

Artificial Intelligence and Family Medicine

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Disclosures and Learning Objectives

- I have no financial disclosures
- Learning objective 1: Understand basic AI techniques and terminology
- Learning objective 2: review applications of AI in medicine that are commercially available
- Learning objective 3: describe high level goals of future AI technologies in medicine and particularly primary care

Outline

- Introduction to AI
- Review of currently available tools
- Potential problems and bias
- Future of AI



Introduction to Artificial Intelligence



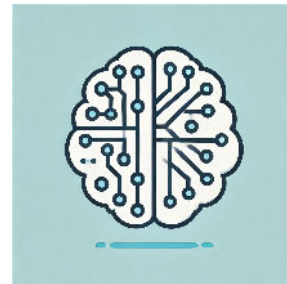
Some basic terminology

AI: Artificial intelligence

- “The science and art of making intelligent machines”
- John McCarthy
- “A branch of computer science that uses algorithms, data, and computational power to enable machines to perform tasks that normally require human intelligence” - ChatGPT

ML: Machine Learning

- Computer systems that are able to learn and adapt without following explicit instructions, by using algorithms and statistical models to analyze and draw inferences from patterns in data



Some basic terminology

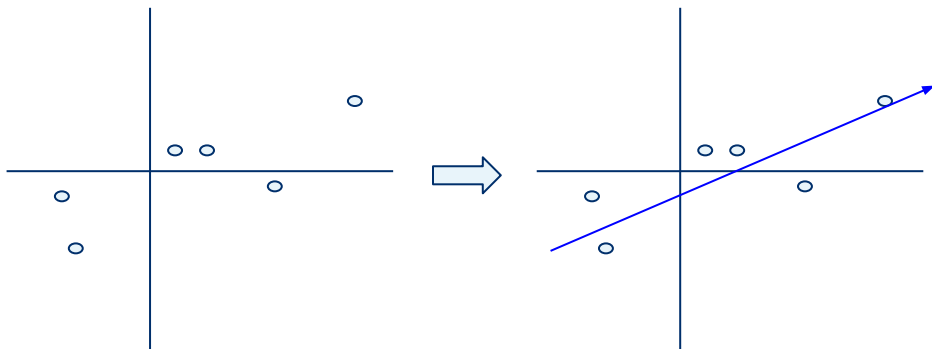
- NLP: Natural language processing
 - Subfield of AI specifically related to processing of spoken or written language
- LLM: Large language model
 - An algorithm for understanding, interpreting, and responding to human language built on an extremely large dataset
- GPT: Generative pre-trained Transformer
 - A type of LLM



Okay but what is AI *really*?

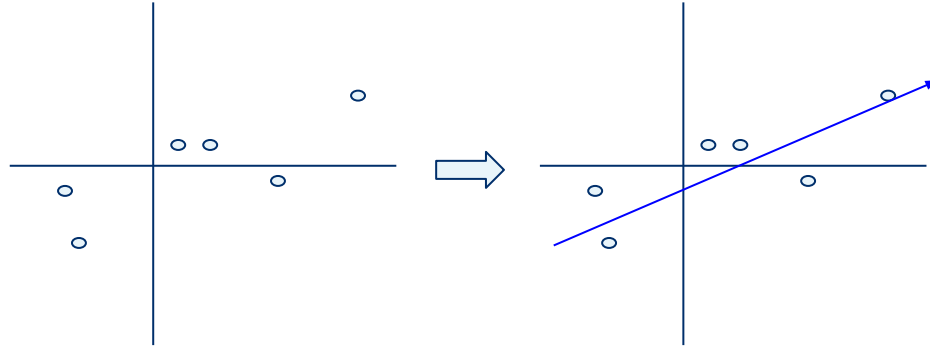
- AI is just another form of automation
 - Data input → answer output
 - Data input → unsupervised tasks
- Never forget: garbage in = garbage out

Is linear regression AI?

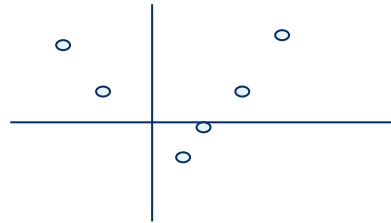


Is linear regression AI?

