



Teaching Fellows About AI: Practical Strategies & Pitfalls

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Additional Disclosures

- Artificial Intelligence is a very fast-moving field! Some of the stuff I am presenting came to my attention this week
- Therefore, some of the recommendations I am making may go out of date or be replaced by superior products...

Learning Objectives

- Name the benefits and use cases in AI in allergy/immunology
- Identify potential hazards in the use of AI in clinical care and education
- Implement AI curricular topics to prepare fellows on the best use of AI in their future practice
- Implement AI-based tools to enhance teaching and assessment in A/I fellowship training.

Imagine you are on call and your fellow calls with follow-up on an inpatient consult:





Hi Dr. A! That flow came back on that 2-month-old DiGeorge baby in the CICU!

She only has mild T cell lymphopenia, so she doesn't need any further immune workup and I can arrange followup before she gets her 12 month vaccines!

Okay, let me get more detail...can you explain how you came up with that plan?

Sure! I researched this case with this new AI app I just downloaded! The CD4 and CD8 lymphopenia is mild and therefore the patient is at low risk for infections and complications from live vaccinations! However, it's recommended to check in every 6 months, especially before the 12 month live vaccines.



Think-Pair-Share



1. Any additional questions?
2. Any concerns about the fellow's approach to this case?
3. What is the best feedback or response?



Risks of “cognitive off-loading”

- Automation bias – risk of error due to reliance on automated systems
- Deskilling – loss of previous skills
- Mis-skilling - reinforcing incorrect behaviors
- Never-skilling – failure to achieve essential competencies

Your fellows are likely using AI tools!



Percent of respondents stating they currently use at least one of the 15 AI use cases presented

AMA Augmented Intelligence Research, February 2025

Your fellows are likely using AI tools!

A majority of Americans say they interact with AI at least several times a week

% who say they interact with artificial intelligence (AI) ...



Pew Research September 16, 2025

Most residents are not receiving formal training in AI

45%

Reported use of an
LLM

95%

Expressed interest in
learning more about
LLMs

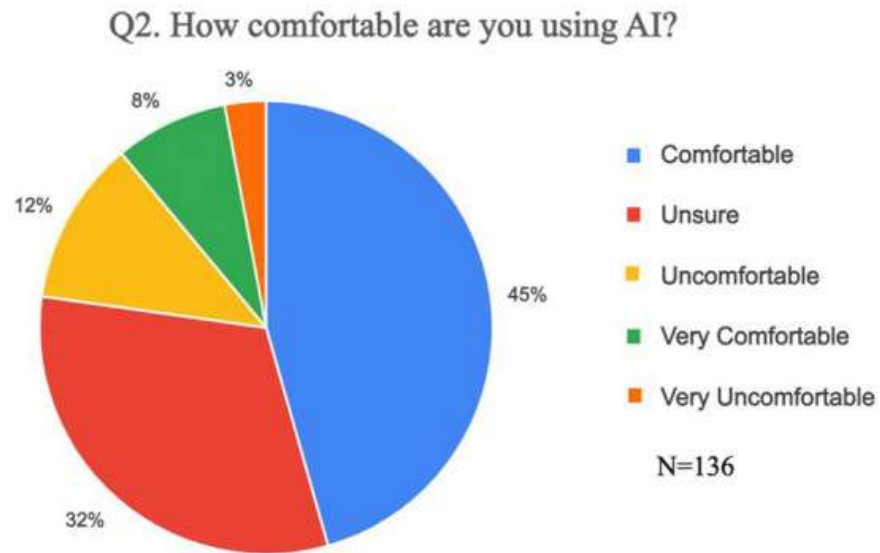
0%

Received formal
training on LLMs

LLM – large language model (e.g. ChatGPT, Claude, etc.)

Fried, A et al. (2024). Large language models in internal medicine residency: current use and attitudes among internal medicine residents. *Discover Artificial Intelligence*.

Faculty may be ill equipped to design formal AI curricula



86% of the respondents' organizations were at the **beginning stages** of adoption

McKell D et al. Med Sci Educ. 2024 Nov 14;34(6):1641-1646.

Artificial Intelligence-Enabled Medical Devices

Software as a Medical Device (SaMD)

[Clinical Decision Support Software Frequently Asked Questions \(FAQs\)](#)

Artificial Intelligence-Enabled Medical Devices

The FDA encourages the development of innovative, safe, and effective medical devices, including devices that incorporate artificial intelligence (AI).

