The Future of the Hospital in the Age of Automation

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Our central paradox...possibility & paralysis



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How have we tried to make healthcare better?

Era 1: Standards

Can we assure a basic minimum standard in healthcare?

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Era 2: Evidence & Measurement

Can we measure quality and ensure it is more evidencebased?

Era 3: Collaborative Improvement

Can we accelerate improvement in quality by working together?





So how are we doing?





How we are doing...



Health Care System Performance Compared to Spending

Data: Spending data are from OECD for the year 2022 and 2023 (updated in July 2024).

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How we are doing...cont'd

Americans face the most barriers to accessing and affording health care.



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Why? Useful but insufficient

Era 1: Standards

Can we assure a basic minimum standard in healthcare?

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Era 2: Evidence & Measurement

Can we measure quality and ensure it is more evidencebased?



Era 3: Collaborative Improvement

Can we accelerate

improvement in quality by

working together?



Growth of the 340B Program has Exploded in the Last Decade



Biologic drug

ehring uniQure

TAUNC:

Trend 2: Growth of Private Equity

Total PE investment in healthcare has skyrocketed in the past 20 years



Source: Appelbaum and Batt 2020.

 NHCM
 The Effects of Private Equity Acquisition

 DATA INSIGHTS
 on Health Care Spending and Utilization

 Researchers examined the implications of private
 Image: Color of the second sec

equity acquisitions on physician practices across dermatology, gastroenterology, and ophthalmology.



Compared to the 2,874 control practices, the **578 private equity-acquired practices reported**:



Singh, Song, Polsky, Bruch, Zhu, 2022 | For full citation, go to www.nihcm.org

Trend 3...Medicaid Margin Pressure

FIGURE 1

Percent Decline in Total Health Care Spending if All States Drop ACA Medicaid Expansion, by State



Source: Urban Institute Health Insurance Policy Simulation Model (HIPSM), 2025.

Figure I. Hospital Uncompensated Care Costs by Expansion Status

Uncompensated care costs as a share of hospital operating expenses (%)



states that expanded prior to 2016 and had limited childless adult eligibility in 2013. Non-expansion states are states that had not expanded as of the end of 2019, excluding Wisconsin. Plotted amounts are simple averages of state estimates. See appendix for additional methodological detail.

Median operating margins for rural hospitals in July 2021-June 2022 were higher in states that have expanded their Medicaid programs



wedian operating margins

Median operating margins (without documented relief funds)

NOTE: Analysis of 438 short-term general and/or critical access rural hospitals with July to June cost reporting periods and complete data during the period of analysis. Expansion designation reflects status as of July 2017 and excludes states that adopted Medicaid expansion after that month and through June 2022 and Wisconsin (the only non-expansion state without a coverage gap). Operating margins reflect the profit margins earned on patient care and other operations of a given hospital, such as from gift shops, parking, and cafeterias. Documented relief funds reflect amounts reported separately from other sources of revenue and likely understate the aggregate amount of relief. SOURCE: KFF analysis of RAND Hospital Data, 2021-2022

Trend 4: US Healthcare has a Productivity Problem



Era 4?





AI (in all its forms)



Let's ask the experts – "What is Generative AI?"

Model: GPT-4

what is generative AI?

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Generative AI refers to a type of artificial intelligence that is capable of generating new content, data, or information by learning patterns and structures in the input data it has been trained on. It can create various forms of output, such as text, images, audio, or even video, depending on the type of data it has been trained on and the specific algorithms used.

One of the most popular generative AI models is the Generative Adversarial Network (GAN), which consists of two neural networks, a generator and a discriminator, working together in a competitive manner. The generator creates new samples, while the discriminator evaluates their authenticity. Through this process, the generator improves its ability to produce realistic output.

Other examples of generative AI models include Variational Autoencoders (VAEs) and autoregressive models like the Transformer architecture, which powers models like OpenAI's GPT series (including GPT-4, the model you're currently interacting with).

