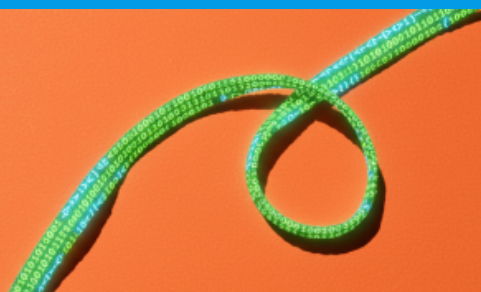


Adding artificial intelligence into your research workflow: a hands-on workshop

Cara Borelli, DO
Alyssa Cheng, DO
Molly Perri, MD
Lilian Denzler, MSci



Presenters and Disclosures

- **Cara Borelli, DO, Yale School of Medicine, New Haven, CT (Disclosures: SAMHSA RISE grant for education and co-editor-in-chief, Journal of Child and Adolescent Substance Use)**
- **Alyssa Cheng, DO, Yale School of Medicine, New Haven, CT (No disclosures)**
- **Molly Perri, MD, University of Illinois College of Medicine Rockford, IL (No disclosures)**
- **Lilian Denzler, MSc, University College London, UK (Disclosure: AbYcloud start-up for antibody design)**
- **Acknowledgement: Tyler Brooke-Wilson, PhD, Yale University**

Outline

1. INTRODUCTION

**3. POTENTIAL
USES OF AI**

**5. PROMPT
ENGINEERING**

**2. LIMITATIONS
OF AI**

**4. COMPARE AND
CONTRAST**

**6. HANDS-ON
SESSION**

01

INTRODUCTION



Learning Objectives



"Low-hanging fruit" image generated by Gemini, 2025

- **Uses of AI in addiction research**
- **Limitations of AI in research (where humans are needed)**
- **How to choose a model**
- **How to construct a prompt**
- **Create or improve skills for AI-assisted literature review**

Meet the guest lecturer

Lilian Denzler, MSci

I am a PhD student in Computational Biology at University College London. My research focuses on developing AI methods for drug development that incorporate protein language models and graph-based models. I also benchmarks existing computational pipelines and assesses the reliability of AI-driven predictions.



Background: What is Artificial Intelligence (AI)?



What is AI?

Artificial Intelligence (AI), a field of computer science and data science that focuses on performing tasks like learning, reasoning, perception, and problem-solving.

Traditional vs. Generative AI





1950's	 Artificial intelligence (AI) <i>Human intelligence exhibited by machines</i>
1980's	 Machine learning <i>AI systems that learn from historical data</i>
2010's	 Deep learning <i>Machine learning models that mimic human brain function</i>
2020's	 Generative AI (Gen AI) <i>Deep learning models (foundation models) that create original content</i>

Image: How artificial intelligence, machine learning, deep learning and generative AI are related
 Source: <https://www.ibm.com/think/topics/artificial-intelligence>

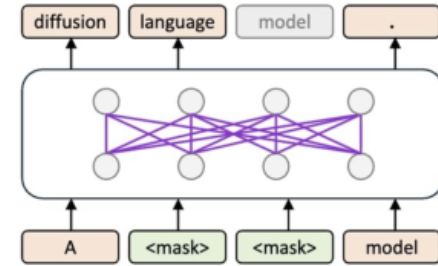


Image: Auto-regressive Language Model
 Source: <https://www.themoonlight.io/en/review/diffusion-vs-autoregressive-language-models-a-text-embedding-perspective>

Noising
 Denoising

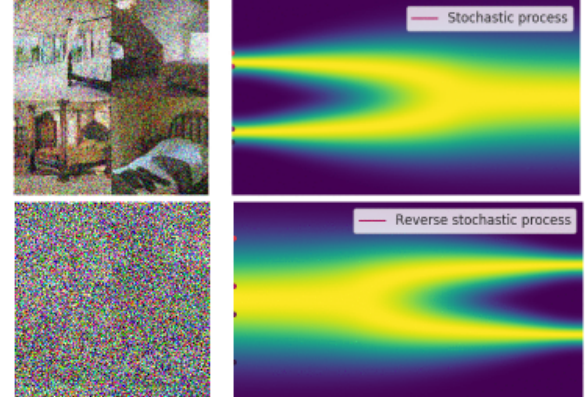


Image: Diffusion model noising and denoising, source: <https://yang-song.net/blog/2021/score>