The AI-Enabled Medical Device List is a resource intended to identify AI-enabled medical devices that are authorized for marketing in the United States. Digital health innovators can refer to this list to gain insights into the current device landscape and regulatory expectations, which can help foster innovation and ensure public safety. This list can also provide transparency for healthcare providers and patients to clearly identify when medical devices use AI technologies.

Content current as of:
12/05/2025

Regulated Product(s)
Medical Devices

Search:

allergy

Show

All



entries

Artificial Intelligence-Enabled Medical Devices

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Regulated Product(s) Medical Devices

Search:

Show entries

Date of Final Decision Submission Number Device Company Panel (Lead) Primary Product Code

No matching records found

Showing 0 to 0 of 0 entries (filtered from 1,357 total entries)

Previous 1 Next

Preparing Allergists to Practice in 2050 Using Artificial Intelligence



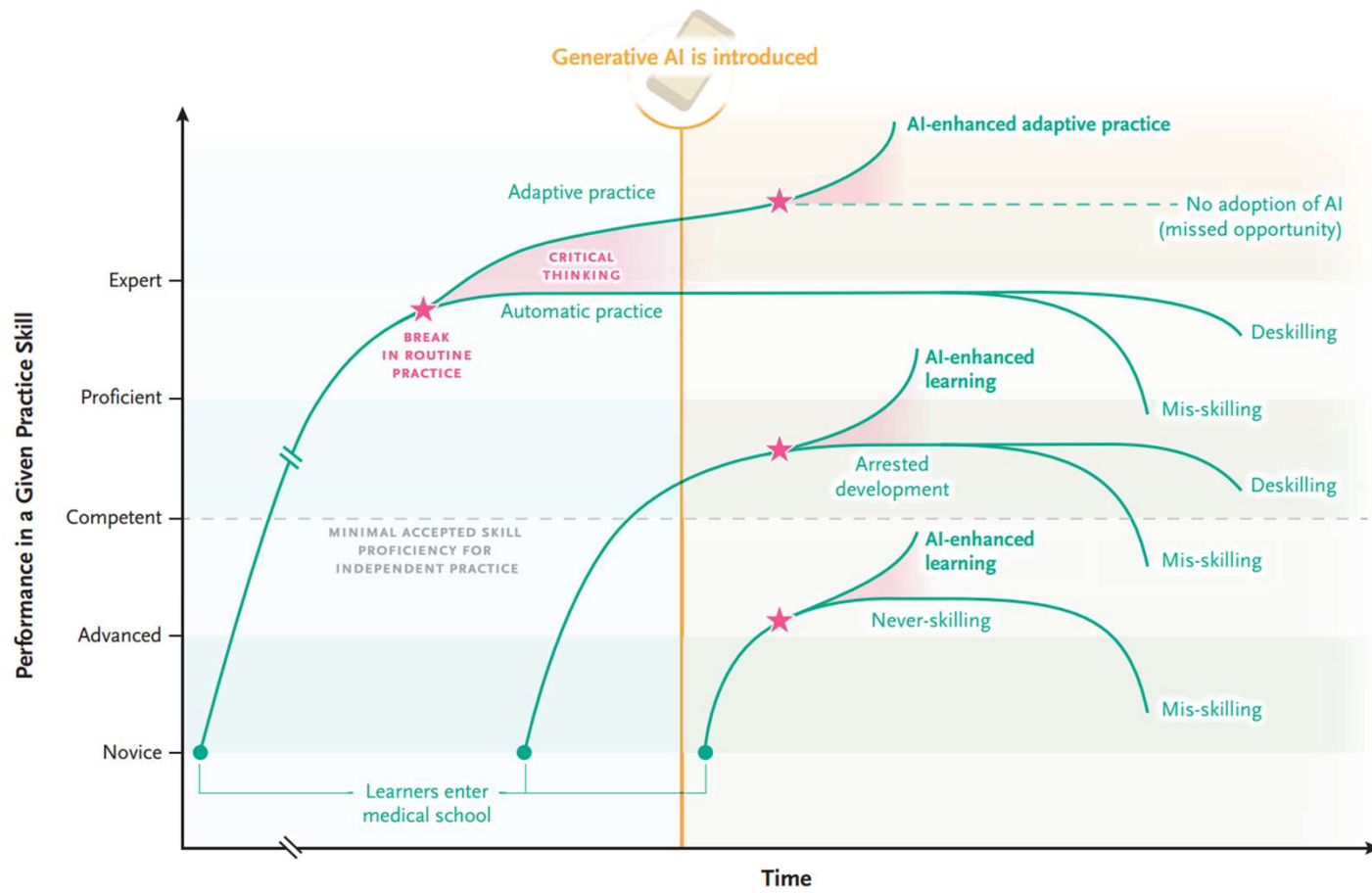
Paneez Khoury, MD, MHSc^a, John Oppenheimer, MD^b, Supinda Bunyavanich, MD, MPH^c,
Christina E. Ciaccio, MD, MSc^{d,e}, and Jay Portnoy, MD^f *Md; NJ; New York, NY; Chicago, Ill; and Kansas City, Mo*