Generative AI has a wide range of applications, including content creation (e.g., generating realistic images or writing human-like text), data augmentation, drug discovery, art and design, and more.

A Exploring Generative AI ~

JN What is generative ai?

Generative AI refers to artificial intelligence systems that are capable of generating new content, such as text, images, audio, or other data, rather than simply analyzing or classifying existing data. These models are trained on large datasets and use techniques like deep learning, neural networks, and language models to learn patterns and relationships in the data.

Some examples of generative AI include:

- 1. Text generation models like GPT-3 (the model I am based on) that can generate human-like text on almost any topic, from stories and articles to code and poetry.
- 2. Image generation models like DALL-E, Stable Diffusion, and Midjourney that can create novel images from text descriptions.
- 3. Audio generation models that can generate realistic speech, music, or other audio signals.
- 4. Video generation models that can create new video footage by combining and processing existing videos or generating entirely new frames.

what is generative ai?

View other drafts 🛛 🗸

1

Generative AI is a type of artificial intelligence that can create new content, such as text, images, and music. It does this by learning from a large amount of data and then using that knowledge to generate new outputs that are similar to the data it was trained on.

Generative AI has a wide range of potential applications, including:

- Creating realistic images and videos
- Generating new text formats, such as poems, code, and scripts
- · Developing new drugs and treatments
- · Designing new products and services
- Improving the accuracy of machine learning models

Generative AI is a powerful tool that can be used to create new and innovative products and services. However, it is important to use generative AI responsibly and ethically. For example, it is important to ensure that generative AI models are not used to create fake or misleading content.

Generating "new" content, and it's interactive

Now give me a two sentence answer - explain it to me like I'm 5



Generative AI is like a super-smart computer that can create new things, like pictures or stories, by learning from examples. It's a bit like teaching a robot how to draw by showing it lots of drawings, and then it can make its own!

4) 🗗 🖒 🖓 🌣 🗸

Foundation Model Basics

- Trained on "the entire internet".

Memorizes associations of word orderings, data, etc. (super autocomplete)
As parameters scaled we started to see "emergent properties"

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Simplified Comparison of AI types

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Feature	Predictive AI	Generative AI	Agentic Al
Purpose	Forecast future outcomes	Create new content	Take autonomous actions
Key Ability	Pattern recognition	Make original outputs	Plan and execute goals
User Role	Review predictions only	Guide content creation	Set goals, minimal oversight
Autonomy	Low	Medium	High
Decisions	Statistical calculations only	Content choices only (ChatGPT)	Multi-step planning decisions (self-driving cars)
Technology	Statistical models	Large language models	Planning algorithms, tool use
Challenge	Prediction accuracy	Avoiding hallucinations Safe goal alignment	

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Why is this different? The technology is finally good enough

Cautionary Tale...

A girl and her family wait in an exam room. Facing away from the family, a pediatrician gazes down at a computer screen.

JAMA 2012 "The Cost of Technology"

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But...I think this is different; Fastest growing app in history

ChatGPT Sprints to One Million Users

Time it took for selected online services to reach one million users



* one million backers ** one million nights booked *** one million downloads Source: Company announcements via Business Insider/Linkedin

statista 🗹

HOW LONG IT TOOK TOP APPS TO HIT 100M MONTHLY USERS

ChatGPT is estimated to have hit 100M users in January, 2 months after it's launch. Here's how long it took other top apps to reach that:



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Gaining new capabilities quickly

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Adapted from Our World In Data

Midjourney - "a hyper realistic image of Harry Potter"



February 2022



April 2022



July 2022



November 2022









December 2023

March 2023 March 2023 (new version) https://hai.stanford.edu/news/ai-index-five-trends-frontier-ai-research

June 2023

"Robot doctor with a stethoscope" - now make it a video





Luma Dream Machine (2024)

Midjourney (2023)

Capabilities Extend to Clinical Medicine

Mastering the USMLE

- Passed USMLE Step 2 in 2022 - Numerous models outperform most humans in 2023 - Multiple choice exams losing ability to rate models effectively

Microsoft - https://arxiv.org/abs/2311.16452

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Dec 22

Dec 22

Mar 23

May 23

Sep 23

Sep 21

Mar 22

And Demonstrating Subjective Empathy...



