



Steven Fox, MD, MPhil

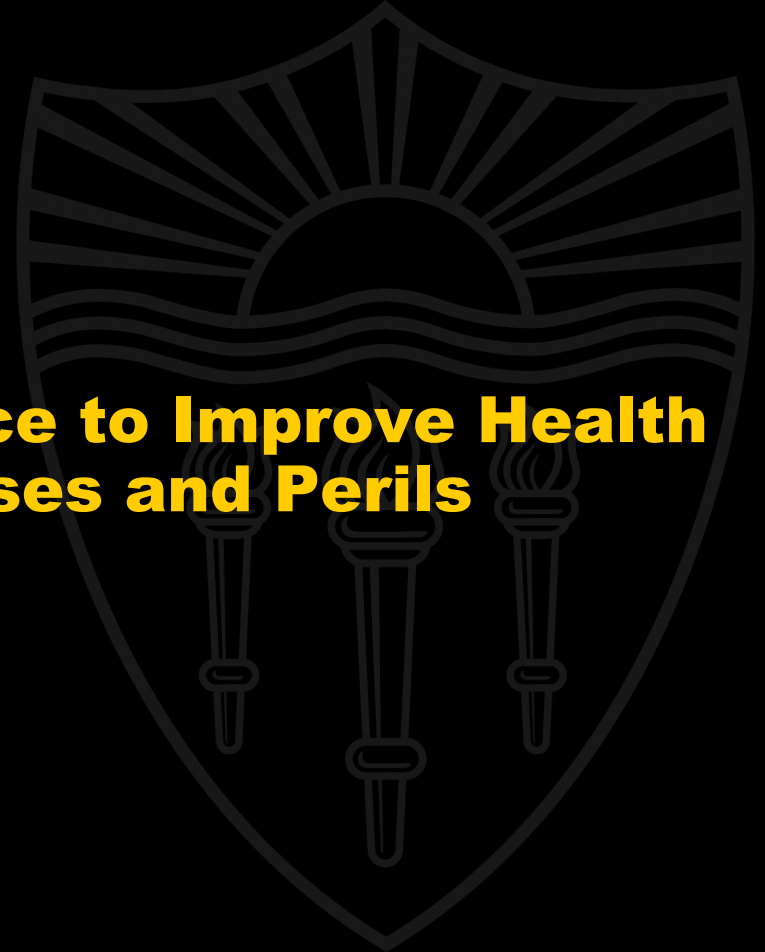
*Associate Director and Research Head, Titus Center for Medication Safety and Population Health
Assistant Professor, Department of Pharmaceutical and Health Economics, Alfred E. Mann School of
Pharmacy and Pharmaceutical Sciences*

Fellow, Schaeffer Center for Health Policy & Economics, University of Southern California



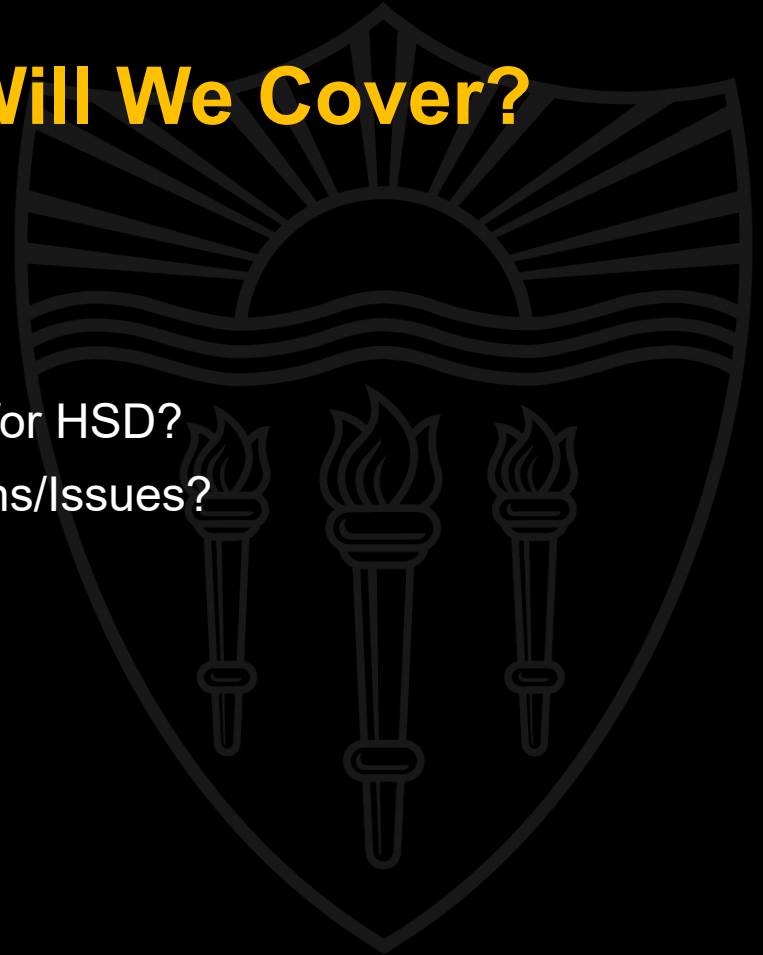
Using Artificial Intelligence to Improve Health Services Delivery – Promises and Perils