Clinical Practice

- Diagnostics – analyze datasets to define disease phenotypes, enhance accuracy of allergy testing, utilize smartphones or apps to assess environmental exposures
- Monitoring – wearables to detect anaphylaxis and guide with treatment
- Treatment – personalized algorithms, acoustic resonance therapy to treat rhinitis, liquid biopsies using DNA/methylation to predict treatment response

Research

- Expand and integrate various datasets to discover patterns of disease, new biomarkers
- Assist with subject enrollment, ensure diversity, classify complex phenotypes, digital “twin” studies using single-cell transcriptome data



Competencies for the Use of Artificial Intelligence–Based Tools by Health Care Professionals

Regina G. Russell, PhD, MA, MEd, Laurie Lovett Novak, PhD, Mehool Patel, MD, Kim V. Garvey, PhD, MS, MLIS, Kelly Jean Thomas Craig, PhD, Gretchen P. Jackson, MD, PhD, Don Moore, PhD, and Bonnie M. Miller, MD, MMHC

1. Basic knowledge of AI
 - Define AI and identify the range of applications and use cases
2. Social and Ethical Implications of AI
 - Explain how social, economic, political systems influence AI tools and its impact on justice, equity and ethics
3. AI-Enhanced Clinical Encounters
 - Carry out responsible use of AI to enhance clinical encounters
4. Evidence-Based Evaluation of AI-Based Tools
 - Evaluate the quality, accuracy, safety, appropriateness, and biases of AI-based tools
5. Workflow Analysis of AI-Based Tools
 - Analyze and adapt to changes in teams, roles and responsibilities with implementation of AI-based tools
6. Practice-Based Learning and Improvement Regarding AI-Based Tools



Webinar Series: AI Skill Building for Medical Educators

- Session 1: Foundations of Skill-Building with Artificial Intelligence
- Session 2: Prompting for Educators: Effective Communication with AI
- Session 3: Evaluating AI Outputs: Ensuring Accuracy and Relevance
- Session 4: AI for Efficiency and Automation
- Session 5: Using AI with Data and Scholarship
- Session 6: Developing AI Enhanced Curricula
- Session 7: Personalizing Learning with AI
- Session 8: AI for Assessment and Evaluation in Medical Education
- Session 9: Preparing for AI Integration in Clinical Education
- Session 10: Continuous Professional Development in AI: Building a Lifelong Learning Plan

<https://www.aamc.org/learn-network/affinity-groups/group-educational-affairs/webinar-series-ai-skill-building-medical-educators>

Creating an educational moment about the use of AI



N Engl J Med 2025;393:786-97

Creating an educational moment about the use of AI



DEFT-AI framework

Diagnosis – ask the learner to think out loud their clinical reasoning process.

Ask how the learner interacted with AI:

Which tool?

How did you use the AI tool?

Which prompts were used?



Creating an educational moment about the use of AI



DEFT-AI framework

Evidence – probe the learner on the supportive and opposing evidence

Assess understanding of pathophysiology, relevant literature/guidelines

Ask the learner about understanding of the inner workings of the AI-tool:

How did you verify the AI responses?
What is the evidence that the AI is accurate and safe?



N Engl J Med 2025;393:786-97

Creating an educational moment about the use of AI



DEFT-AI framework

Feedback – guided self-reflection on the case

Is there growth opportunities? (missed DDx, medical knowledge gaps, AI literacy)

How did you evaluate your own use of AI in this case?

How can you improve your use of AI?