Figure. Distribution of Average Quality and Empathy Ratings for Chatbot and Physician Responses to Patient Questions

Chatbot response preferred to the physician 78.6% N=585 (evaluations)

195 Q/A exchanges

Physician answers ~50% length

Ayers et al. - JAMA Intern Med. 2023;183(6):589-596. doi:10.1001/jamainternmed.2023.1838

Kernel density plots are shown for the average across 3 independent licensed health care professional evaluators using principles of crowd evaluation. A, The overall quality metric is shown. B, The overall empathy metric is shown.

And we are already using it... Demand led, Not Supply driven



Microsoft Survey on 31,000 Knowledge Workers Gen Al Use

Three Out of Four People Use AI at Work

Usage nearly doubled in the last six months.

75% of people are already using AI at work

46% of them started using it less than 6 months ago



Of people who use AI at work:

- 78% of AI users are bringing their own AI tools to work
- 52% of people who use AI at work are reluctant to admit to using it

https://www.microsoft.com/en-us/worklab/work-trend-index/ai-at-work-is-here-now-comes-the-hard-part

Usage of AI use cases nearly doubled



Top use cases gain users



AMA

Physicians' powerful ally in patient care

Which, if any, of the following use cases do you currently incorporate into your practice?

Diagnostic reasoning aided by AI vs. AI (study design)

Figure 1: 50 physicians randomized to complete diagnosis quiz with GPT-4 vs. conventional resources. Participants were asked to offer differential diagnosis with supporting statements of findings in favor or against each differential, and to propose best next diagnostic evaluation steps.



Physicians from Stanford, Beth Israel, and University of Virginia - Goh et al.

What were the results?

- Physicians using GPT4 scored **76.3** (65.8, 86.8)
- Physician using conventional resources scored 73.7 (63,2, 84.2)
- GPT-4 alone scored **92.1** (82.2, 97.4)

Takeaway - We have big gaps in training clinicians to use AI tools effectively

Goh et al. https://www.medrxiv.org/content/10.1101/2024.03.12.24303785v1.full.pdf

Most survey respondents said their organizations are pursuing gen Al initiatives or have already implemented solutions.



Question: What are your current activities or plans regarding gen Al opportunities within your organization?

Source: McKinsey US Gen Al Healthcare Survey, Dec 2024, n = 150 (60 from payers, 60 from health systems, 30 from healthcare services and technology groups) (29% of respondents are C-level executives, and 37% are from organizations with greater than \$10 billion in revenue)

McKinsey & Company

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Loads of distant promises... What's here today?



Documentation

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Growth in AI Scribe Usage

This chart shows the overall adoption of providers using an AI scribe and the cumulative number of AI scribe visits, from October 2023 through December 2024.



Source: The authors NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society



https://www.fiercehealthcare.com/ai-and-machinelearning/ambient-scribes-decrease-burnout-60-small-primarycare-providers-phyx

https://catalyst.nejm.org/doi/full/10.1056/CAT.25.0040

Peterson Center Healthcare Taskforce PHTI on AI

SUMMARY OF EARLY INSIGHTS ON THE IMPACT OF AMBIENT SCRIBE ADOPTION

+ Suggest or Support Positive Impact 🛛 Too Early to Draw a Conclusion 💛 Mixed Feedback on the Impact

