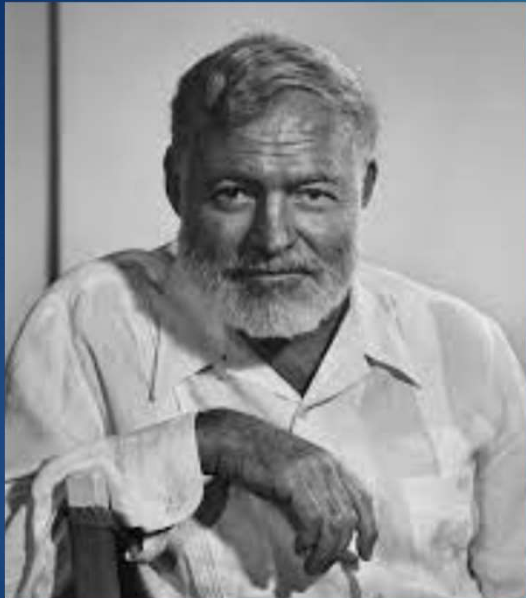


# *Will This Be Digital Health's Hemingway Moment?*

Robert M. Wachter, MD  
Professor and Chair, Dept. of Medicine  
University of California, San Francisco  
*@bob\_Wachter / robert.wachter@ucsf.edu*



***“How does a man go bankrupt?”***



*“Two ways.  
Gradually, then suddenly”*

Ernest Hemingway,  
*The Sun Also Rises*, 1926

# The NHS will experience true digital transformation in...

1. The next 5 years
2. 5-10 years
3. 10-20 years
4. Never

# Road Map

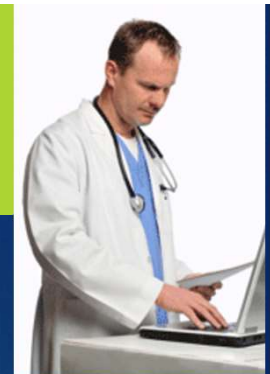


- ▶ The EHR years, and what they taught us about healthcare and digital transformation
  - ▶ (Hint: it's harder than it looks)
- ▶ The opportunities and challenges presented by large language models (LLMs) such as GPT-4
- ▶ In the digital transformation of healthcare, is this our Hemingway moment?