Creating an educational moment about the use of AI



DEFT-AI framework

Teaching – build upon the learner’s self-reflection and use of the AI-tool

Reinforce the clinical reasoning process

Encourage evidence-based medicine

Promote AI-literacy:

- Look for possible errors in outputs
- Ask the AI to explain its reasoning
- Verify outputs with reliable sources



AI-based tools to enhance fellowship training

AI-Tools can be adapted to address ACGME Core Competencies

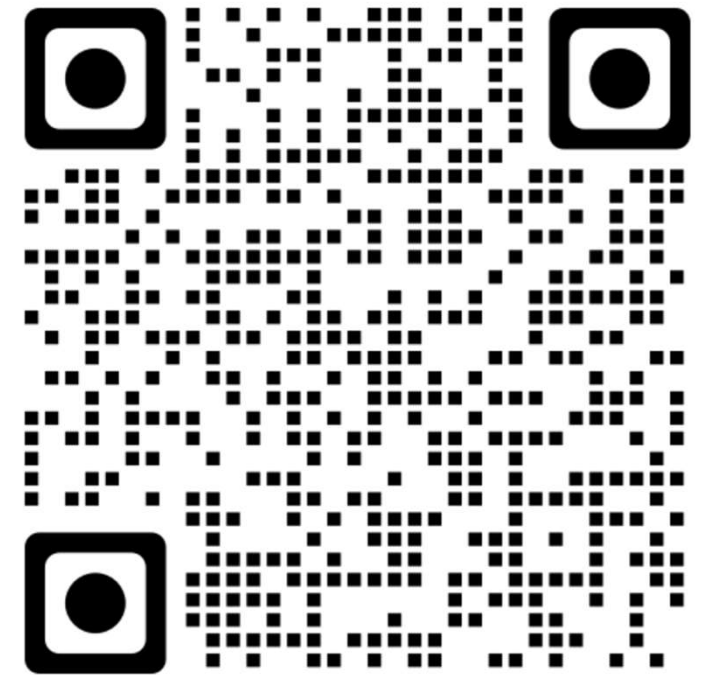
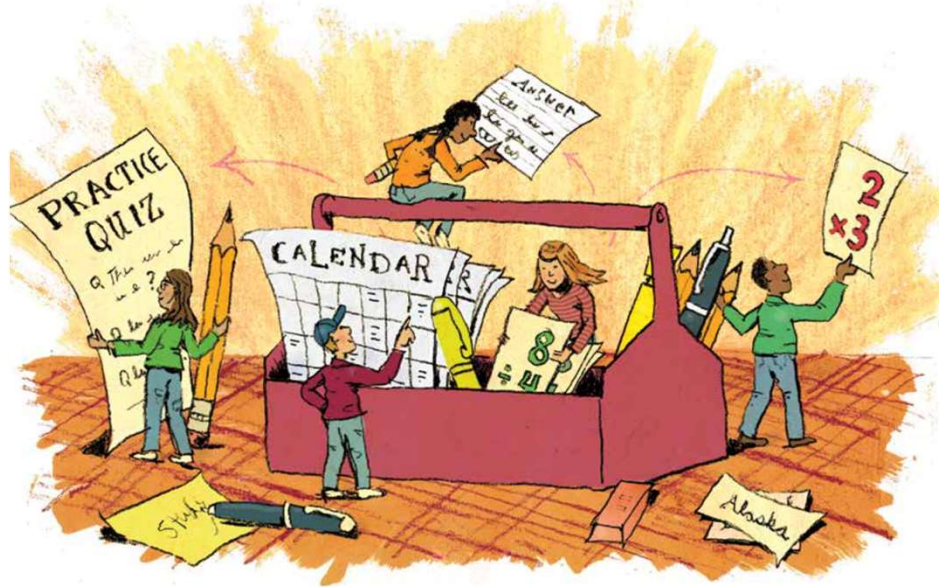
Competency	AI Tool
Basic Science/Clinical Knowledge	Chatbots, NotebookLM, Consensus
Patient Care	Chatbots, OpenEvidence, UpToDate Expert AI
Research/QI projects	Chatbots, Julius.ai
Interpersonal and Communication Skills	Chatbots, Ambient scribes

Chatbot – ChatGPT, Gemini, Claude, etc. etc.

What are the best learning strategies?