AI Terminology to Know

- **Machine learning:** focuses on algorithms for learning from data; instead of programming the algorithm, the machine learns it from the data
- **Neural networks:** a series of nodes and edges loosely inspired by neurons in the brain, which constitute the leading class of machine learning algorithms
- **Natural language processing:** machine learning for understanding text and spoken language
- **Large language model:** neural networks trained on massive amounts of language data to perform various language tasks (trained on most of the internet)
- **Bias:** when large language models are trained, they are sensitive to the training data, which may include bias
- **Hallucinations:** a situation where an AI system produces fabricated nonsensical, or inaccurate information

Discussion topic:
How will AI's impact
on healthcare change
over time?



THE
NEW YORKER

IF A.I. CAN DIAGNOSE PATIENTS, WHAT ARE DOCTORS FOR?

*Large language models are transforming
medicine—but the technology comes with side
effects.*

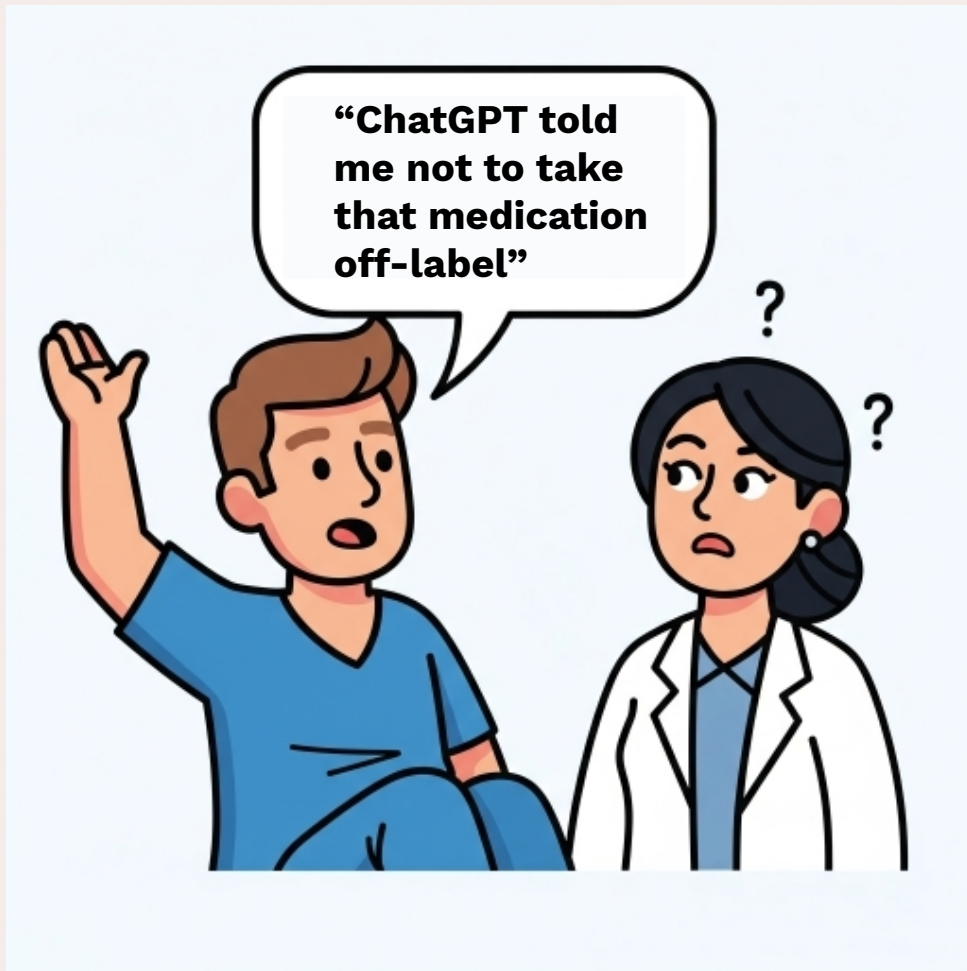
By Dhruv Khullar

September 22, 2025



"I'm worried these tools will erode my ability to make an independent diagnosis," a medical student said. Illustration by Petra Péterffy

*(Inspired by
true events)*



“He...shared that, after reading about the negative effects that sodium chloride, or table salt, has on one’s health, he was surprised that he could only find literature related to reducing sodium from one’s diet. Inspired by his history of studying nutrition in college, he decided to conduct a personal experiment to eliminate chloride from his diet.”