D. Steven Fox, MD, MPhil



Intro/Overview – What Will We Cover?

- Definitions - What is AI?
- Functions – What Can AI Do?
- Applications – How is It/Can It be Used for HSD?
- Perils & Pitfalls – What are the Limitations/Issues?



Who Am I?

- Physician/Former Clinical Professor
 - Internal Medicine
 - Pediatrics
 - Public Health & Tropical Medicine
- Data Scientist/Current Research Professor
 - Effectiveness of Health Services Delivery Innovations
 - Big Data Analysis (EHR+Claims) Using Machine Learning
 - Predictive Analytics & Time Series Analysis on Rich (Multi-modal) Diabetes Datasets
 - Health Economics & Health Policy Analysis



Audience Warning: This should be a marathon, but instead we will sprint!

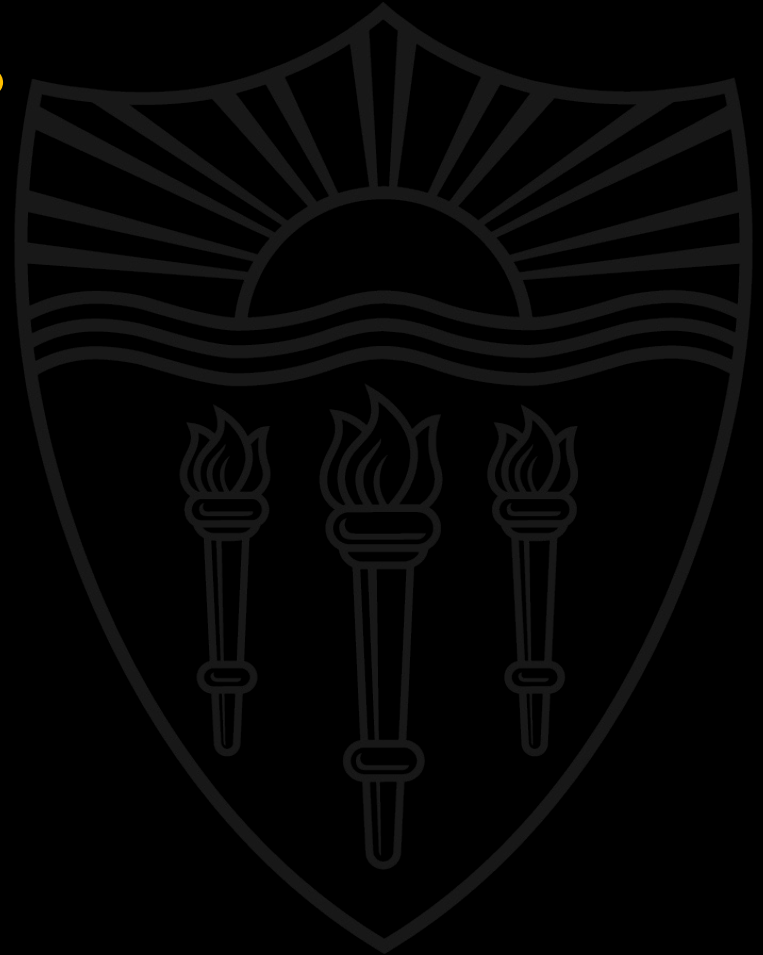
See the slides for fuller details...



Definitions - What is AI?

“AI” is NOT JUST ONE THING!

- Machine Learning
- AI
- LLM
- Generative AI
- AI Agents



What AI is NOT (yet)...