Strengthening the Student Toolbox

Study Strategies to Boost Learning



<https://eric.ed.gov/?id=EJ102106>

Effective Learning Strategies

1. Practice Testing

- Retrieval practice: attempting to recall previous information from memory
- Flash cards, practice questions

2. Distributed Practice

- Studying over several shorter sessions rather than 1 massed session

3. Interleaved Practice

- Studying different materials in a single session: mix together different types of problems or different kinds of material

Generative AI can create practice tests

Gemini and Claude can program interactive tests which provide feedback

The screenshot displays the Gemini chat interface. On the left, a user asks: "Can you generate a practice quiz testing mastery of each week of basic science in the Month 1 study plan?". Below this, a "Show thinking" section explains that the quiz is designed to test mastery of foundational concepts in the "Month 1 Study Plan", covering Innate Immunity, Cellular Biology, Hypersensitivity, and Research Principles. A "Temporary Chat" window is open, titled "ITE Mastery: Month 1 - Basic Science". It shows a progress bar at 1/10 and a score of 1 correct answer. The first question is: "1. In the signaling pathway of most Toll-like receptors (TLRs), which adapter protein is required for the induction of pro-inflammatory cytokines through the NF-κB pathway?". The options are A. MyD88, B. STING, C. CARD9, and D. TRIF. Option A is selected and highlighted in green, with a checkmark and the text "That's right! MyD88 is the primary adapter molecule used by all TLRs except TLR3 to initiate downstream signaling cascades." A "Next" button is visible at the bottom right of the chat window. At the bottom of the Gemini interface, there is a note: "Gemini can make mistakes, so double-check it".

NotebookLM: podcasts, flashcards, practice tests

Anatomy and Functions of the Lymphoid System

Sources

+ Add sources

Search the web for new sources

Web Fast Research

Select all sources

Chapter 2 (Raje)

Chat

• **Protecting Healthy Host Cells:** Macrophages (a type of white blood cell) have a specific surface molecule called **SIRP alpha** (transcribed in the sources as "serp alpha") ¹. This molecule specifically recognizes **CD47**, a marker that is naturally present on healthy host cells ¹. When SIRP alpha interacts with CD47, it signals the macrophage to leave the cell alone, preventing it from damaging or killing healthy tissue ¹.

• **Recognizing Invaders:** To identify and attack pathogens, macrophages rely on detecting microbial products. For example, they become activated when they encounter molecules like **lipopolysaccharides (LPS)** from microbes ^{1 2}. These microbial molecules interact with receptors on the macrophage's surface, triggering them to engulf (phagocytose) and destroy the invader ^{1 2}.

• **Identifying Stressed or Dead Cells:** When host cells are no longer healthy, the immune system detects this change. **Innate lymphoid cells (ILCs)** are part of the innate immune system and are capable of recognizing and eliminating cells that are stressed or damaged ³. Additionally, macrophages act like a "garbage disposal" system by recognizing and clearing out dead host cells that have undergone apoptosis (programmed cell death), which prevents the dead cells from spilling harmful enzymes into surrounding tissues ⁴.

Save to note

How do macrophages act as the body's 'garbage disposal'?

What are 'NETs' and how do neutrophils use them?

How do different tissues change a macrophage's specific function?

Start typing... 1 source

Studio

Audio Overview Slide Deck

Video Overview Mind Map

Reports Flashcards

Quiz Infographic

Data Table

Immunology Quiz 1 source - 48d ago

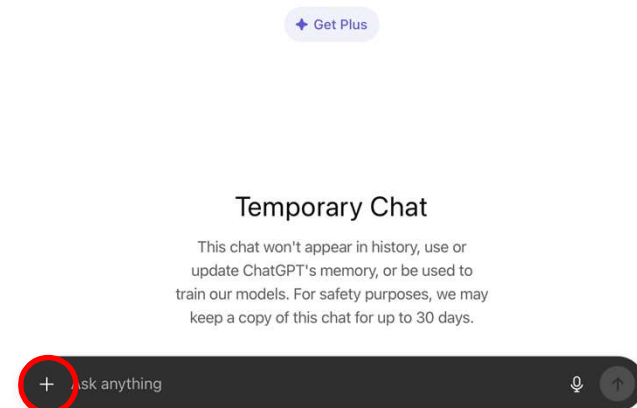
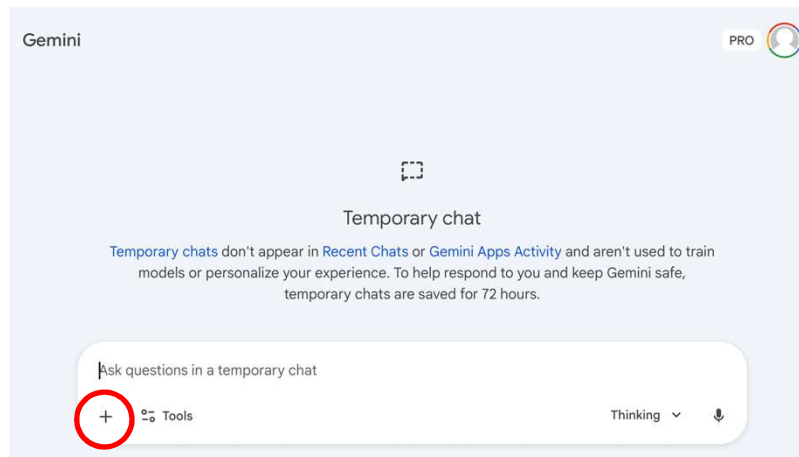
Immunology Flashcards 1 source - 48d ago