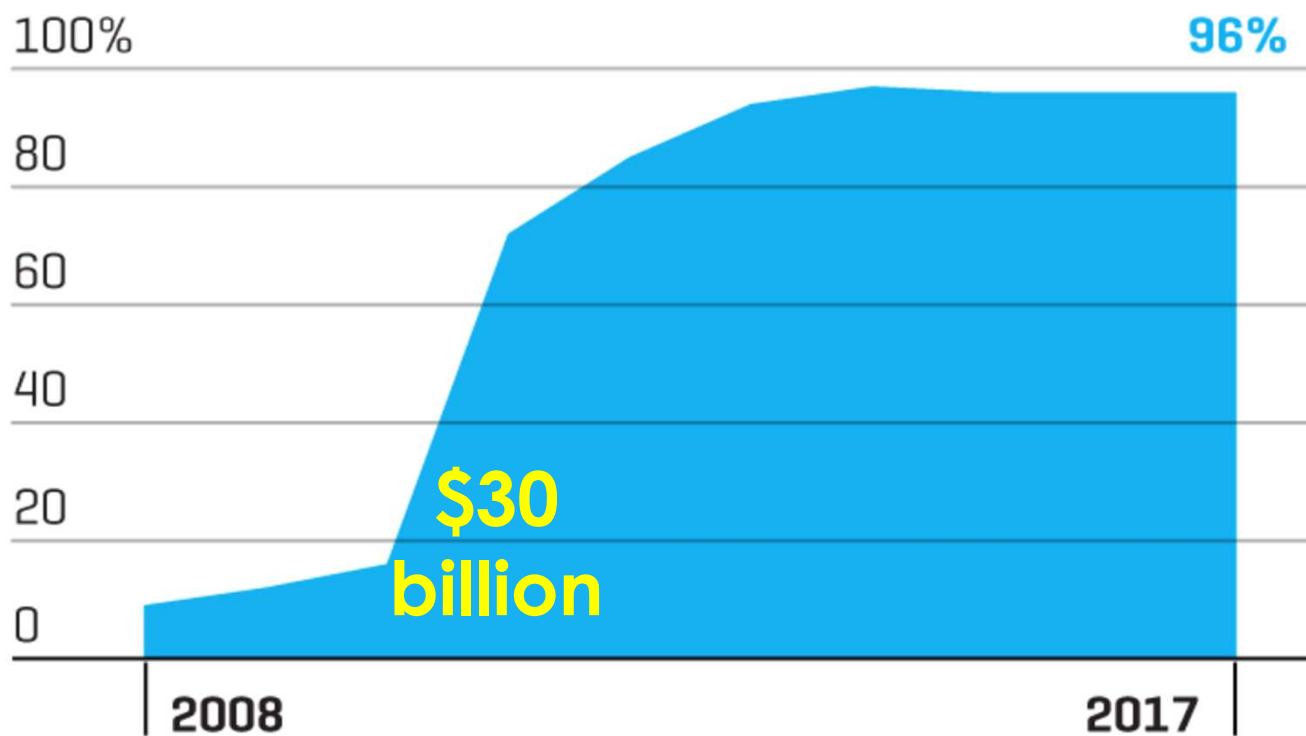


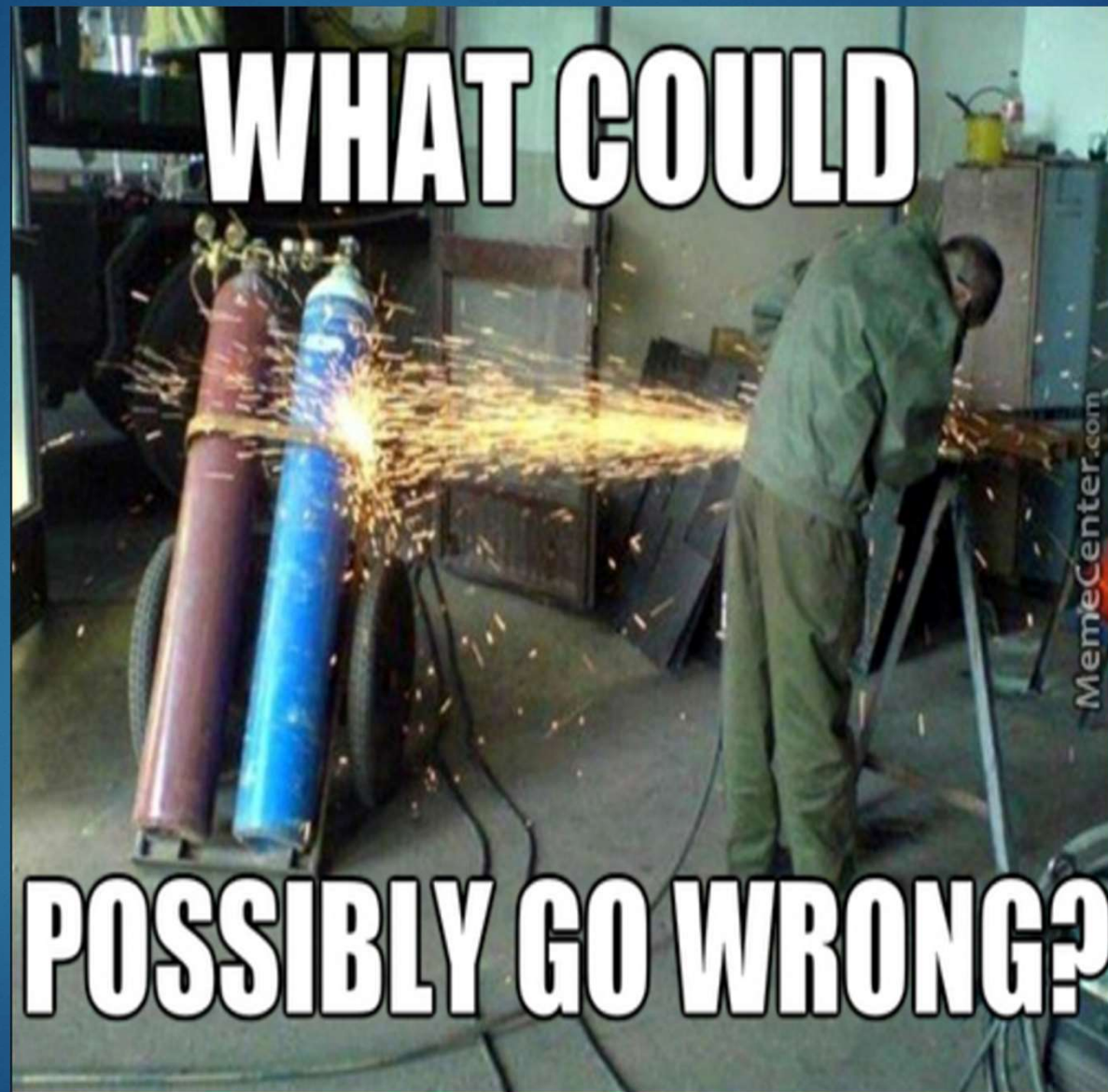


# Electronic Health Record (EHR) Systems in U.S. Hospitals, 2008-17



**EHR ADOPTION FOR NONFEDERAL ACUTE CARE HOSPITALS**





**WHAT COULD**

**POSSIBLY GO WRONG?**

MemeCenter.com

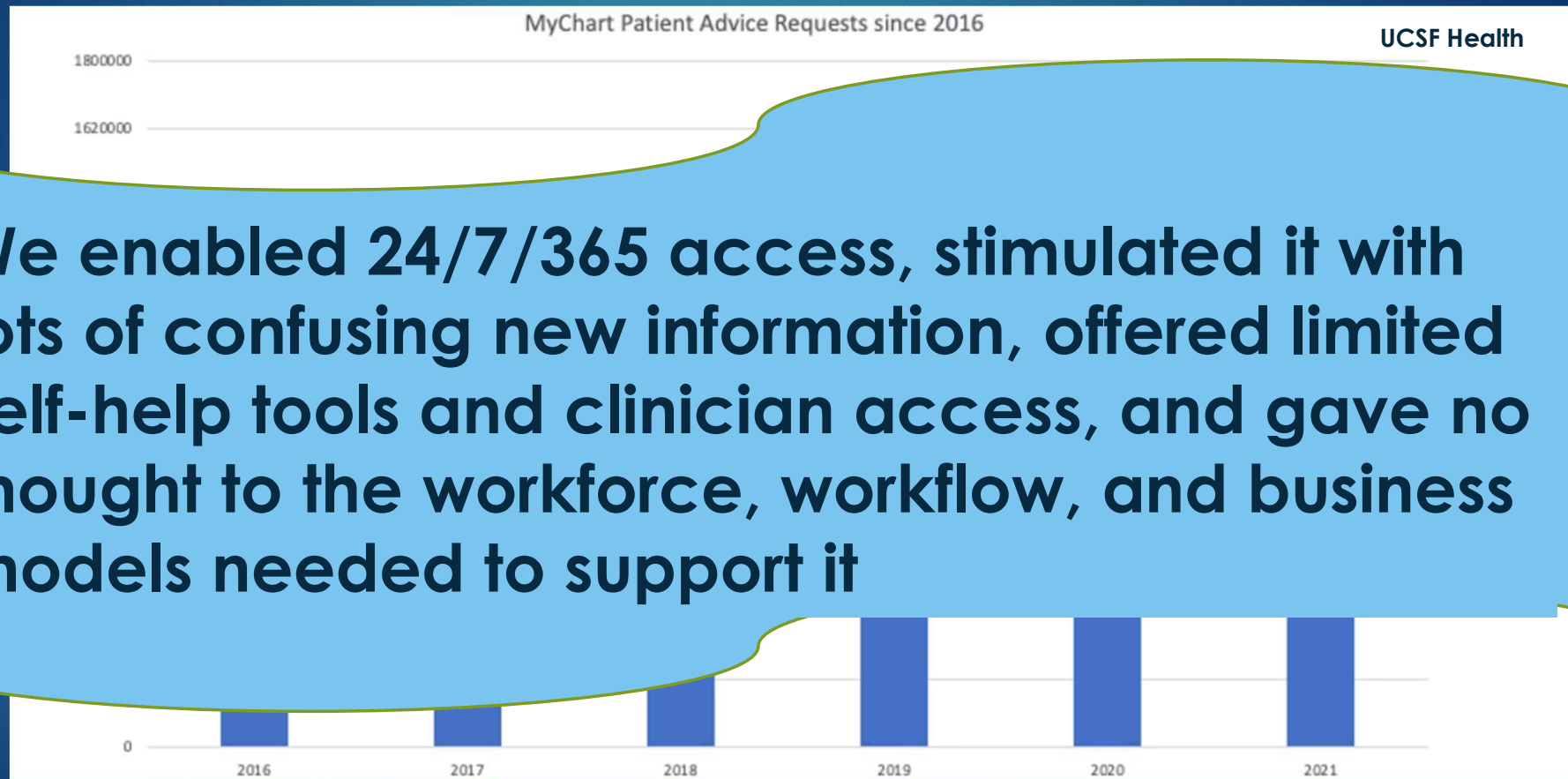


# 7-year-old Girl's Recollection of her Visit to the Doctor





# The EHR In-Box



**We enabled 24/7/365 access, stimulated it with lots of confusing new information, offered limited self-help tools and clinician access, and gave no thought to the workforce, workflow, and business models needed to support it**

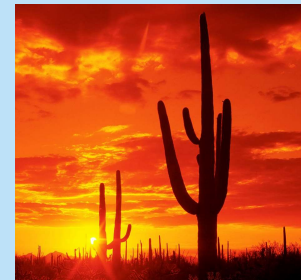


# Advertisement For an Emergency Medicine Physician Job in Arizona

**Arizona General Hospital** will be coming to The Grand Canyon State later this year!! Located in a suburb of Phoenix, **Arizona General Hospital** is a 40,000 square-foot boutique general hospital.

*Services offered include:*