Published online at
<https://www.acpjournals.org/doi/10.7326/aimcc.2024.1260>

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Publication date: 5 August 2025

Disclosures

Disclosure forms are available with the article online.

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How to Cite

Eichenberger A, Thielke S, Van Buskirk A. A case of bromism influenced by use of artificial intelligence. *AIM Clinical Cases*. 2025;4:e241260. doi:10.7326/aimcc.2024.1260

A Case of Bromism Influenced by Use of Artificial Intelligence

Audrey Eichenberger, MD¹; Stephen Thielke, MD¹; and Adam Van Buskirk, MD¹

¹University of Washington, Seattle, Washington

Keywords

Signs and symptoms, Sodium, Internet, Ingestion, Consultation, Chlorides, Salts, Medical risk factors, Anions, Sodium chloride, Bromism, Toxicity, ChatGPT

Abstract

Ingestion of bromide can lead to a toxidrome known as bromism. While this condition is less common than it was in the early 20th century, it remains important to describe the associated symptoms and risks, because bromide-containing substances have become more readily available on the internet. We present an interesting case of a patient who developed bromism after consulting the artificial intelligence–based conversational large language model, ChatGPT, for health information.

Background

Bromide toxicity, or bromism, was once a well-recognized toxidrome in the early 20th century that precipitated a range of presentations involving neuropsychiatric and dermatologic symptoms (1, 2). Bromism was thought to have contributed to up to 8% of psychiatric admissions at that time, as bromide salts were found in many over-the-counter medications targeting a wide array of indications, including insomnia, hysteria, and anxiety (1, 2). The incidence of bromism declined dramatically when the U.S. Food and Drug Administration eliminated the use of bromide between 1975 and 1989 (3). However, case reports of bromism have reemerged within recent years, including from dietary supplements, bromide-containing sedatives, and excess dextromethorphan (2, 4, 5). While cases of bromism may remain relatively rare, it remains prudent to highlight bromism as a reversible cause of new-onset psychiatric, neurologic, and dermatologic symptoms, as bromide-containing substances have become more readily available with widespread use of the internet.

“For 3 months, he had replaced sodium chloride with sodium bromide obtained from the internet after consultation with ChatGPT, in which he had read that chloride can be swapped with bromide, though likely for other purposes, such as cleaning.”

Discussion topic:
How have you used
AI in your work or
research?



