org/10.4103/ijp.IJP_814_19.

[2]. Jeetu, G., & Anusha, G. (2010). Pharmacovigilance: a worldwide master key for drug safety monitoring. Journal of young pharmacists : JYP, 2(3), 315–320. https://doi.org/10.4103/0975-1483.66802

[3]. Humphries, C., Jaganathan, S., Panniyammakal, J., Singh, S. K., Goenka, S., Dorairaj, P., Gill, P., Greenfield, S., Lilford, R., & Manaseki-Holland, S. (2019). Patient and healthcare provider knowledge, attitudes and barriers to handover and healthcare communication during chronic disease inpatient care in India: a qualitative exploratory study. BMJ open, 9(11), e028199. https://doi.org/10.1136/bmjopen-2018-028199.

[4]. Raza, M. A., Aziz, S., Noreen, M., Saeed, A., Anjum, I., Ahmed, M., & Raza, S. M. (2022). Artificial Intelligence (AI) in Pharmacy: An Overview of Innovations. Innovations in pharmacy, 13(2), 10.24926/iip.v13i2.4839. https://doi.org/10.24926/iip.v13i2.4839.

[5]. Paul, D., Sanap, G., Shenoy, S., Kalyane, D., Kalia, K., & Tekade, R. K. (2021). Artificial intelligence in drug discovery and development. Drug discovery today, 26(1), 80–93. https://doi.org/10.1016/j.drudis.2020.10.010.

[6]. Liang, L., Hu, J., Sun, G., Hong, N., Wu, G., He, Y., Li, Y., Hao, T., Liu, L., & Gong, M. (2022). Artificial Intelligence-Based Pharmacovigilance in the Setting of Limited Resources. Drug safety, 45(5), 511–519. https://doi.org/10.1007/s40264-022-01170-7.

[7]. Kompa, B., Hakim, J. B., Palepu, A., Kompa, K. G., Smith, M., Bain, P. A., Woloszynek, S., Painter, J. L., Bate, A., & Beam, A. L. (2022). Artificial Intelligence Based on Machine Learning in

Pharmacovigilance: A Scoping Review. Drug safety, 45(5), 477–491. https://doi.org/10.1007/s40264-022-01176-1.
[8]. Suke, S. G., Kosta, P., & Negi, H. (2015). Role of Pharmacovigilance in India: An overview. Online journal of public health informatics, 7(2), e223. https://doi.org/10.5210/ojphi.v7i2.5595.
[9]. Jeetu, G., & Anusha, G. (2010). Pharmacovigilance: a worldwide master key for drug safety monitoring. Journal of young pharmacists : JYP, 2(3), 315–320. https://doi.org/10.4103/0975-1483.66802.
[10]. Tandon, V. R., Mahajan, V., Khajuria, V., & Gillani, Z. (2015). Under-reporting of adverse drug reactions: a challenge for pharmacovigilance in India. Indian journal of pharmacology, 47(1), 65–71. https://doi.org/10.4103/0253-7613.150344.
[11]. van der Lee, M., & Swen, J. J. (2023). Artificial intelligence in pharmacology research and practice. Clinical and translational science, 16(1), 31–36. https://doi.org/10.1111/cts.13431.
[12]. Bajwa, J., Munir, U., Nori, A., & Williams, B. (2021). Artificial intelligence in healthcare: transforming the practice of medicine. Future healthcare journal, 8(2), e188–e194. https://doi.org/10.7861/fhj.2021-0095.
[13]. Bohr, A., & Memarzadeh, K. (2020). The rise of artificial intelligence in healthcare applications. Artificial Intelligence in Healthcare, 25–60. https://doi.org/10.1016/B978-0-12-818438-7.00002-2.