Add note

NotebookLM can be inaccurate; please double check its responses.

Using AI to analyze fellow ITE performance

- Generative AI tools are able to help analyze ITE reports to assist with assessing knowledge gaps, suggesting study plans, and generating quizzes
- To maintain privacy, would remove identifying information and use the “temporary chat feature”



Create study schedules to encourage distributed and interleaved practice

Gemini

Temporary Chat



Month 1: Immunology & Basic Science Foundations

Primary Goal: Address the significant gap in Basic Science (33% score).

- **Week 1: Innate Immunity & Signaling**
 - Study **TLR signaling pathways** (TLR9, MyD88) and **IL-18**.
 - Review **complement, coagulation, and bradykinin metabolism**.
 - Reference: *Middleton's Allergy* (9th Ed) Chapter 1 and *Abbas* (10th Ed).
- **Week 2: Cellular Biology & Histocompatibility**
 - Review **Antigen presentation** and HLA processing.
 - Study **Neutrophil chemokine receptors** and **T & B cell ligand interactions**.
 - Reference: *Abbas* (10th Ed) pp. 51, 139-147.
- **Week 3: Hypersensitivity & Pathology**
 - Focus on **Delayed Type Hypersensitivity (DTH)** and **immune complex disorders**.
 - Review **Dermatology Pathology** and keratinocyte function.
 - Reference: *Middleton's* Chapter 32.
- **Week 4: Practice Questions & Research Principles**
 - Review **Study Power, Bias in experiments, and Human Subject Protection**.
 - Complete 50 practice questions focusing on Basic Immunology.

Ask questions in a temporary chat

+ Tools

Thinking

Literature Searches: Consensus

Limits searches only to peer-reviewed studies

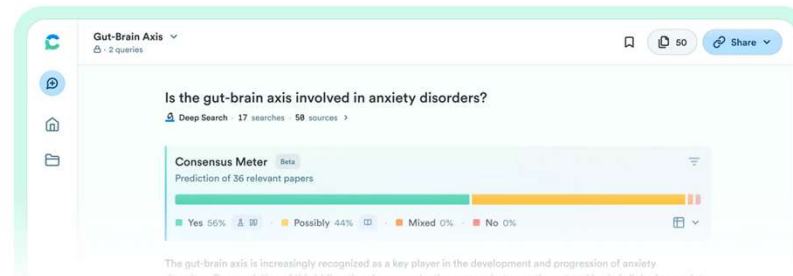
Consensus Product Resources About Contact Sign in Search for free



Less Noise. More Knowledge.

Consensus is an AI-powered search engine for scientific research papers. Our mission is to make the world's best knowledge more accessible for all.

Contact Us Try Consensus



Claude Connectors can utilize peer reviewed search engines when researching topics

✿ What shall we think through?

How can I help you today?

+

- Add files or photos
- Take a screenshot
- Add to project >
- Research
- Web search ✓
- Use style >
- Connectors >

- bioRxiv
- Consensus
- PubMed
- Scholar Gateway
- Add from bioRxiv >
- Add from Consensus >
- Manage connectors
- Tool access >

Opus 4.6 Extended ▾

☕ Life stuff

Patient Care

- Generative AI has been trained on medical knowledge, but can be susceptible to hallucinations/outdated sources
- OpenEvidence and UptoDate Expert AI limits searches to reference materials
- Can also be used to draft templates, prior authorization letters

The image displays two screenshots of AI-powered medical search interfaces. The top screenshot is for OpenEvidence, featuring a search bar with a microphone icon and a 'Deep Consult' button. Below the search bar, three example questions are listed: 'Does early nursery attendance impact infant immune system development?', 'Impact of precision nutrition on prevention of respiratory allergies', and 'Acute neuromuscular crises from emerging immunotherapies in the ED'. A 'Refresh' button is located below the list. The bottom screenshot is for UptoDate Expert AI, showing a search bar with a microphone icon and a right arrow button. The text 'Built by clinicians for clinicians' is prominently displayed above the search bar. At the bottom of the screenshot, there is a small icon and the text 'Ask about treatments, procedures, diagnoses, and more'.