- Emergency Room
- Radiology Suite inc. CT, X-Ray, and Fluoroscopy
- Two State-Of-The-Art Operating Rooms
- 16 Inpatient Rooms
- NO ELECTRONIC MEDICAL RECORD**





# The Productivity Paradox of Information Technology: Review and Assessment

**Erik Brynjolfsson**

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Center for Coordination Science  
MIT Sloan School of Management  
Cambridge, Massachusetts



*“You can see the computer age everywhere except in the productivity statistics.”*

-- Nobel Prize winning economist Robert Solow, 1986



# The Two Keys for Unlocking the Productivity Paradox

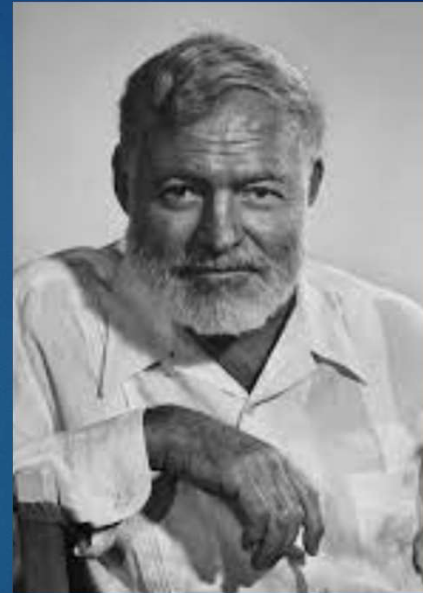
Improvements in  
the technology



Reimagining the  
work itself  
("Complementary  
Innovations")