- Takes input as some set of points
- Gives output that “summarizes” the information



What if there is no linear cohesion?



Currently available tools



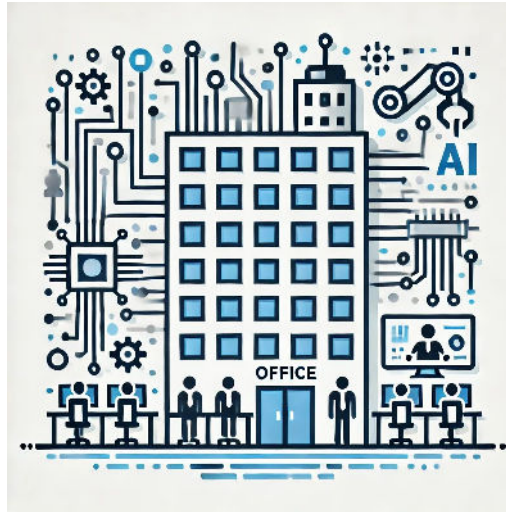
Image processing

- GE Quality care suite - image processing and “diagnostic tools”
 - Siemens YSIO
 - Zebra medical vision
-
- Long story short - the tech just isn't there yet for PCPs.
 - Diagnostic sensitivity, bias, liability



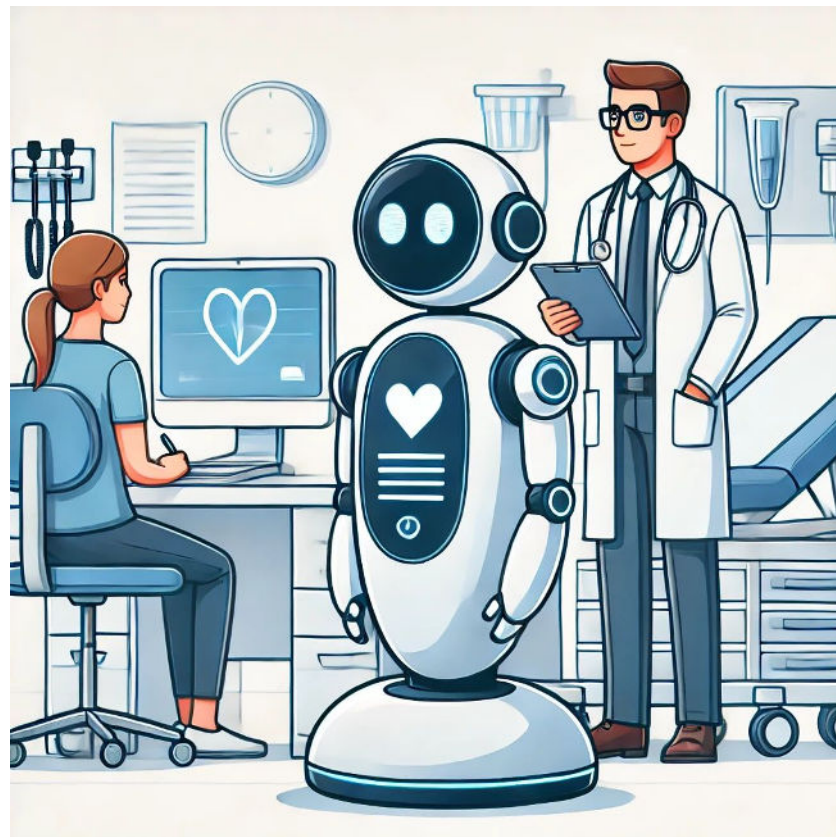
Corporate and Administrative tools

- Automated patient message responses
 - actively undergoing clinical trials
- Large scale text processing
 - Anticipate clinical reviews to be incorporating AI