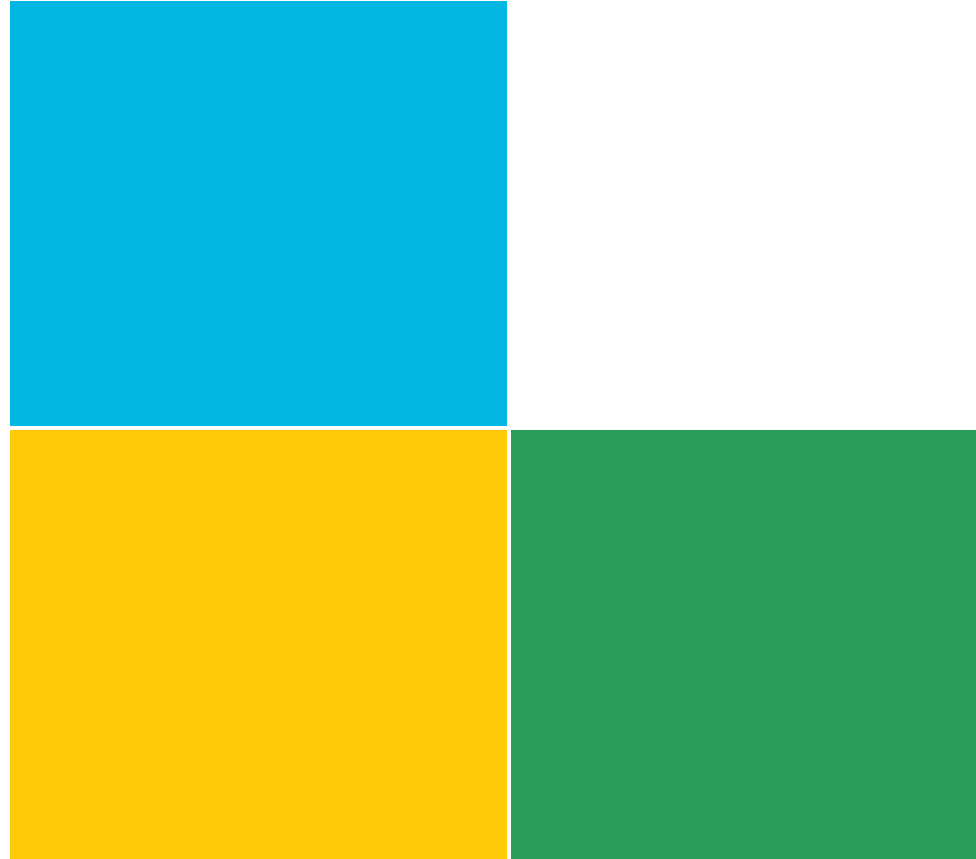
02

LIMITATIONS OF AI



LIMITATIONS

- Privacy of intellectual property
- Patient privacy
- Plagiarism
- Hallucinations/misinformation
- AI substance use safeguards misapplied
- Missing sources
- Sycophancy
- Bias
- De-skilling
- **Any others?**

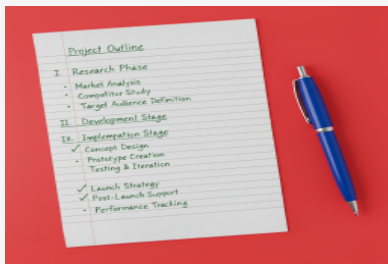


03

POTENTIAL USES OF AI IN ADDICTION RESEARCH



POTENTIAL USES OF AI



DEVELOPING A PAPER OR GRANT OUTLINE

Have AI create a grant or paper outline for the essential parts of the grant/paper



AI MOCK PEER REVIEW

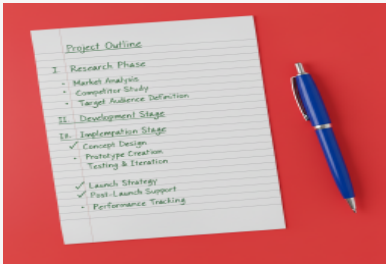
Anticipate what peer reviewers will say about your paper and address them pre-submission



AI-ASSISTED LITERATURE REVIEW

Have AI link papers that fit within your research topic or assist with a search strategy

POTENTIAL USES OF AI



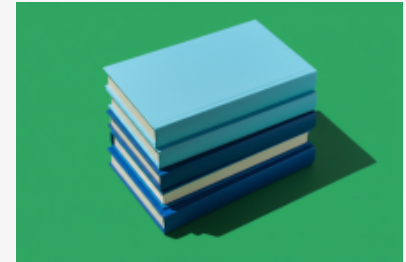
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Have AI link papers that fit within your research topic or assist with a search strategy



FOCUS
CREATE
REPEAT

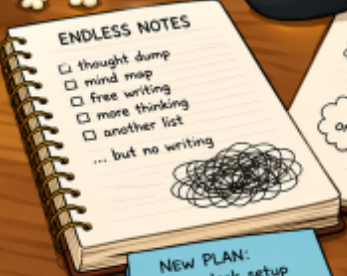
Outline
re-outline
re-re-outline

Research
"Rabbit
Hole" 😊

DEADLINE:
FRIDAY 5PM
(3 DAYS LEFT)