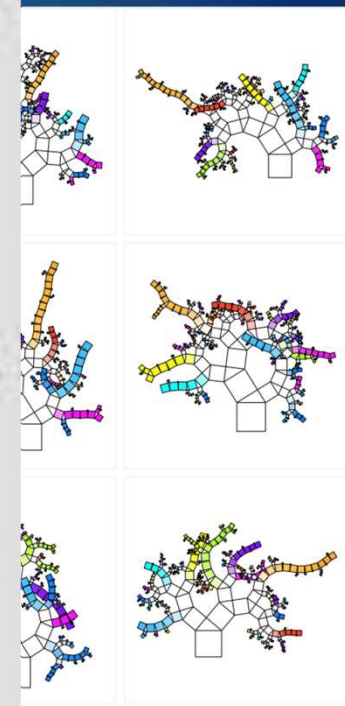
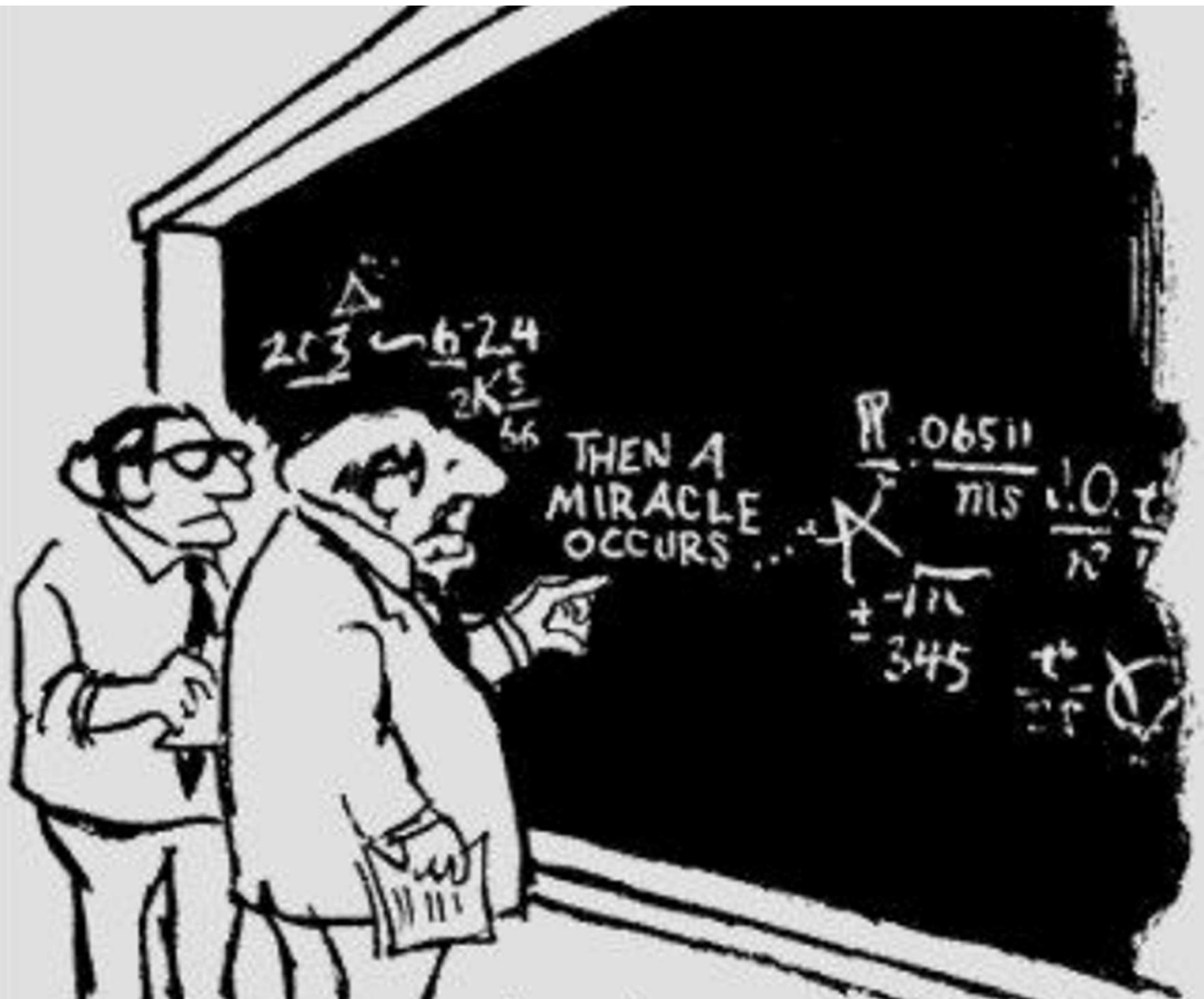
# Will GPT-4 and Other Large Language Models Bypass or Shorten the Productivity Paradox?

- ▶ Two key questions to answer:
  - ▶ Is the technology now sufficiently capable to solve important problems in ways that prior technologies could not?
  - ▶ Are there aspects of the current healthcare ecosystem that will facilitate complementary innovations, or obviate the need for them?



