JPPT | Invited Commentary

The Pharmacy Students' Guide to Artificial Intelligence–AI

Chandler Batson and David Mara

KEYWORDS artificial intelligence; AI; communication; education; pharmacy

J Pediatr Pharmacol Ther 2024;29(1):85–89

DOI: 10.5863/1551-6776-29.1.85

Introduction

Amidst the growing popularity of artificial intelligence (AI), many pharmacy students remain unaware of its potential. Alongside this unfamiliarity, undefined limitations, and blurry lines of its integration within academia create caution. Despite many concerns regarding cheating or plagiarism, AI tools may be valuable to assist in student learning. Students can navigate its potential by utilizing AI as a supplementary aid while also carefully considering its limitations. This commentary highlights the practical ways you can integrate AI into your pharmacy school educational experience, from developing study aids, idea generation, and professional communication to enhance your learning.

Your Personal Tutor

In pharmacy school, you are taught a wide range of interconnected topics that require a solid foundation. Establishing this foundation is crucial to facilitate future growth. Fortunately, AI can simplify these complex subjects to streamline the learning process. Utilizing tools like ChatGPT or QuillBot, traditional lecture content, book chapters, articles, and theoretical models can be easily paraphrased, and the key points extracted.[1,2] For example, ChatGPT can explain intricate concepts like the Krebs Cycle in more understandable terms, aiding in comprehension. If you do not understand a challenging paragraph in a text or article, copy and paste it into ChatGPT and request an explanation in simpler terms. Navigating the ever-changing field of pharmacy can be a daunting task; however, with the assistance of AI, you can master essential concepts found within the most current treatment guidelines, ensuring that you remain up-to-date with the latest advancements in the field. Regardless of the subject, AI can serve as an accessible tutor, deepening understanding and fostering lifelong learning.

Study Aids. Memorization of dosages and recognizing brand/generic drug names is an essential part of mastering the pharmaceutical curriculum. Mnemonics, limericks, and rhymes created by AI are great ways to save time memorizing content. Figure 1 shows an example of a ChatGPT-generated mnemonic for HIV non-nucleoside reverse transcriptase inhibitor (NNRTI) medications. While it is time-consuming to create these study aids on your own, ChatGPT can generate a multitude of ideas in mere seconds.[1] Additionally, tables are a simple way to compare medications and disease states. They can be used as a quick reference guide for preparing for exams and rotations. Prompting AI with more detail in the table's structure and material will generate a well-designed study tool. Furthermore, study aids such as flowcharts and concept maps, as shown in Figure 2, may be extremely helpful for visual learners. Many AI tools, such as Taskade, Algor Education, and ChatGPT, can utilize your content from class notes and create these visual aids.[1,3,4] Although many AI resources allow free usage, pro versions offer upgrades to enhance your experience and provide greater capabilities.

Practice Problems. Practice questions are an excellent study method for evaluating comprehension and retention of material. Providing AI with lecture content and requesting practice questions can aid in self-assessment and gauge readiness for an upcoming exam. Utilizing each professor's content can ensure that the generated questions align closely with their teachings rather than relying on AI to generate its own content. Moreover, AI can create case-based questions that allow you to practice your treatment approach, timing, and knowledge-based application. Lastly, AI can be a fast, accessible way to learn the rationale for answer choices in past quizzes or homework questions. Knowing why an answer is correct and the other options are incorrect is essential. This can help you be more prepared when similar questions appear on exams and rotations. While this is an excellent utilization of AI, it is important to proceed cautiously when trusting AI to generate the content of the practice questions due to the updates in guidelines and specific institutional procedures that AI has yet to be programmed with.

Schedules. Pharmacy students have multiple classes, exams, midterms, and practicals. Organizing a study

Figure 1. Example of a mnemonic created with the use of ChatGPT.

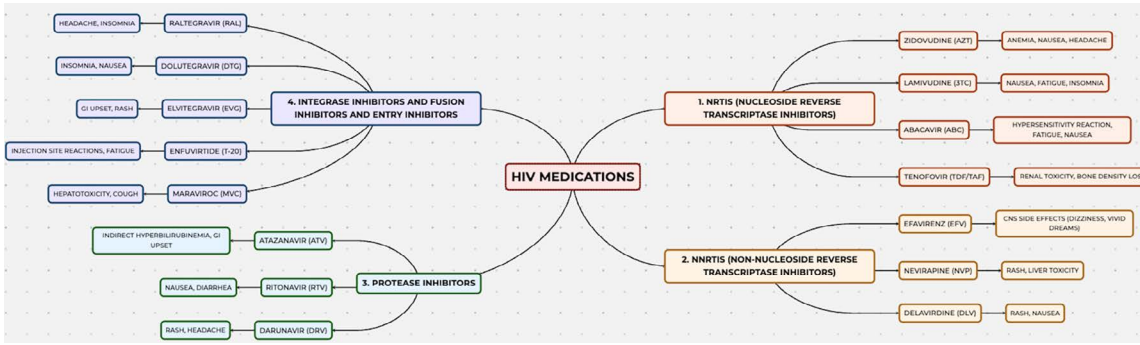
ChatGPT

Absolutely, here are a couple of mnemonics to help remember these NNRTI medications:

1. **R-E-E-D for NNRTIs:**
   - **R**ilpivirine
   - **E**travirine
   - **E**favirenz
   - **D**oravirine
2. **Remember Eager Elephants Dance:**
   - **R**ilpivirine
   - **E**travirine
   - **E**favirenz
   - **D**oravirine

These phrases use the initial letters of the medications to create memorable sequences!