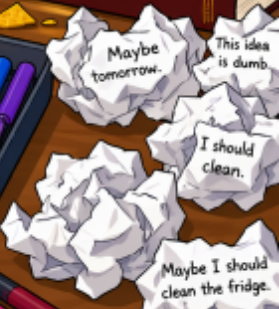
TODAY'S PLAN:

- Get coffee
- Organize desk
- New notebook
- Fancy pens
- Perfect playlist
- More coffee
- WRITE** 🚧



NEW PLAN:
- new desk setup
- new playlist
- new me
TOMORROW

Not
feeling
it. 😞





Create an outline of a SAMHSA grant to fund an educational initiative to train medical students on substance use education using workshops run by addiction faculty for a longitudinal curriculum.



Show thinking

Of course. Here is an outline for a SAMHSA grant proposal to fund a longitudinal substance use education curriculum for medical students.

What do you want to build?



Canvas



SAMHSA Grant Outline: Medical Student Substance Use Education



Create



SAMHSA Grant Proposal Outline: A Longitudinal Substance Use Education Initiative for Medical Students

Project Title: Integrating Addiction Medicine Experts into Medical Education: A Longitudinal Workshop-Based Curriculum for Future Physicians

1. Project Summary/Abstract

- **Problem:** There is a significant gap in substance use disorder (SUD) education within standard medical school curricula, leaving future physicians ill-equipped to address the ongoing substance use crisis.
- **Project Goal:** To develop, implement, and evaluate a comprehensive, longitudinal SUD curriculum for medical students, delivered through a series of interactive workshops led by addiction medicine faculty.
- **Target Population:** All medical students (M1-M4 years) at [Name of Medical School].
- **Key Activities:**
 - Curriculum development integrating evidence-based practices (e.g., screening, brief



- **Key Activities:**

- Curriculum development integrating evidence-based practices (e.g., screening, brief intervention, referral to treatment (SBIRT), motivational interviewing, harm reduction).
 - Execution of a four-year, staged workshop series.
 - Recruitment and training of addiction medicine faculty facilitators.
 - Rigorous evaluation of student competency, confidence, and attitudes towards patients with SUDs.
- **Expected Outcomes:** Graduating medical students will possess the core competencies, clinical skills, and professional attitudes necessary to effectively identify, treat, and manage SUDs in their future practice. This initiative will create a scalable and replicable model for other medical schools.

2. Statement of Need

- **National Data:** Cite statistics from SAMHSA, NIDA, and the CDC on the prevalence of substance use disorders, overdose deaths, and the economic burden on the healthcare system.
- **Gap in Medical Education:** Present data and literature showing the limited number of required hours dedicated to addiction education in U.S. medical schools. Highlight the consequences: provider stigma, under-diagnosis, and missed opportunities for intervention.

- **Institutional Context:** Describe the specific need at [Name of Medical School]. Include local or state-level data on substance use trends. Explain the current state of SUD education at the institution and why the proposed initiative is a critical enhancement.
- **SAMHSA Priorities:** Align the project with SAMHSA's strategic priorities, such as preventing substance use and misuse, enhancing access to treatment, and developing the addiction workforce.

3. Project Narrative: Goals, Objectives, and Activities

Goal 1: To implement a required, longitudinal SUD curriculum across all four years of medical school.

- **Objective 1.1:** By the end of Year 1, develop and receive curriculum committee approval for a 4-year modular workshop series.
 - **Activity:** Convene a curriculum design team of addiction faculty, medical education experts, and student representatives.
 - **Activity:** Map learning objectives for each year, ensuring a progression from foundational knowledge to advanced clinical skills.
- **Objective 1.2:** Annually, 100% of medical students in each cohort (M1-M4) will participate in their respective year's workshops.
 - **Activity:** Schedule and integrate workshops into the existing academic calendar.
 - **Activity:** Deliver workshops facilitated by trained addiction medicine faculty.

Create an outline of a SAMHSA grant to fund an educational initiative to train medical students on substance use education using workshops run by addiction faculty for a longitudinal curriculum.