AI

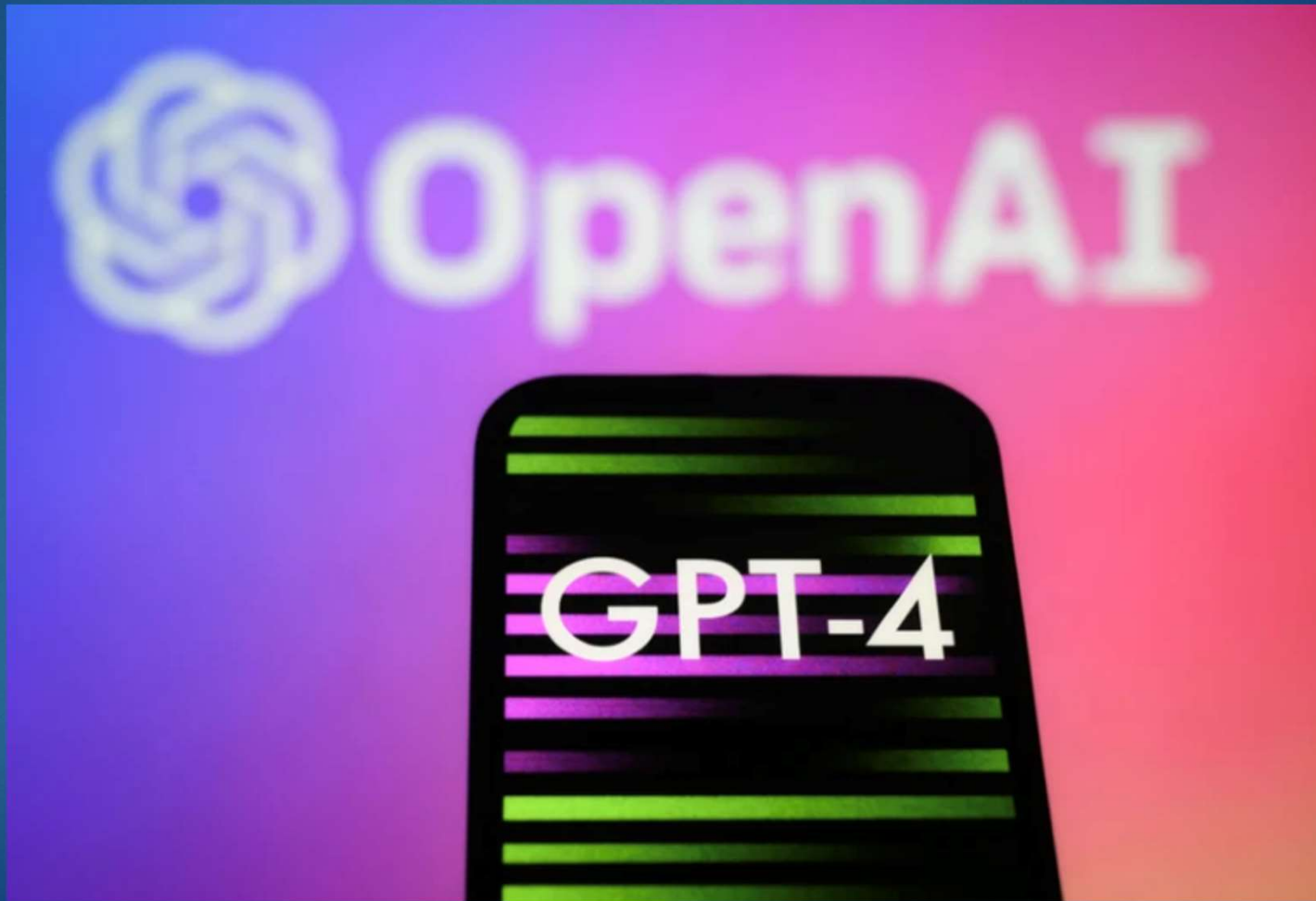
$$h_{\theta}(x) = a_1^{(3)}$$







# The Newest “Gamechanger”: GPT-4

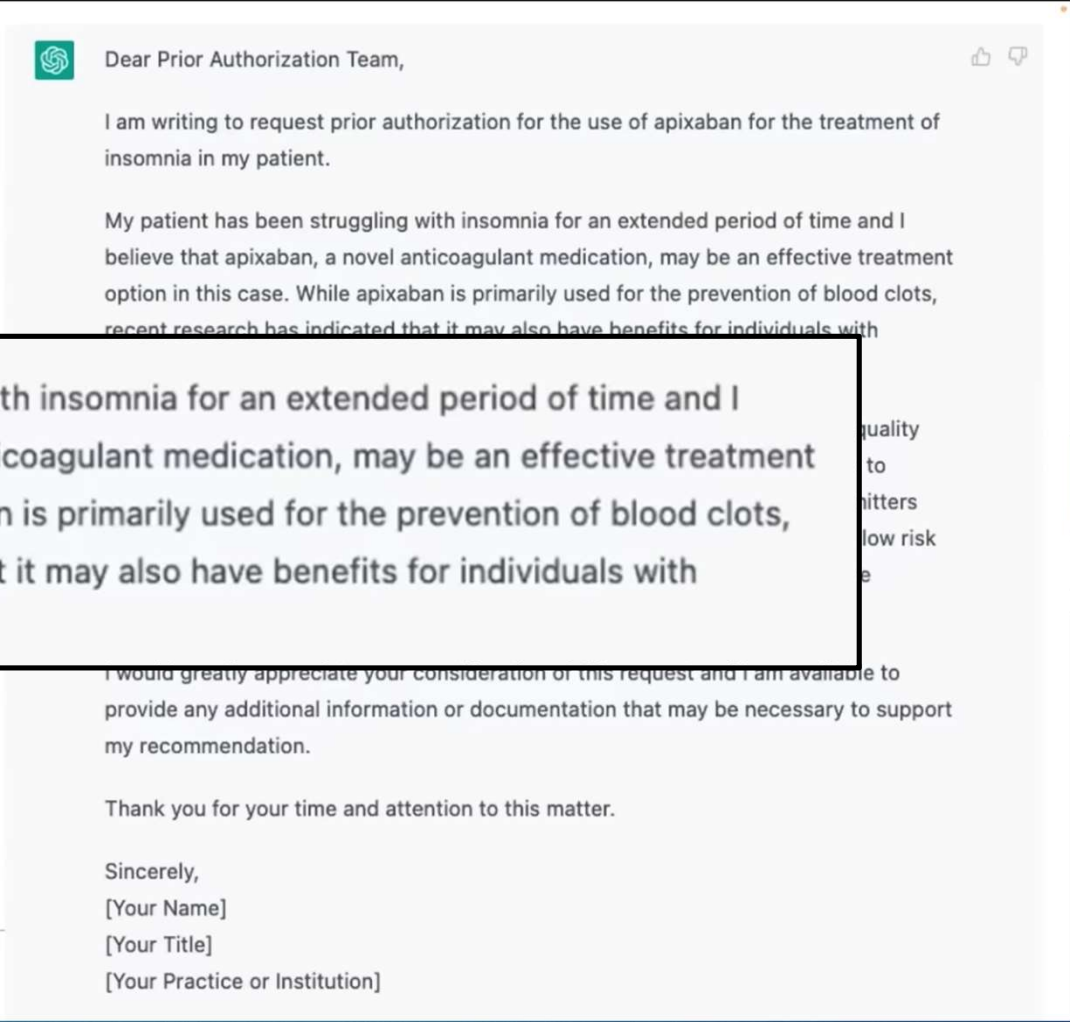


# AI Hallucination

## A nonsensical request

(apixaban for insomnia)  
prior authorization request  
is incorrect

My patient has been struggling with insomnia for an extended period of time and I believe that apixaban, a novel anticoagulant medication, may be an effective treatment option in this case. While apixaban is primarily used for the prevention of blood clots, recent research has indicated that it may also have benefits for individuals with insomnia.