Patient Care: Simulations

Generative AI has been used to create interactive virtual patients which tests history, physical exam, clinical reasoning, and management



The screenshot shows the 'ddx' simulation interface. At the top, there are navigation tabs: 'Cases', 'Courses', 'Insights', and 'Rubrics'. The main title is 'Dark Urine in a 19 year-old male' with a 'Text mode' button. Below this are tabs for 'Chart Review', 'Pre-DDx', 'History', 'Physical Exam', 'Attending Discussion', 'Results', and 'Teaching Points'. The 'History' tab is active. On the left, a 'Chart' section shows patient information: 'John Smith - 19yr male', 'Dark urine', and vital signs: BP 135/82 mmHg, HR 88 bpm, RR 16 per min, SpO2 99% Room Air, T 98.6°F. A 'Notes' section is also present. The main chat area shows a conversation with 'John Smith - 19yr male'. The AI-powered conversation includes: 'Hey doc, thanks for seeing me.', 'Hi, thanks for coming in today. I understand you're seeing dark urine?', 'Yeah, that's right. I've had dark urine for the past four days or so.', 'You were recently on a hiking trip, yes? How long was that trip? Did you drink enough water?', 'Yeah, I was on a hiking trip. It lasted about three weeks. I tried to stay hydrated by drinking water, but I feel like I fell behind at times.', 'Did you feel exhausted in a way you normally wouldn't?', 'Yeah, I did feel pretty exhausted. Even though I'm usually active, the trip was a lot more exertion than I'm used to.', 'Did you experience any other symptoms you would relate to dehydration?', 'I've mainly noticed the dark urine.', 'What about a sore throat?', 'Oh, yeah I did have a sore throat a few days into the trip. It eventually went away after a few days.', and 'Did you feel especially hot or cold?'. At the bottom of the chat, there are 'Back' and 'Continue' buttons. On the right, a 'DDx Builder' section prompts the user to 'Review findings to build your differential. Drag to rank by likelihood.' with an 'Enter diagnosis' field and an 'Add' button. Below this, it says 'No diagnosis added yet. Enter diagnosis to start building your differential diagnosis.'

Patient Care: Simulations

ChatGPT and Google Gemini can also perform simulations with the correct prompts

- Cons: difficult to design/share, has variability in the output between simulations

Claude can create interactive web apps that can be shared, such as simulations



Anaphylaxis simulation created in 2.5 hrs

Anaphylaxis Simulation
Allergy & Immunology Fellowship Training
Rapid Cycle Deliberate Practice • 4 Clinical Cases • Free-Text Response

About This Simulation

- Setting**
All 4 cases take place in an allergy/immunology clinic — SCIT reaction, food challenges, and a drug challenge
- Format**
Type your responses freely — answers are evaluated by AI for clinical accuracy, not keyword matching
- RCDP**
Rapid Cycle Deliberate Practice: up to 3 attempts per question before the answer is revealed
- Difficulty**
Cases escalate: Adult (SCIT) → Adolescent (food challenge) → Infant (food challenge) → Elderly patient (drug challenge)

Select a Case to Begin

- Case 1** (Introductory): Adult — SCIT Reaction
- Case 2** (Intermediate): Adolescent — Food Challenge
- Case 3** (Advanced): Infant — Food Challenge
- Case 4** (Expert): Elderly Patient — Drug Challenge

Select a case above to begin

INTRODUCTORY SCIT — Adult Patient Q 1 / 4

35-year-old female · 70 kg Allergy/Immunology clinic — post-injection observation area

BP 88/52 mmHg **HR** 118 bpm **RR** 22 /min **SpO₂** 94 %

CURRENT EXAM FINDINGS
Patient appears anxious and flushed. Generalized urticaria on trunk and arms. She is scratching her throat and states it feels 'tight.'

CLINICAL DECISION POINT 1 OF 4
Based on this presentation, what is your diagnosis? What specific criteria are you using to make this diagnosis?