STILL SCIENCE FICTION:

- HAL-9000
- WOPR
- SkyNet
- Cylons
- Lore
- Agent Smith
- Ultron
- Cybertruck FSD



Machine Learning

- Complex, non-linear algorithms for associating *features* (independent variables) with *outcomes* (dependent variables)
- Examples: Neural Net, Random Forest, Boosted Trees, etc.
- “Supervised” Learning
 - Requires *structured* data
 - Must tell machine what variables to use; what algorithms to apply
 - Must train (and test) the model
- Often accurate, but usually not interpretable

Artificial Intelligence - AI

- General Definition: Computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems
- Usually not just a better algorithm – performs multi-step, multi-function tasks
- AI often applies *Deep Learning*
 - Recognizes complex patterns in images, language (written or aural), other data (e.g., car sensors)
 - Makes predictions or produces useful insights (e.g., full self-driving)
- Often “Unsupervised” Learning
 - Chooses own algorithms/variables
 - Can handle unstructured data
 - Still requires training dataset and *ground truth*
- May (or may not) provide interpretability

Large Language Model - LLM

- Can process and understand language
- What most people mean when they think of AI
 - ChatGPT
 - Apple Intelligence
 - *Many others...*
- Can handle unstructured data – “free text”
- Still depends on its training dataset
 - Only “knows” what is in the training data
- Still depends on its algorithm sets
 - Can only solve problems using algorithms that it also “knows”

Generative AI

- Creates an output (NEW content) based on a set of instructions
- Output may be written text, reports, pictures, music, computer code, etc.
- Usually linked to an LLM, both to understand the instructions and (for language-based outputs) generate the output
- Examples
 - ChatGPT
 - Dall-E
 - MuseNet
 - GitHub Copilot

AI Agent

- Software program that uses AI to perform tasks on its own
- Potential tasks include
 - Collecting data
 - Analyzing data
 - Making decisions
 - Taking actions (e.g., answer questions, solve problems, or interact with external environments)
 - **Learning from prior interactions to improve performance**
- Latest AI Agents can control other computers, including via keyboard & mouse inputs...

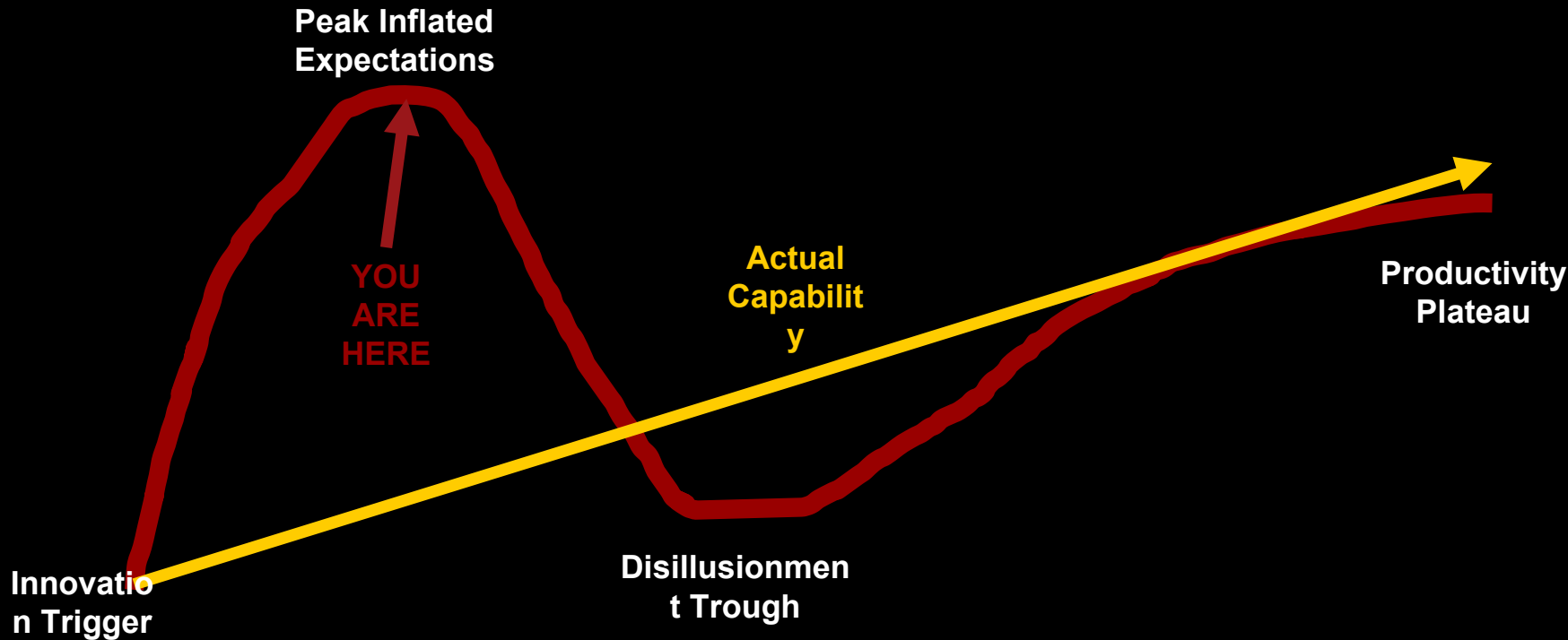
Hope or Hype?