Perplexity Search

Outline of a SAMHSA Grant Proposal: Substance Use Education Initiative for Medical Students

Project Title

"Integrating Substance Use Education into Medical Training: A Longitudinal Workshop-Based Curriculum Led by Addiction Faculty"

I. Executive Summary

A concise summary outlining the need to enhance substance use education in medical schools through a longitudinal, faculty-led workshop series designed to improve clinical competence, reduce stigma, and promote evidence-based care for patients with substance use disorders (SUDs).

II. Statement of Need

- Evidence of insufficient SUD education in current U.S. medical curricula.
- Public health impact of SUDs and the shortage of addiction-trained physicians.
- Gaps in medical student preparedness to screen, diagnose, and manage SUDs.
- Institutional data (if available) demonstrating gaps in knowledge, confidence, or attitudes related to addiction care.

III. Project Description

A. Goal

To develop and implement a sustainable, longitudinal substance use education curriculum integrated across the four years of medical training.

B. Objectives

1. Increase medical student knowledge about prevention, diagnosis, and treatment of SUDs.
2. Improve attitudes toward patients with SUDs and reduce stigma.
3. Equip future physicians with communication skills for screening and brief interventions.
4. Strengthen collaboration between addiction faculty and medical education leaders.

C. Approach and Activities

- **Curriculum Design:**
 - Develop a sequence of workshops to be embedded in pre-clinical and clinical years.
 - Topics include neurobiology of addiction, pharmacotherapy, harm reduction, motivational interviewing, and recovery support systems.
- **Workshops and Delivery Method:**
 - Interactive, case-based workshops facilitated by addiction psychiatry and addiction medicine faculty.
 - Incorporate standardized patients, reflective exercises, and simulated clinical encounters.
- **Longitudinal Integration:**
 - Year 1–2: Foundational science and screening skills.
 - Year 3–4: Clinical application during clerkships and elective rotations.
- **Faculty Development:**
 - Train addiction specialists and other clinical faculty in educational methods.
- **Evaluation:**
 - Pre/post assessments of knowledge, confidence, and attitudes.
 - Objective Structured Clinical Examination (OSCE) performance metrics.
 - Longitudinal tracking of student outcomes and feedback.

POTENTIAL USES OF AI



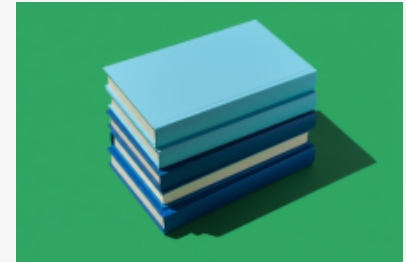
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AI MOCK PEER REVIEW

Anticipate what peer reviewers will say about your paper and address them pre-submission



AI-ASSISTED LITERATURE REVIEW

Have AI link papers that fit within your research topic or assist with a search strategy

[Download PDF](#) [Download ePub](#) Brief Report | [Open access](#) | Published: 28 January 2024

Implementation of an education session on buprenorphine induction in the emergency department, a resident-led initiative

[Cara Marie Borelli](#)  & [Han Tony Gao](#)[Harm Reduction Journal](#) **21**, Article number: 22 (2024) | [Cite this article](#)1129 Accesses | 2 Citations | 4 Altmetric | [Metrics](#)

Abstract

Introduction




Many physicians including emergency medicine physicians report insufficient training and education on prescribing buprenorphine for opioid use disorder. As emergency departments implement buprenorphine induction protocols, educational sessions can provide physicians with further familiarity with the treatment of opioid use disorder. This quality improvement project aimed to address the barrier of physician education in the implementation of buprenorphine initiation in the emergency department and presents a model for resident-led education sessions of emergency medicine physicians.

“Please provide a rigorous peer review on this paper. Be harsh and give constructive feedback on things to change.”

Let's take a look:

1. Methodology: Procedural Rigor and Bias

The primary weakness of this study is its design as a single-center, uncontrolled quality improvement project with a small sample size.