Figure 2. Example of a concept map created with the use of Algor Education.



schedule can ensure that time is used wisely and efficiently. AI can produce a personalized day-by-day plan tailored to each student's unique needs. By implementing this tool, you can ensure you allocate adequate time to each topic to maximize study time. Additionally, group projects can be efficiently completed when you use AI, such as ChatGPT, which can simplify the process of delegating tasks among group members and establishing deadlines.[1] By doing this, you can ensure the project's quality and timely completion, making collaboration with peers manageable and efficient.

Calculations. The pharmaceutical field heavily depends on accuracy in calculations. Using AI to create practical math problems, solve problems, and even provide detailed explanations for its solutions can help you understand these calculations better. Currently, based on personal experience, AI such as ChatGPT and Wolfram are only effective with more straightforward calculations and should not be relied upon for complex calculations.[1,5] For example, AI for pharmacokinetic problems should be used cautiously and only for practice purposes. As an increasing number of AI generators are developed to tackle these complex calculations, it is advisable to test the software with practice pharmacokinetic questions with known answers. This can help ensure that AI is capable and reliable for future use of these complex problems.

Text to Speech. The extensive reading of articles, books, and notes for school can often be a tiring task. However, AI can transform these texts into audio content and present them in a human-like voice. Simply upload a PDF or insert your desired text into Speechify

for an easy conversion into audible speech.[6] Additionally, you can install the Google Chrome extension to directly access instant text-to-speech capabilities within your web browser. With tools such as Speechify, you can gain the ability to personalize your reading and optimize productivity by adjusting the speed and even the preferred reading voice. Not only is this tailored to auditory learners, but these benefits can also extend beyond consumption and aid in having personal written work read aloud to improve quality.

Quality. To receive greater quality of the information generated by AI, you should input specific commands. The more detail you provide to the software, the better the output will be. For example, simply posing the general question "What is Alzheimer's Disease?" will not yield a targeted response. Instead, when you ask AI to "explain the pathophysiology and anatomical changes of Alzheimer's Disease," you will prompt a more informative reply, aiding in your understanding.

Accuracy. For optimal accuracy, you should provide AI with content and allow it to present the data in ways that facilitate learning. When relying solely on an AI-generated response, it gathers data from public sources on the internet. Because of this, the information provided by ChatGPT may not always be reliable, especially when derived from non-peer-reviewed articles or websites.[1] However, one method to ensure the accuracy of AI-generated content is to prompt ChatGPT to include references for the information it generates. This way, you can access the provided references to verify the reliability of the information. Additionally, ChatGPT only offers information up until September 2021, posing challenges with the constantly updated treatment guidelines and new discoveries. To bridge this gap, outside plugins and ChatGPT are introducing the ability to search the web within your prompts, accessing more up-to-date information beyond 2021. However, it should still be used cautiously and only as a tool for educational purposes. While AI tools continue to adapt and upgrade to address limitations, individual judgment and verification of information accuracy remains essential.

Idea Generator

For students of science, the painstaking process of idea generation oftentimes presents significant difficulties. Dissecting subjects of old and generating innovative ideas can be quite thought-provoking and challenging. This is where AI can help. For starters, AI can sift through the scientific literature, particularly research papers, and present information to you pertaining to a special topic. This approach allows pharmacy students to access advancements in the various fields of interest coupled with the foundational knowledge to help generate the necessary ideas. The only caveat is found in the updated information, as ChatGPT notifies users of its lack of knowledge past September 2021.[1] As a pharmacy student, electing to present a controversial topic for a journal presentation can be an excellent way to engage peers and professors in meaningful discussions, broaden borders of thinking, and overall touch on topics that are critical to the success of pharmacy. Below is a practical outline (see Figure 3) of how to utilize Google AI Bard to generate an outline discussion on the topic of vaccine hesitancy and the positive implications of a community pharmacist.[7]