- From a recent article on the future of AI by Dario Amodei, previously Vice President of Research at OpenAI (ChatGPT designer), now CEO of Anthropic, a public benefit AI corporation:
 - “My basic prediction is that AI-enabled biology and medicine will allow us to compress the progress that human biologists would have achieved over the next 50-100 years into 5-10 years.”
 - “Reliable prevention and treatment of nearly all natural infectious diseases”
 - “Elimination of most cancer.”
 - “Prevention of Alzheimer’s”
 - “Doubling the human life span”
- Fox’s Rule: Any time someone tells you that “No, this time it will be different!” (i.e., that the rules have changed), they are almost certainly wrong.
- Facts change, methods change, winners and losers change, but people’s behavior and fundamental system rules rarely do.

Amara's Law Applies

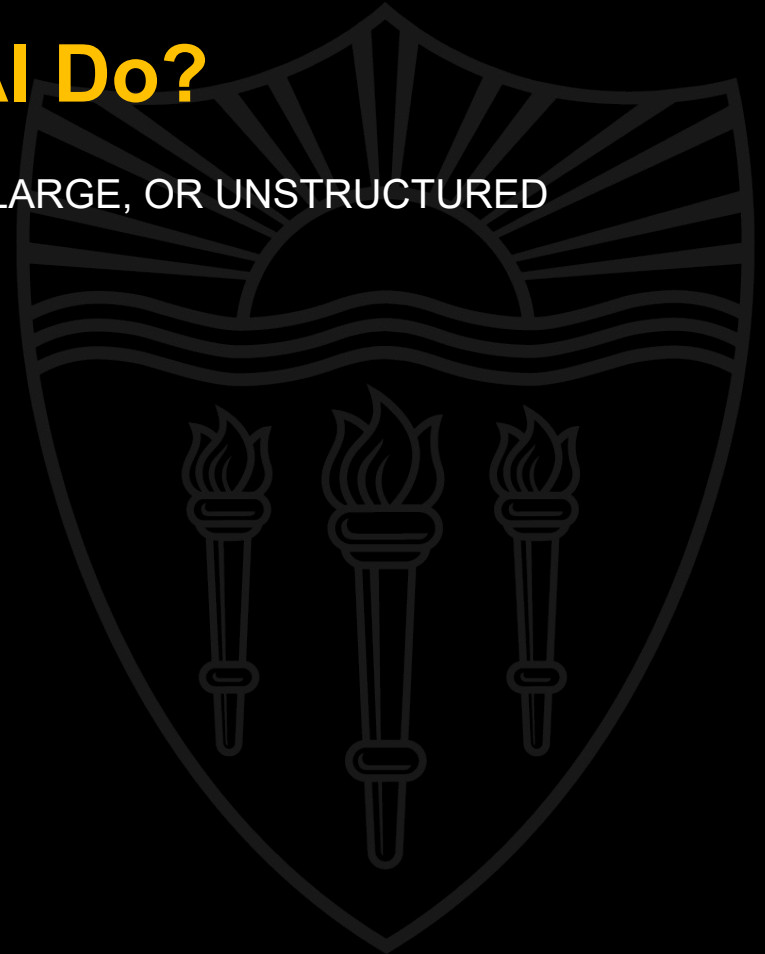
"We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run."

- Roy Amara



Functions – What Can AI Do?