Attempts: ● ● ● 3 attempts remaining

Type your clinical response here. Be specific — include drug names, doses, calculations, routes, and rationale as you would in clinical practice...

Ctrl/Cmd + Enter to submit

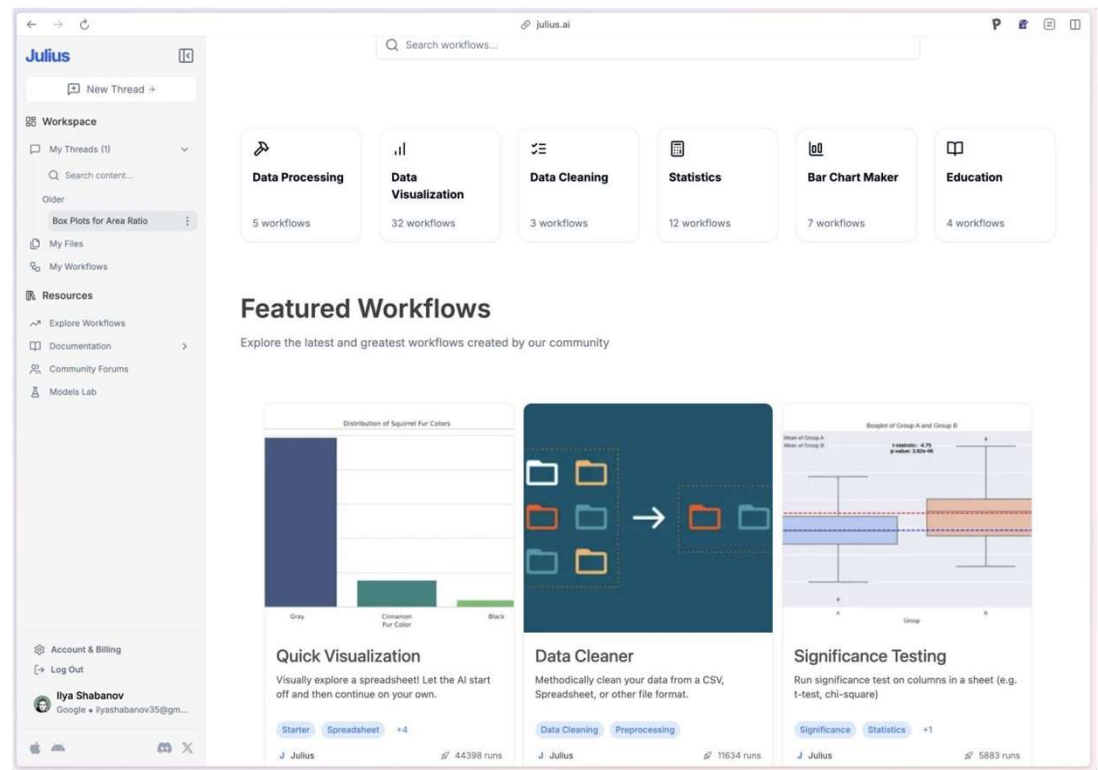
Submit Response



<https://claude.ai/public/artifacts/9133f519-198c-4c39-b58b-895fa45aa7fc>

Research/QI Projects

- Fellows can use chatbots to explain unfamiliar research protocols, statistical concepts, or even help write grants/papers
- Julius.ai is a platform that can also help with data cleanup, visualization, and analysis for fellows not familiar with SAS or SPSS
 - Be sure it is an approved AI tool with your IRB
 - Double check analysis with statistician



Research/QI Projects

Image generators such as Nano Banana Pro in Gemini can help create recruitment posters

Are you a caregiver for a baby under 12 months?



We need your help!

Children's Healthcare of Atlanta and Emory University are studying how infant skin care routines may affect eczema development.

Take part in the study today.
Scan to complete a short online survey.



Your participation helps keep baby skin healthy!



Interpersonal/Communication Skills

- Ambient AI scribes use AI to convert conversations into clinical documentation
- Can reduce charting time
- Can improve patient communication by maintaining eye contact, active listening
- Can make errors, hallucinate, or omit important detail so manual review is essential of all transcripts



Nuance®
DAX™ Copilot

Summary

- Most fellows are using artificial intelligence, but have not have formal curricula on its use
- The DEFT-AI framework can help fellows consider the best practices of AI-tools in the clinical setting
- AI curricula should not only review use-cases, but include social and ethical implications
- AI-tools have the potential to assist fellows in achieving mastery in the ACGME competencies