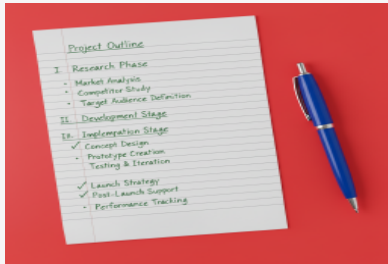
- **Attrition and Response Bias:** There is a notable drop-off from 47 pre-survey participants to 37 post-survey participants. The authors do not account for this 21% attrition rate. It is highly probable that those who did not complete the post-survey were less engaged or less convinced by the intervention, which introduces a significant **positive response bias** into the 100% "understanding" and "comfort" metrics. 
- **Survey Validation:** The manuscript states the surveys were "adapted from two emergency medicine didactic workshops", but there is no mention of whether these instruments were formally validated for psychometric reliability. 
- **Confounding Variables:** The session took place in 2019, yet the report references the 2023 removal of the DATA-X waiver. The "intent to prescribe" data from 2019 is severely confounded by the regulatory barriers that existed at the time of the workshop but no longer exist today. 

Constructive Feedback:

- You must explicitly discuss the 21% attrition rate and its potential to skew the results.
- Clarify if the surveys were pilot-tested or validated.

“Please provide a rigorous peer review on this paper. Be harsh and give constructive feedback on things to change.”

POTENTIAL USES OF AI



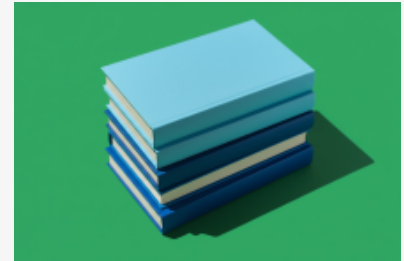
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AI-ASSISTED LITERATURE REVIEW

Have AI link papers that fit within your research topic or assist with a search strategy

AI-ASSISTED LITERATURE REVIEW

AI can be used to explore the literature on topics you are interested in and can be used to supplement a literature search.

AI can also be used to help develop a search strategy, e.g., identify other relevant MeSH terms

“Conduct a literature search of English, Spanish, or French-language, peer-reviewed literature published with full-text available between 1970 and 2024 using PubMed, Ovid, Embase, using the MESH terms: saliva [MeSH] OR oral hygiene [MeSH] OR Gram-Negative Anaerobic Bacteria [MeSH] AND [substance-related disorders [MeSH] OR substance abuse, intravenous [MeSH]], [behavior, addictive [MeSH] OR substance-related disorders [MeSH] OR addiction [MeSH]. Additional keywords: licking, needles, saliva, infection, IVDU, oral bacteria

Then, repeated prompts of “Find more case reports and link them” was used to find additional articles.”

Perri, MM, Borelli, CB, and Cheng, A. Recurrent polymicrobial bacteremia from licking syringe plungers a case report and artificial-intelligence-augmented scoping review of oropharyngeal bacterial infections linked to unsafe injection practices. Journal of Addiction Medicine. Accepted pending publication.

DM SERIF DISPLAY

“A post-hoc re-analysis using artificial intelligence to refine the MeSH terms 190 for traditional database searches using OVID Medline, Embase, and APA PsychINFO resulted in 2 usable MeSH terms and **hallucinations of “Addiction” and “Mouth Microbiota.””**

Perri, MM, Borelli, CB, and Cheng, A. Recurrent polymicrobial bacteremia from licking syringe plungers: a case report and artificial-intelligence-augmented scoping review of oropharyngeal bacterial infections linked to unsafe injection practices. Journal of Addiction Medicine. Accepted pending publication.



AI-ASSISTED LITERATURE REVIEW

The AI-assisted scoping review took approximately 1/10th the time of the traditional review

“In the traditional scoping review database search, studies were identified using OVID Medline, Embase, and APA PsychINFO, and after deduplicating 940 were reviewed. 937 studies were excluded including cases not listing the specific unsafe injection practice linked to the infection.

The new MeSH search helped to narrow the search to 156 sources, with 136 after deduplicating, including 2 sources previously found only with AI sources, 1 new source, and 1 already cited from the previous MeSH search.”