- FUNDAMENTAL UTILITY: HANDLING MESSY, LARGE, OR UNSTRUCTURED DATASETS...
- Functions - Examples
 - Transcribe – Clinic Encounter
 - Sort – Rx List
 - Summarize – Medical History
 - Monitor – BG readings
 - Analyze – Sleep Patterns
 - Predict – CHF Exacerbation
 - Control – Insulin Infusion
 - Decide – Trigger Patient Alerts
 - Generate Ideas – Create Exercise Plan
 - Interact – Schedule Appointments



Where is AI Currently BEING Used?

- Image Interpretation
 - MRI, CT, US
 - Retinal Scans
 - Identifying Laparoscopic Surgical Landmarks
- Disease Screening
 - Dementia
- Transcribing Patient Encounters/Generating Summaries (e.g., HPI)
- Summarizing/Monitoring Treatments & Prescription Adherence
- Suggesting Diagnoses & Treatment Protocols
 - ASCVD
- Predicting Disease Risk/Onset
 - ICU Acuity & Arrhythmia Monitoring
- Post Surgery Treatment Coaching/Monitoring
 - TKR, Arthroplasty

Refs: Bitkina, *et al.*, 2023; Varnosfaderani, *et al.*, 2024

But Does AI Really Work?

“Despite the plethora of claims for the benefits of AI in enhancing clinical outcomes, there is a paucity of robust evidence. In this systematic review, we identified only a handful of RCTs comparing AI-assisted tools with standard-of-care management in various medical conditions.”

- Lam, *et al.*, 2022

What About Health Services Specific AI Applications?

- Surprisingly little published work on HSD-specific AI
- Mostly Routine Tasks
 - Surveillance – Identifying high risk patients
 - Monitoring – Especially RTM with wearables, internet enabled medical devices
 - Education/Coaching – Interacting with patients as an augment to in person
 - AI Agents - Facilitate scheduling & appointments
 - (Soon?) Automated Form Completion - Facilitating paperwork for coverage eligibility, patient assistance programs, etc.
- Significant logistical issues, especially for medically underserved patients
 - Not receiving regular care => incomplete data
 - Hardware & connectivity gaps – no internet, no smart phone
 - Tech literacy, health literacy, and plain old literacy issues
 - Privacy, privacy, privacy...

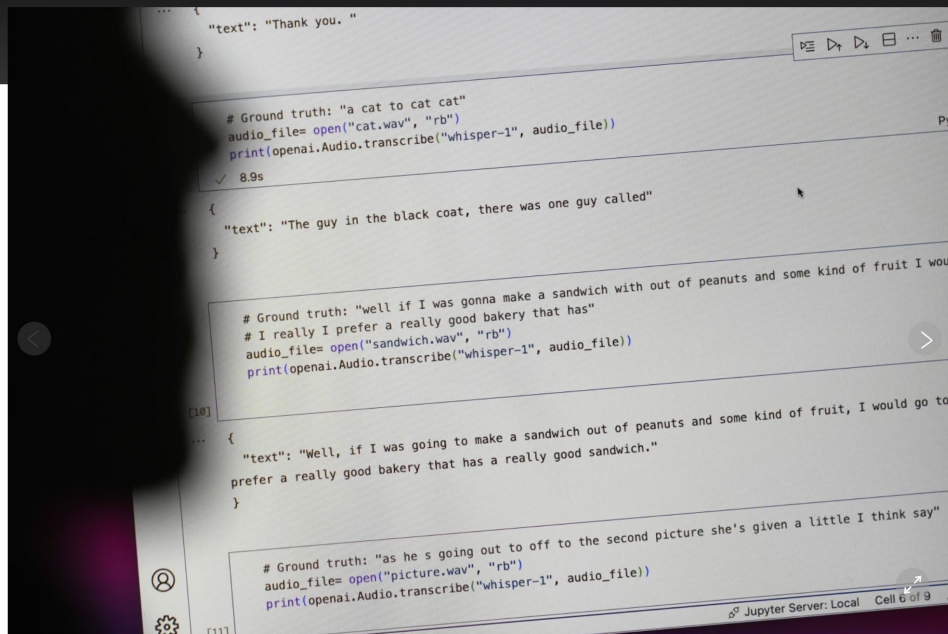
• Shohei Ohtani injury Middle East wars Election 2024 AP Top 25 Christie Sides