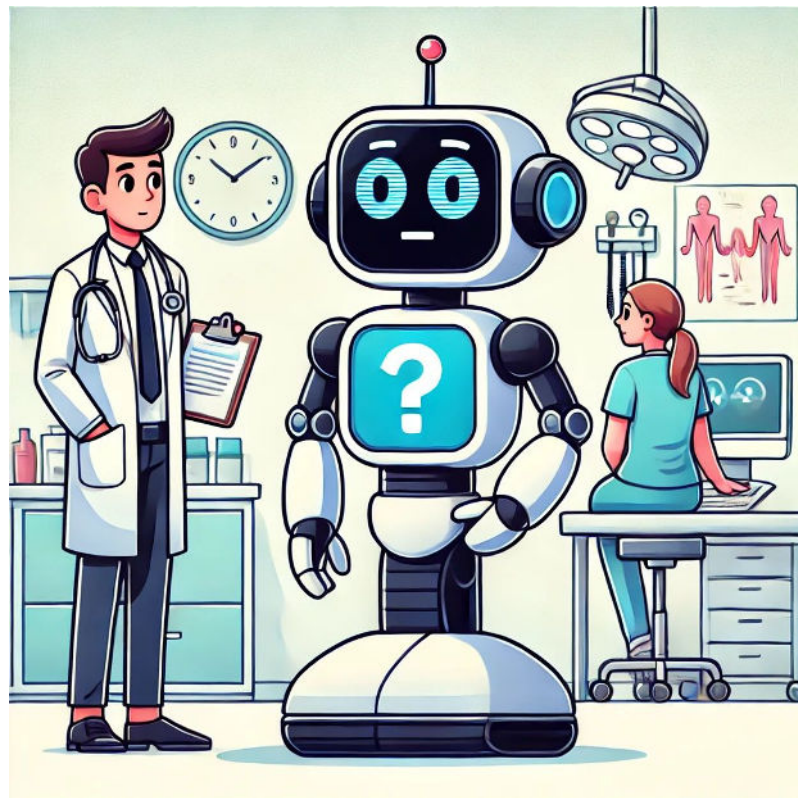
The real deal: AI scribes

- Ultimate use case:
 - enable microphone
 - talk with patient
 - exit room with note and orders drafted
- DAX copilot from Dragon/Nuance
- DeepScribe partnering with EPIC
- Many others using “copy/paste”



AI Scribes: Issues and considerations

- Are patient encounters stored?
- Who owns any recorded and transcribed data?
- Are any recordings subject to subpoena, or just the edited transcripts?
- Do you need to use informed consent?



AI Scribes: The bottom line

- You should be paying attention to these technologies
- Represent most promising use of AI for primary care
- A note of caution: would you trust a radiologist who doesn't understand how a CT machine works?



ChatGPT: what is it?

- Freely available website:

chat.openai.com

- Generative Pretrained Transformer

- generates text based on inputs
- “trained” on ~500 GB of data
- sequence-predicting chatbot

- Built on LLM, essentially a “very large” artificial neural network



ChatGPT: what can it do?

- Take in small amount of text (the prompt)
- Produce excellent, well structured output

Small input: write a differential for an 83 year old patient with chest pain

write a differential for an 83 year old patient with chest pain

When evaluating an 83-year-old patient with chest pain, it's important to consider a broad differential diagnosis that includes both cardiac and non-cardiac causes. Here's a differential diagnosis to consider:

Cardiac Causes:

1. **Acute Coronary Syndrome (ACS):**
 - Unstable Angina
 - Myocardial Infarction (STEMI/NSTEMI)
2. **Aortic Stenosis:**
 - Common in elderly patients, presenting with chest pain, syncope, and heart failure.
3. **Heart Failure:**
 - Could cause chest pain due to ischemia or strain on the heart.
4. **Pericarditis:**
 - Inflammation of the pericardium, with pleuritic chest pain often relieved by sitting forward.
5. **Aortic Dissection:**
 - Sudden, severe, tearing chest pain radiating to the back.
6. **Arrhythmias:**
 - Rapid or irregular heartbeats causing discomfort or chest pain.

Pulmonary Causes:

Next steps?

Diagnostic tests needed?

Message ChatGPT



ChatGPT: what can it do?