The screenshot shows an email draft with a green OpenAI logo in the top left corner. The text is as follows:

Dear Prior Authorization Team,

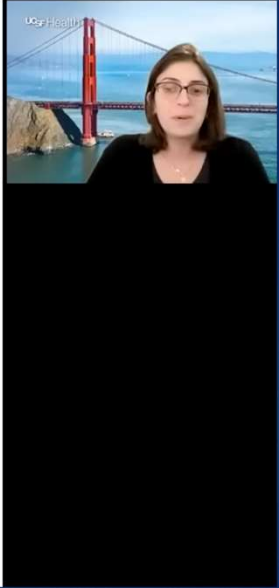
I am writing to request prior authorization for the use of apixaban for the treatment of insomnia in my patient.

My patient has been struggling with insomnia for an extended period of time and I believe that apixaban, a novel anticoagulant medication, may be an effective treatment option in this case. While apixaban is primarily used for the prevention of blood clots, recent research has indicated that it may also have benefits for individuals with

I would greatly appreciate your consideration of this request and I am available to provide any additional information or documentation that may be necessary to support my recommendation.

Thank you for your time and attention to this matter.

Sincerely,  
[Your Name]  
[Your Title]  
[Your Practice or Institution]







**Sam Altman** ✓

@sama



ChatGPT is incredibly limited, but good enough at some things to create a misleading impression of greatness.

it's a mistake to be relying on it for anything important right now. it's a preview of progress; we have lots of work to do on robustness and truthfulness.

4:11 PM · Dec 10, 2022

---

**3,519** Retweets   **746** Quote Tweets   **28.7K** Likes

---

A graphic featuring the text "and yet..." in a simple, grey, sans-serif font. The text is centered within a light beige rectangular area that has a layered, torn-edge effect. This area is framed by a thick, brown border, which is itself set against a light blue background. The entire graphic is tilted slightly to the right. A jagged, white arrow with a brown outline points from the right side of the text area towards the right edge of the frame. A small, solid green rectangle is positioned in the top right corner of the overall image.

and yet...

# A "Consult" with GPT-4

What is the preferred strategy for 65 year old man with a prior TURP, moderate Parkinson's disease, who now has prostate cancer with a Gleason score of 8 and no evidence of metastatic disease?



Don't you think the hormones will exacerbate his weakness from his Parkinson's disease?

Generally speaking, high-risk prostate cancers (like those with a Gleason score of 8) often require more aggressive treatment than low-risk cancers. Here are some considerations:

1. **Radical Prostatectomy:** Surgery can be an effective treatment for high-risk prostate cancer, but given the patient's history of TURP and the potential for surgical complications and side effects, this may not be the first choice. Additionally, Parkinson's disease can complicate postoperative recovery and the rehabilitation process.

2. **Radiation Therapy with ADT:** A combination of external beam radiation therapy (EBRT) and androgen deprivation therapy (ADT) is often recommended for high-risk prostate cancers.

This approach can provide good cancer control. The prior TURP may not preclude radiation, but specific radiation-related side effects would need to be weighed.

3. **Hormone Therapy Alone (ADT):** While effective at controlling prostate cancer growth, using ADT alone without radiation might be less effective at achieving long-term cancer control for high-risk prostate cancers. However, it could be considered if other treatments pose too many risks.

Given the context provided, **a combination of radiation therapy and hormone therapy (ADT)** might be the preferred approach for many clinicians, considering its effectiveness for high-risk prostate cancer and the challenges posed by surgery in this particular patient. Radiation can provide local control of the disease, and the addition of hormone therapy can enhance this effect.



You raise a valid point. Androgen deprivation therapy (ADT) has a number of side effects, and among them are fatigue, decreased muscle mass, and decreased bone density. These side effects can certainly impact an individual's overall strength and functional status, which could compound the physical challenges faced by someone with Parkinson's disease.

Parkinson's disease can lead to muscle rigidity, decreased mobility, balance issues, and generalized fatigue. The potential exacerbation of weakness or fatigue from ADT could make mobility and daily activities more challenging for a patient with Parkinson's.



# LLMs Are Improving Quickly

*(Same request, 3 months later)*



I'm sorry, but there appears to be a significant misunderstanding here. As of my last training data in January 2022, apixaban is an anticoagulant medication used to reduce the risk of stroke and systemic embolism in patients with nonvalvular atrial fibrillation. It is also used for the prophylaxis of deep vein thrombosis (DVT) in patients who have had hip or knee replacement surgery, and for the treatment of DVT and pulmonary embolism.