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Impact Area	Example Metrics	What	What We Know Today	
Clinician - - -	Attrition		Too early to draw a conclusion	
	Burnout	+	Emerging evidence suggests a positive impact	
	Clinician experience	•	Mixed feedback on the impact	
	Clinician time saved	•	Mixed feedback on the impact	
	Cognitive load	+	Emerging evidence suggests a positive impact	
	Pajama time	•	Mixed feedback on the impact	
	Quality of clinical note summary	*	Data/anecdotal feedback support a positive impact, with a human in the loop	
Patient	Patient experience	+	Emerging evidence suggests a positive impact	
Financial _	Number of patient encounters per period	•	Mixed feedback on the impact	
	Accuracy of coding		Too early to draw a conclusion	

https://phti.org/ai-adoption-early-applications-impacts/

Scheduling

Mercy saves \$30 million in 2023 with Al-powered nursing workforce management tech

Before deploying the technology, staff was 67% core staff, 8% flexible staff and 25% agency staff. Afterward, the mix became 69% core, 23% flexible and gig staff, and only 8% agency staff.





Communications...

Digital Health Companies know how to engage E.g. Healthvana's Conversational AI for care navigation 囼 70% of conversations are with communities of color medication, or diagnostic advice, and you should not rely on the information provided by the AI agent as a substitute for professional advice. If this is an emergency, please call 911 or go to your 15,000 missed calls can be addressed nearest emergency room Al Care Navigator Hello, fabulous being! I'm your dazzling assistant from Healthvana, ready to serve you Multi-language, multi-persona approach with sparkle and care. What can I do for you today? 🎔 When was I last tested for STIs? **Conversations are for:** Al Care Navigator Administrative purposes (e.g., appointment scheduling) (60%), Oh, honey, let me check that for you! Your nost recent little rendezvous with us for STI Medical/sexual health education (29%), testing was on 8/20/23. And let's throw some confetti because all your test results were negative! 🔰 If you're thinking it's time for a **Insurance or financial queries (5%)** new test or have any other questions, just let ne know, sugar Lbgard about a daily pill that can prevent HIV 1 in 5 messages occur outside of clinic hours Al Care Navigator High touch, low cost approach Healthvana

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Chart Abstraction (to liberate our Quality offices to actually improve systems)

Annual FTE Hours for Quality Metric Reporting

Johns Hopkins Hospital in Baltimore, MD

32%



Hours Spent on Quality Data Prep and Reporting



Source: Saraswathula A, et al.. The Volume and Cost of Quality Metric Reporting. JAMA. 2023 Jun 6;329(21):1840-1847

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336k

Total Hrs

Chart Abstraction: LLMs can perform abstraction for complex quality measures today

Sample of 100 Manual SEP-1 Abstractions

University of California, San Diego Health in 2022

The LLM system consistently assigned the same measure categories and agreed with manual abstractors for **90 of 100 cases**



LLM agreed w/ manual abstraction Discordant case and LLM was correct

Discordant case and abstractor was correct

94%

Percent of cases where the LLM system accurately abstracted EHR data for complex quality measures

Source: Boussina A, et al. Large Language Models for More Efficient Reporting of Hospital Quality Measures. NEJM AI. 2024 Oct 21

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Finding Gaps in Care



All the rest...

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Notice anything here?

Documentation Scheduling Communication Chart abstraction Care Gaps Closure

It turns out that it is the super-boring stuff that creates time for the caregivers and enables the relationship with the patient AND they create real value for the system.



How to recognize places where AI will help

Three Lessons to Identify Productivity Bottlenecks:

- 1. Where are there a lot of people working below their license?
- 1. Where are there a lot of errors/incompleteness in the current process?
- 1. Where is there not enough time (or information) to do something important?



What can we do as Leaders



Our work in Era 4

- Look for those productivity bottlenecks and direct the work of your AI team there
- Find partners that can build not one app, but the next 50 applications (you will need >50)
- 3. Enable "citizen development" and encourage your innovators (you all have them)
- 4. Deploy digital monitoring & governance solutions to securely deploy AI
- 5. Recognize and celebrate that roles will shift (e.g. editor, not author)
- 6. Remember that value isn't created by technology until the people learn how to use it



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Thanks

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