- Contextual power:
 - knowledge of entire conversation so far

“Okay, now rewrite the differential with the knowledge that the patient is a 50 year smoker and has a history of abdominal aortic aneurysm”

write a differential for an 83 year old patient with chest pain

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ChatGPT: some specific use cases

write a letter of medical necessity as if you were the primary care physician for a patient who needs a power wheelchair. They have a history of multiple falls due to peripheral neuropathy and nyha class 3 HFrEF

[Patient's Full Name] is an [age]-year-old [gender] with a history of advanced heart failure, specifically New York Heart Association (NYHA) Class III Heart Failure with Reduced Ejection Fraction (HFrEF). This condition significantly impairs their ability to tolerate physical activity, leading to marked limitation of physical activity. Even minimal exertion causes fatigue, palpitations, and shortness of breath.

In addition to heart failure, the patient also suffers from peripheral neuropathy, which has resulted in multiple falls over the past year. The peripheral neuropathy is progressive and has led to substantial loss of sensation and motor control in their lower extremities, further compromising their balance and mobility.

Impact on Mobility and Daily Functioning:

Given these conditions, [Patient's Full Name] has significant difficulty with ambulation. They are unable to walk long distances and are at constant risk of falls, which poses a serious threat to their safety. The patient currently requires assistance for most activities of daily living and is largely confined to their home due to their mobility limitations.

A power wheelchair is medically necessary for [Patient's Full Name] to improve their mobility, independence, and quality of life. The use of a power wheelchair will allow the patient to move safely within their home and community, reducing the risk of falls and injuries. It will also enable them to perform essential daily activities, such as attending medical appointments and engaging in social interactions, which are crucial for their overall well-being.

The patient's condition is expected to be long-term, and there is no alternative treatment that will restore their mobility or prevent falls to a sufficient degree. A power wheelchair is the most appropriate and effective solution for maintaining the patient's safety, independence, and dignity.

Given the severity of [Patient's Full Name]'s medical conditions and their impact on mobility, it is my professional opinion that a power wheelchair is medically necessary. I strongly recommend that insurance coverage be provided for this essential medical device to support the patient's health and quality of life.



ChatGPT: some specific use cases

write a letter appealing an insurance denial of a referral to MD anderson oncology. The patient has metastatic melanoma and is seeking a second opinion after initial consultation at Stephenson Cancer Center

I am writing to formally appeal the recent denial of my patient's referral to MD Anderson Cancer Center for a second opinion regarding the management of their metastatic melanoma.

Patient Background:

[Patient's Full Name] is an [age]-year-old [gender] who has been diagnosed with metastatic melanoma, a highly aggressive and challenging malignancy. The patient has already undergone an initial consultation and treatment planning at Stephenson Cancer Center. While the care provided at Stephenson has been commendable, given the complex and rapidly evolving nature of metastatic melanoma, the patient and I believe that a second opinion from a leading institution like MD Anderson Cancer Center is crucial for optimizing their treatment plan.

Rationale for Referral to MD Anderson Cancer Center:

MD Anderson Cancer Center is recognized as one of the premier oncology centers in the world, particularly known for its expertise in the management of melanoma. They have access to the latest research, clinical trials, and advanced treatment protocols that may not be available at other centers. Given the poor prognosis associated with metastatic melanoma and the need for a highly specialized and potentially innovative treatment approach, a second opinion from MD Anderson is not only appropriate but necessary.

Furthermore, the patient's case is complicated by [any additional relevant details about the patient's condition or history that might warrant a second opinion]. These factors further justify the need for evaluation at a top-tier center with extensive experience in complex melanoma cases.

Importance of a Second Opinion:

The National Comprehensive Cancer Network (NCCN) Guidelines and best practices in oncology care encourage second opinions for complex cancer cases to ensure that patients receive the most comprehensive and up-to-date treatment recommendations. A second opinion from MD Anderson will provide the patient with peace of mind and confidence in their treatment plan, which is critical for their psychological well-being and overall outlook.