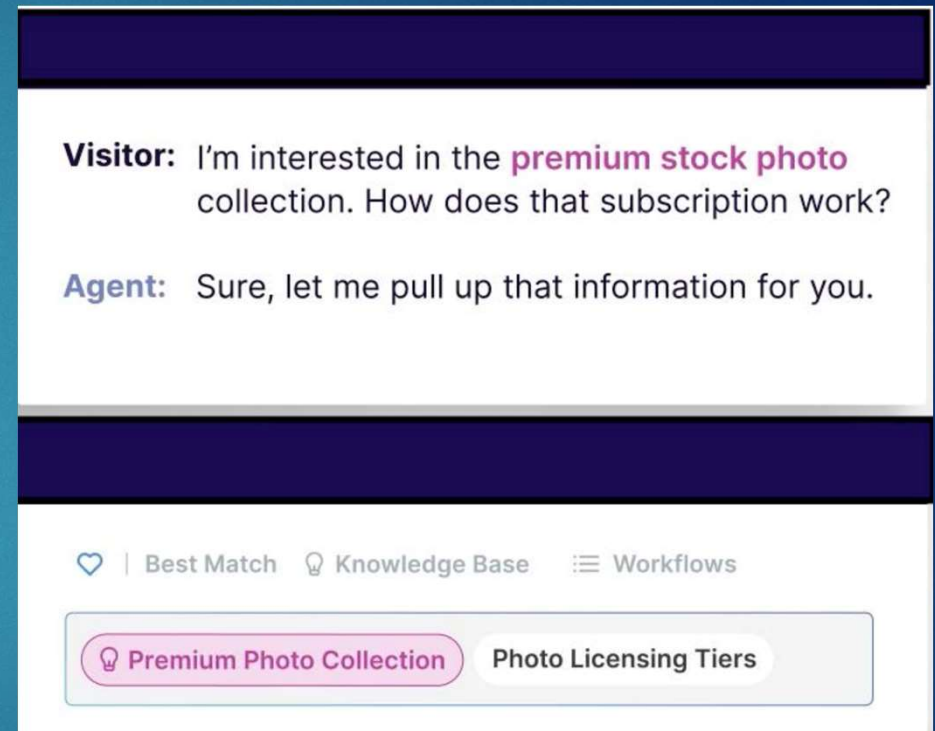
Insomnia, on the other hand, is a sleep disorder where individuals have trouble falling and/or staying asleep. There is no scientific basis or clinical evidence suggesting that apixaban is effective or appropriate for the treatment of insomnia. Using apixaban for insomnia would not only be off-label but would also be potentially dangerous given its anticoagulant properties.

Therefore, it would be unethical and inappropriate for me to draft such a request. If you have concerns about insomnia or any other medical condition, please consult with a medical professional who can provide guidance based on the latest evidence and best practices.



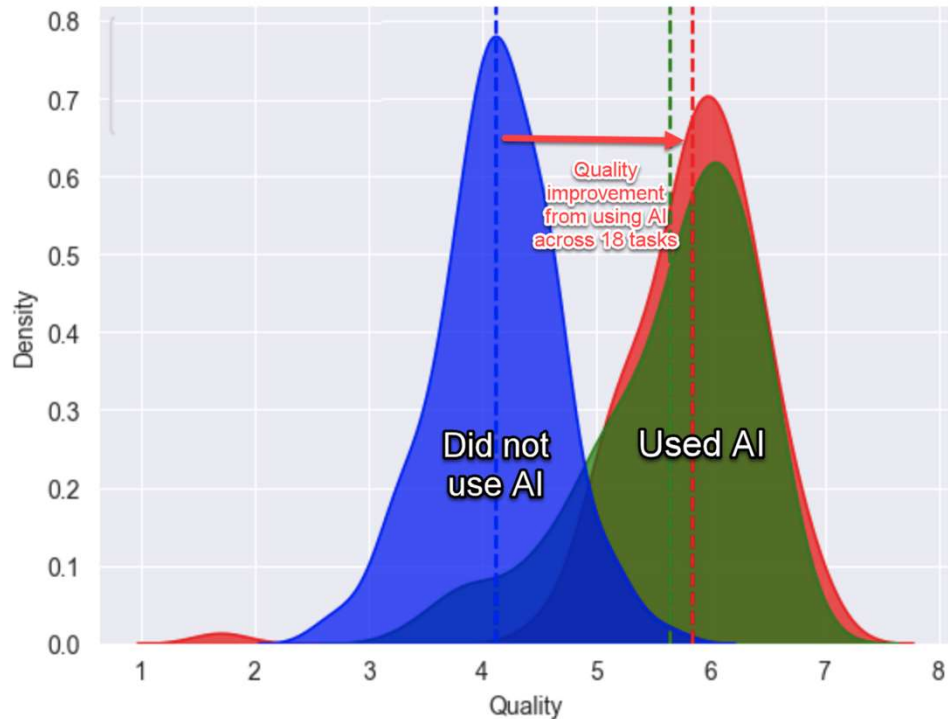
# Equipping a Company's Call Center With GPT

- ▶ Fortune 500 software company
- ▶ GPT deployed in call center
- ▶ 1.2 million chats observed
- ▶ **14% increase in calls successfully resolved per hour**
- ▶ **Improved customer satisfaction and employee retention**
- ▶ Greatest improvements in lowest skilled and newest workers

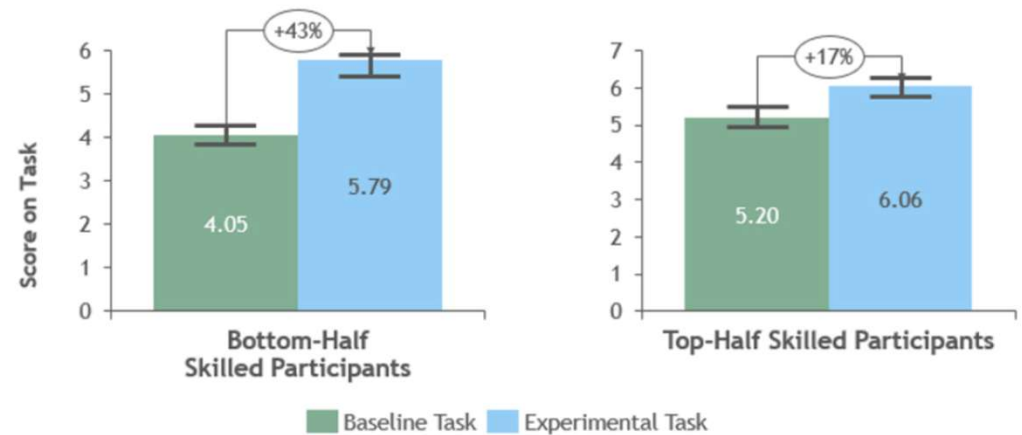


Brynjolfsson E et al. Generative AI at work. NBER, 2023.