AP SETS THE STANDARD FOR POLITICAL REPORTING.
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TECHNOLOGY

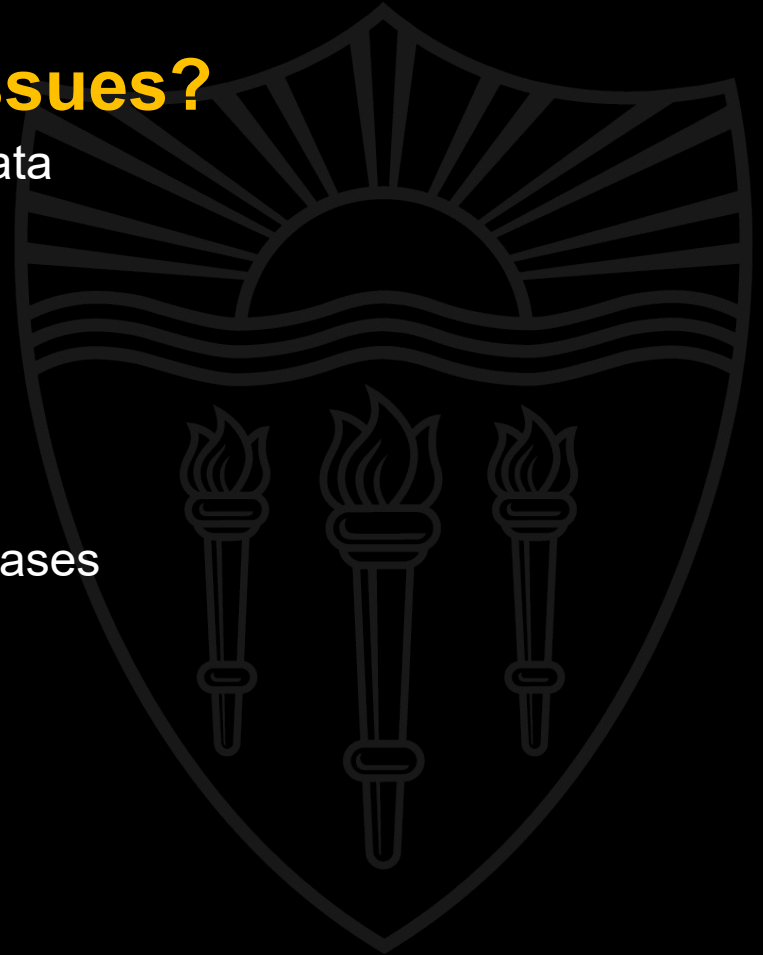
Researchers say an AI-powered transcription tool used in hospitals invents things no one ever said



1 of 6 | Assistant professor of information science Allison Koenig, an author of a recent study that found hallucinations in a speech-to-text transcription tool, works in her office at Cornell University in Ithaca, N.Y., Friday, Feb. 2, 2024. The text preceded by "#Ground truth" shows what was actually said while the sentences preceded by "'text'" was how it was transcribed. Read More

Perils & Pitfalls – What are the Limitations/Issues?

- GIGO – You are only as good as your data
 - Incomplete
 - Inaccurate
 - Insufficient
 - Lacking Ground Truth
- Hallucinations – Making S--t Up
- Biases - AI Mirrors and Magnifies Our Biases
 - Stereotypes
 - Treatment Assignments
- Transparency/Interpretability
 - Pneumonia Example
- Provider Trust – What If It's Wrong?



Data Privacy is a Huge Stumbling Block

A large, faint watermark of the USC Mann logo is visible in the background. It features a shield with a rising sun at the top and three torches at the bottom.

- Accessing data
- Getting it inside the firewall
- Aggregating, linking, & harmonizing data from multiple sources
- Anonymization/Deidentification
- Keeping it inside the firewall
 - Data Leakage
 - Unauthorized Access
- Keeping it up to date
- NOTE that these are all tasks that AI Agents may eventually assist with...

Bottom Lines –

- 1) Image processing is the big success story, so far.**
- 2) AI is now automating many other healthcare tasks, but issues remain before we can trust specific applications' security, reliability & utility.**
- 3) The most useful and acceptable AI will not be a replacement for healthcare providers, but an augment that makes their tasks easier...**

Questions?

- Anyone?
- Buhler? Buhler?
- Email: steven.fox@med.usc.edu