Conclusion and Request for Reconsideration:

I respectfully request that you reconsider the denial of this referral. The patient is facing a life-threatening condition, and access to a second opinion at MD Anderson Cancer Center is vital to ensure they receive the best possible care. The potential benefits of this referral far outweigh any associated costs, as it may lead to improved treatment outcomes and, ultimately, may reduce overall healthcare expenditures by potentially avoiding ineffective or unnecessary treatments.

Please feel free to contact me directly if you require further information or clarification regarding this appeal. I appreciate your time and attention to this urgent matter and look forward to a favorable resolution.



ChatGPT: some specific use cases

write a procedure note for a
pap smear

Procedure Note: Pap Smear

Date of Procedure: [Date]
Patient Name: [Patient's Full Name]
Date of Birth: [Patient's DOB]
Medical Record Number: [Patient's MRN]
Performed by: [Your Name, MD]
Location: [Clinic/Facility Name]

Indication:
Routine cervical cancer screening.

Procedure:

Patient Preparation:

The patient was placed in the lithotomy position on the examination table.
A chaperone was present throughout the procedure.
The external genitalia were examined and appeared normal.
Speculum Examination:

A warmed, lubricated speculum was gently inserted into the vagina to visualize the cervix.
The cervix was well visualized, with no lesions, discharge, or abnormalities noted.
Collection of Samples:

A plastic spatula was used to collect cells from the ectocervix.
A cytobrush was then inserted into the endocervical canal and rotated 360 degrees to collect cells from the endocervix.
Both samples were adequately collected and placed into a vial containing the appropriate preservative solution.
Completion:

The speculum was carefully removed, and the patient was assisted to a seated position.
The patient tolerated the procedure well, with no immediate complications.
The collected samples were labeled and sent to the laboratory for cytological analysis.

Post-Procedure Instructions:
The patient was advised that they might experience mild spotting or cramping following the procedure, which is normal. The patient was instructed to report any significant bleeding, pain, or unusual symptoms. Follow-up for results was discussed and will be scheduled accordingly.

Assessment:
The procedure was completed without difficulty or complications. No immediate concerns were noted.

Plan:
Await cytology results and discuss further management based on findings.



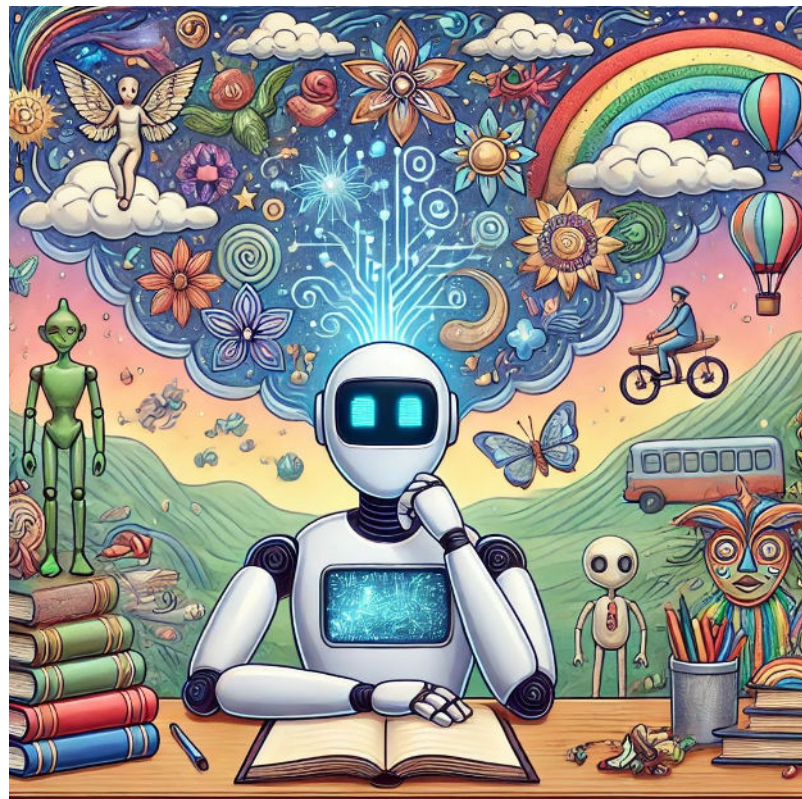
ChatGPT: other tasks

- “generate a handout of patient information for a new diagnosis of type II diabetes”
- “what are some ways a patient could reduce their cholesterol without medication?”
- “what are some topics that I should cover when making a presentation on AI in primary care?”
- “summarize this article for me”