Overall, 9 new sources were identified with AI-augmented searches that were not identified with the traditional search, and 1 article was a duplication already found with the traditional methods. Google Gemini Deep Research resulted in 1 duplication of an article already identified with the traditional search, 2 hallucinations, and 22 other sources of which 9 met criteria using iterative searching techniques of prompting for additional articles. Perplexity identified 5 articles, but all were excluded. DeepSeek required 3 prompts to embed articles, and of the 6 articles provided without embedment, all were hallucinations. However, variations on the hallucinations found by using a traditional search engine identified slight variations on the title and author list that led to 2 new articles being provided. On the third iteration, embedded links were provided, 1 of which was already cited (the same article noted with Gemini Deep Research) and the other 2 were excluded.”

Perri, MM, Borelli, CB, and Cheng, A. Recurrent polymicrobial bacteremia from licking syringe plungers: a case report and artificial-intelligence-augmented scoping review of oropharyngeal bacterial infections linked to unsafe injection practices. Journal of Addiction Medicine. Accepted pending publication.

AI-ASSISTED LITERATURE REVIEW

Prompt template example:

You are a research assistant.

Goal: build a literature map for:
<topic>.

Input: I will paste 5–10 abstracts.

Output: (1) themes, (2) key variables,
(3) disagreements, (4) open questions,
(5) a list of *claims to verify* with
sources needed.

Constraints: do not invent citations; if
uncertain, say “unknown”

Triage → Map → Verify

Can utilize AI to organize what you already have
(abstracts, notes, PDFs).

Example of tasks:

- Query expansion (synonyms, methods, datasets)
- Extract key claims from provided text (with quotes)
- Cluster papers by theme/methods/population
- Draft an annotated bibliography (after verifying citations)

AI-ASSISTED LITERATURE REVIEW



Project Checklist:

1. What did AI do? (task + boundaries)
2. Inputs provided (and what was excluded)
3. Prompt with model version
4. Output saved (with timestamps)
5. Human verification steps (tests, citations, re-runs)
6. Final decisions + rationale

Audit log example

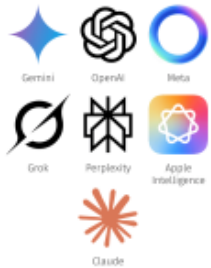
Task	Prompt	Verification
Abstract summary	Summarize (10 abstracts)	Cross-check with PDFs
Methods edit	Reword for clarity	Track changes and co-author review
Bibliography	Draft annotated	Cross-check with resources

04

COMPARE AND CONTRAST AI MODELS



COMPARE AND CONTRAST AI MODELS



General preferences are models that...

- Provide embedded links to literature
- Source literature from peer-reviewed sources, e.g., OpenEvidence
- Are thinking models (more compute per query but slower)
- Are the latest versions of the models
 - Consider paid versions

“Make an image of procrastination in the writing process in the format of ClipArt”



Claude Sonnet 4.6, 2026



Gemini Nanno Banana 2, 2026



ChatGPT 5.5, 2026

RE-EVALUATE

**Don't pick
one model
and stick
with it**



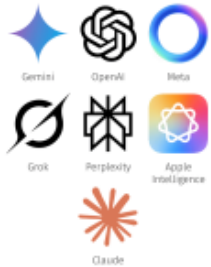
Gemini 3 image, Generated March 6th, 2026

05

PROMPT ENGINEERING



WHAT MAKES A SUCCESSFUL QUERY?



- Provide context
 - Can upload files
- Be as specific as possible
- Exploration with iteration
- More hallucination happens with longer threads
- Prompt engineering is a skill you can improve with practice

WHAT MAKES A SUCCESSFUL QUERY?

You're planning to write a literature review of GLP-1 agonists for AUD, but you are not familiar with the topic.

Bad query: "Is it bad to recommend GLP-1 agonists for alcohol addiction?"



viewshark.com



How could you
improve this query?



06

**INTERACTIVE SESSION:
COMPLETE AN AI-ASSISTED
LITERATURE REVIEW**



1. Come up with a research question
2. Develop a literature search for a scoping review
3. Use the same input for 2 different AI search engines

(15 minutes, then will share)



Key points



- **Construct context-rich, specific prompts**
- **Protect patient privacy and intellectual privacy**
- **Fact check and review primary literature**
- **Prepare to run iterative searches**