Professional Communication

As a pharmacy student, you utilize your developing expertise and in-depth knowledge pertaining to pharmaceutical therapy to communicate information effectively and efficiently to peers, preceptors, and persons of lay backgrounds. Effective communication, particularly the marriage between verbal and written, is paramount for a pharmacy student to obtain proficiency. From a professional standpoint, as you advance in your academic journey and broaden your experiences through coursework and clinical practice, you grasp the significance of crafting an effective "elevator speech." Students can further develop verbal skills by utilizing various forms of AI to generate role-play practice sessions of real-world scenarios on patient counseling with different medical conditions being initiated on a new therapy. Such practice sessions can foster an environment that allows you to learn how to explain therapy usage and potential side effects, all the while adapting to address the patient with empathy and clarity in speech. Other scenarios where student pharmacists can utilize AI are in simulating conversations with physicians and the various health care professionals who seek the expertise of a pharmacist on specific medications, drug interactions, etc. Such practice facilitates clear and concise communication between the health care team. Finally, you can utilize AI, such as ChatGPT, to simulate topic discussions over emerging treatment guidelines and specific subjects, and AI can provide key steps to follow in such presentations.[1]

On top of verbal communication, developing strong written communication is of utmost importance for a student of pharmacy. Interprofessional collaboration between pharmacists and other health care professionals is mainly conveyed through effective written communication. Thus, it is paramount for you to sharpen your written communication. This can be followed in various aspects of the student's career, from initially learning how to email a professor clearly and respectfully to aiding with resume review and generating a letter of intent for application to residency programs.

Limitations

With the emergence of this technology, there are opportunities but also limitations. ChatGPT, a popular AI tool, has knowledge only up until September 2021.[1] However, with the evolving updates and available

Figure 3. Example of journal presentation outline.

Outline for a journal presentation on vaccine hesitancy and community pharmacy

Introduction

- What is vaccine hesitancy?
- Why is vaccine hesitancy a public health concern?
- What is the role of community pharmacies in promoting vaccination?

Body

- **Promoting vaccination in community pharmacies**
  - Providing education and counseling to patients about vaccines
  - Making vaccines accessible and convenient for patients
  - Partnering with other healthcare providers and community organizations to promote vaccination
- **Addressing vaccine misinformation, parental rights, and vaccine mandates**
  - Vaccine misinformation
    - What are the common types of vaccine misinformation?
    - How can community pharmacists address vaccine misinformation?
  - Parental rights
    - What are the ethical considerations related to parental rights and vaccination?
    - How can community pharmacists balance parental rights with the public health need for vaccination?
  - Vaccine mandates
    - What are the different types of vaccine mandates?
    - What are the arguments for and against vaccine mandates?
    - How can community pharmacists support patients who are affected by vaccine mandates?

Conclusion

- Summary of key points
- Recommendations for community pharmacists on how to promote vaccination and address vaccine hesitancy

Discussion

- Encourage audience participation and discussion on the following topics:
  - What are the biggest challenges that community pharmacists face in promoting vaccination?
  - What are some effective strategies for addressing vaccine misinformation, parental rights, and vaccine mandates?
  - How can we work together to increase vaccination rates and protect our communities?

References

- Include a list of references used to support your presentation.

Additional considerations

- When tailoring your presentation to a specific audience, be sure to consider their level of knowledge and interest on the topic.
- You may want to include personal anecdotes or case studies to illustrate your points and make your presentation more engaging.
- Be prepared to answer questions from the audience.

plugins, such as the ability to search the internet within your prompt to obtain information beyond this 2021 limitation, more recent data should be accessible, but students should continue to verify the accuracy of the information and exercise sound judgment. Furthermore, it is essential to remember that this tool acknowledges the possibility of "... occasionally producing harmful interactions or biased content." AI operates with a literal approach that lacks the ability to make judgments or draw comparisons autonomously. Consequently, it can erroneously merge information from different sources and generate nonsensical responses. Therefore, reviewing the information and allowing AI to refine and enhance the content you provide is of utmost importance when using AI tools. As a student, incorporating AI should not involve replacing or generating

the original content but instead utilizing it to optimize and reinforce the material and information you provide.

Conclusions

The integration of AI into education allows you, as a pharmacy student, the opportunity to enhance your learning experience. Whether it is simplifying complex concepts, facilitating efficient study schedules, generating practice problems, or refining communication skills, the potential of AI in education is extensive. However, navigating this new technology with judgment is crucial, recognizing that AI should complement and support the learning process rather than replace it. With careful consideration of its limitations, you can explore the many ways AI can improve the pharmacy school experience.

Article Information

Affiliations. Chandler Batson and David Mara are PharmD candidates, School of Pharmacy Texas Tech University Health Sciences Center and are anticipated to graduate in 2025.

Correspondence. Chandler Batson; cbatson52@gmail.com

Disclosure. The authors declare no conflicts or financial interest in any product or service mentioned in this commentary, including grants, equipment, employment, gifts and honoraria.

Ethical Approval and Informed Consent. Not applicable

Acknowledgments. The authors acknowledge the assistance and guidance of our advisor Sherry Luedtke, PharmD, FPPA in preparing this commentary.

Submitted. October 18, 2023

Accepted. December 4, 2023

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