ChatGPT: some words of caution

- Hallucination (or confabulation)
- No guarantee of real-time updates
- Patient data security
- Bias

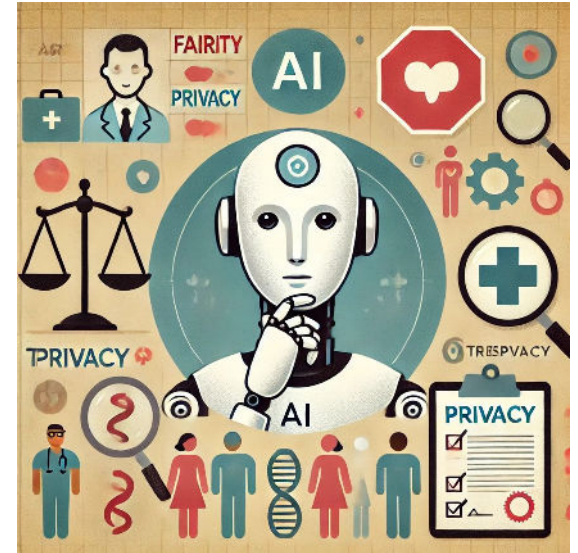


Issues with AI



Liability and Ethics

- Diagnostic errors
- Deviation from standard of care
- Difficult to understand/extract AI rationale
- Is informed consent necessary?
- Should patients be able to opt out?



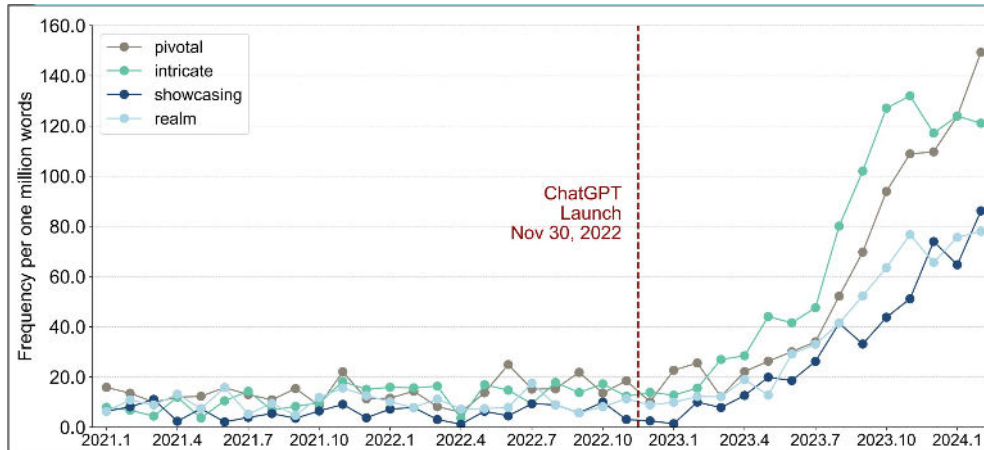
Ownership of data

- Who owns patient data?
- Tremendous value of data of any kind
- Do you trust your institution (or EHR vendor) to safeguard any data being used?



Bias: what is it?

- Algorithms are **very** dependent on their training dataset
- Bias = more likely to decide upon one outcome or diagnosis based on their *construction* rather than the clinical case
- Example: crackles on lung exam
- Example: “pivotal, intricate, showcasing, realm”



Bias: A case study

Measuring the impact of AI in the diagnosis of hospitalized patients

Authors: Sarah Jabbour et al, JAMA. 2023

Goal: evaluate how clinicians perform when given an AI tool that is systematically biased

Study Design

- Present clinicians with several clinical vignettes: patient with AHRF, labs, physical, and chest xray
- Then asked to differentiate between possible diagnosis: pneumonia, heart failure, or COPD
- Then clinicians were given several more vignettes along with AI-based interpretation of the xray