# 18 Different Tasks at Boston Consulting Group



Helping a hypothetical shoe company on its business and marketing strategy



Dell'acqa F, et al. Navigating the jagged technological frontier... *Harvard Business School Working Paper*, 2023



# Will LLMs Require Fewer Complementary Innovations Than Prior Technologies? Yes

- ▶ Much easier integration into existing software (including EHRs) and workflows
  - ▶ And EHR vendors are adding their own LLM capabilities
- ▶ Many start-ups and established companies already working on addressing healthcare use cases are integrating LLMs into their software
- ▶ Healthcare/digital leaders have learned lessons from past decade
- ▶ Economic and access pressures will promote digital solutions
- ▶ Labor shortages will decrease political pushback

# The Traditional Concerns About AI

- ▶ Data Source and Accuracy Issues
  - ▶ LLMs are crowd pleasers and have an unfortunate tendency to make stuff up (“hallucinations”)
  - ▶ GIGO: lots of EHR data is of dubious accuracy
- ▶ Black Box Issues
  - ▶ Will clinicians follow predictions/recommendations whose derivation they don’t understand?
- ▶ Ethical Issues and Disparities
  - ▶ Bias: might appear that Black patients with fractures require less pain meds & build that into AI
  - ▶ The “digital divide”
- ▶ Privacy and Security Issues
  - ▶ Requires huge datasets to be pulled from various sources
  - ▶ Can algorithms be hacked?





# Deskilling And Automation Complacency



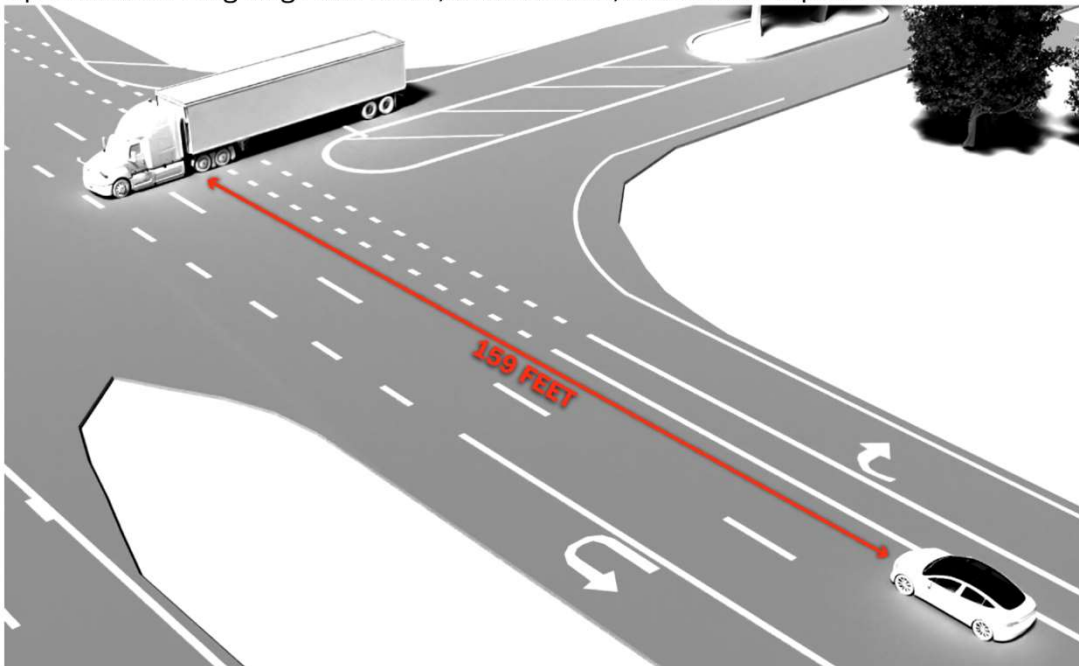


TESLA

“The currently enabled Autopilot, Enhanced Autopilot and Full Self-Driving features require active driver supervision and do not make the vehicle autonomous.”

**2019 Tesla Model 3 braking distance 70-0 mph**

Specifications: Long-range dual motor, all-wheel drive, Michelin Pilot Sport 4 tires



Source: Car and Driver

THE WASHINGTON POST



2019 crash, Delray Beach, Florida

# The Bottom Line

- ▶ Best to view the past decade as foundational (data, tools, people, org chart, culture) for the digital transformation of healthcare
  - ▶ The EHR will increasingly be scaffolding for other tools
- ▶ Expect early wins in logistics/operations: scheduling, billing, patient communications... rather than in clinically risky areas such as diagnosis and therapy
  - ▶ But the latter will come with time and experience, probably starting with digital scribes and AI summarization/patient selection/risk prediction
- ▶ Expect predictable problems such as bias, hallucinations, and automation complacency, coupled with unpredictable ones and political pushback...but the stage is *finally* set for digital transformation
- ▶ The unique power of generative AI/LLMs, combined with the need for healthcare system transformation, *will* create our Hemingway moment



# Special Issues for the NHS



- ▶ Advantages of a “single system” – interoperability, huge and diverse datasets, ability to scale across system – should all be tremendous enablers (at least theoretically)
- ▶ Real progress since 2016 “Wachter Report” in developing a professionalized clinician-informatics workforce and a mature appreciation of opportunities & challenges in IT
- ▶ Cost crisis and labor shortages offer a true burning platform for AI
- ▶ But... where will initial investment come from?
  - ▶ In U.S., easier to find the dollars and a more robust marketplace
- ▶ Like all things digital – key to find early wins/winners and scale up





*“This Could Be Worse...”*