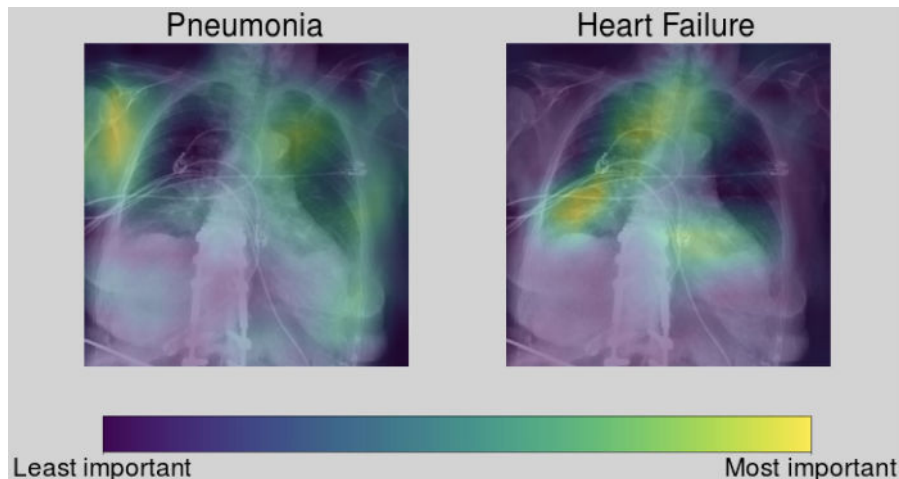
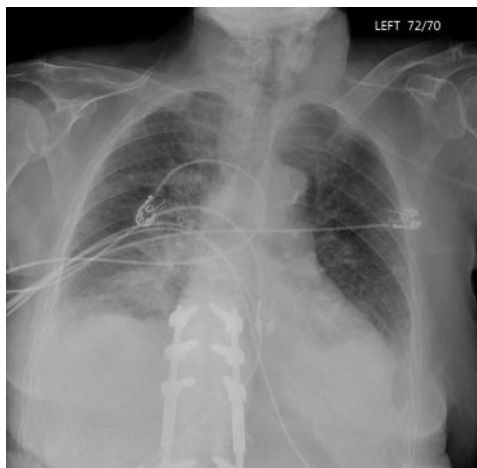
Study Design: The ole bait and switch

- Some participants were randomized to get AI models which had some inherent bias
- Essentially, much more likely to predict heart failure than the other diagnoses based on training data (and other bias mechanisms)



Study Design: The ole bait and switch...?

- Importantly, all clinicians were primed and told that some of the models **may have bias**
- Some were even given a display that showed what portions of the xray the AI model was using to base its prediction on



Results

Setting	Average Marginal Effect
Clinician + Standard Model	2.9
Clinician + Standard Model + Explanations	4.4
Clinician + Systematically Biased Model	-11.3
Clinician + Systematically Biased Model + Explanations	-9.1
Clinician + Clinical Consult	8.1



What to make of all this?

- Automation bias
 - People are more likely to trust information that is given to them
 - Essentially when given a tool, people need a reason to mistrust the output of that tool



What to make of all this?

- I am not saying you should never trust any AI-based clinical tool
- Sometimes sensitivity is preferred in diagnostics
- Bias is present in many clinical situations, not just AI



Future Directions and Other Miscellany



Promising applications of AI

- Virtual therapists
- Genomic medicine
- Drug interaction and novel drug development
- Integration with wearables
- Population and resource management
- Institutional monitoring



A note on in-house AI

- It's really hard to make an AI tool integrate into your EMR
- FDA approval is required
- The location of your data matters



Other miscellaneous AI applications

- Image generation - DALLE
- Scientific inquiry - [elicit.com](https://www.elicit.com)
- Medical education
 - your students are already using ChatGPT
- Virtual reality-based trainings



Final Thoughts

- You should use ChatGPT
- Be cautiously optimistic about AI scribing tech
- Be wary of any diagnostic support tools
- AI is here to stay.



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Thank you

Questions?