WashU Medicine

Artificial Intelligence and the Future of Medicine:

Accelerating Research, Improving Learning, Amplifying Practice

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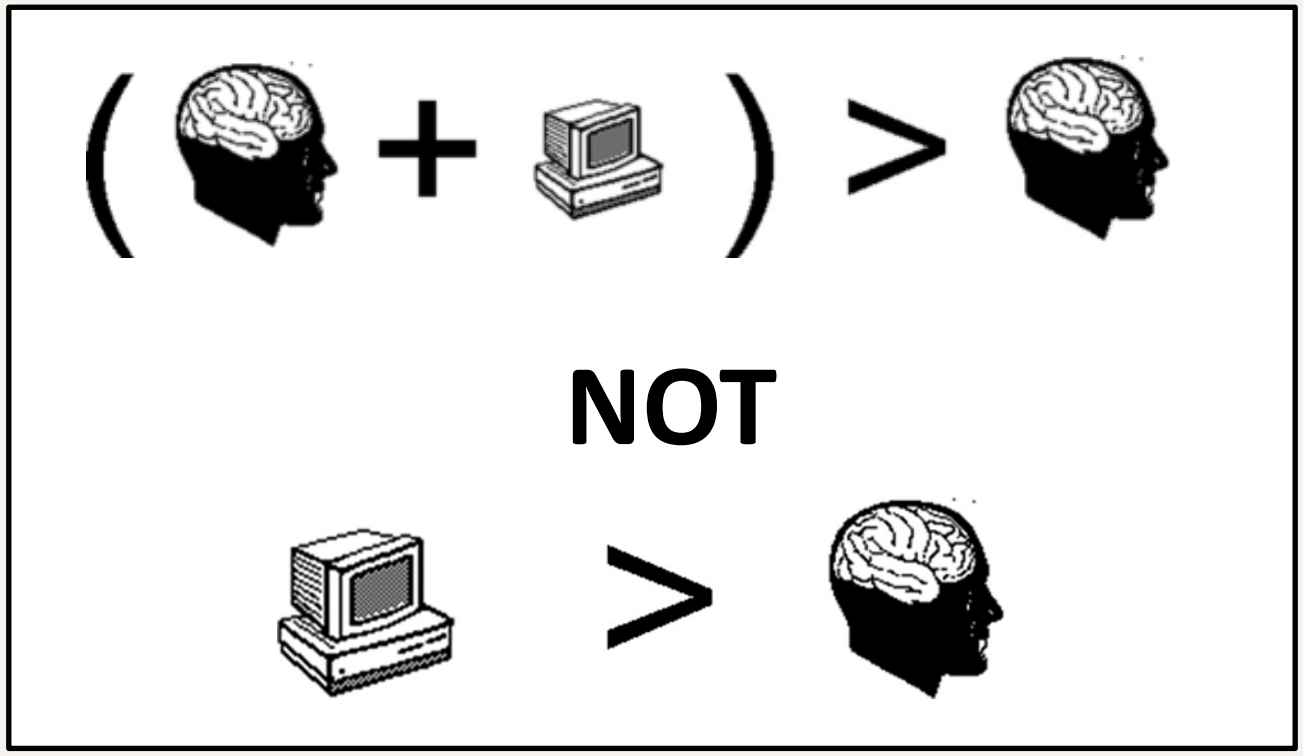
“We look for medicine to be an orderly field of knowledge and procedure. But it is not. It is an imperfect science, an enterprise of constantly changing knowledge, uncertain information, fallible individuals, and at the same time lives on the line.”

Atul Gawande, Complications: A Surgeon's Notes on an Imperfect Science

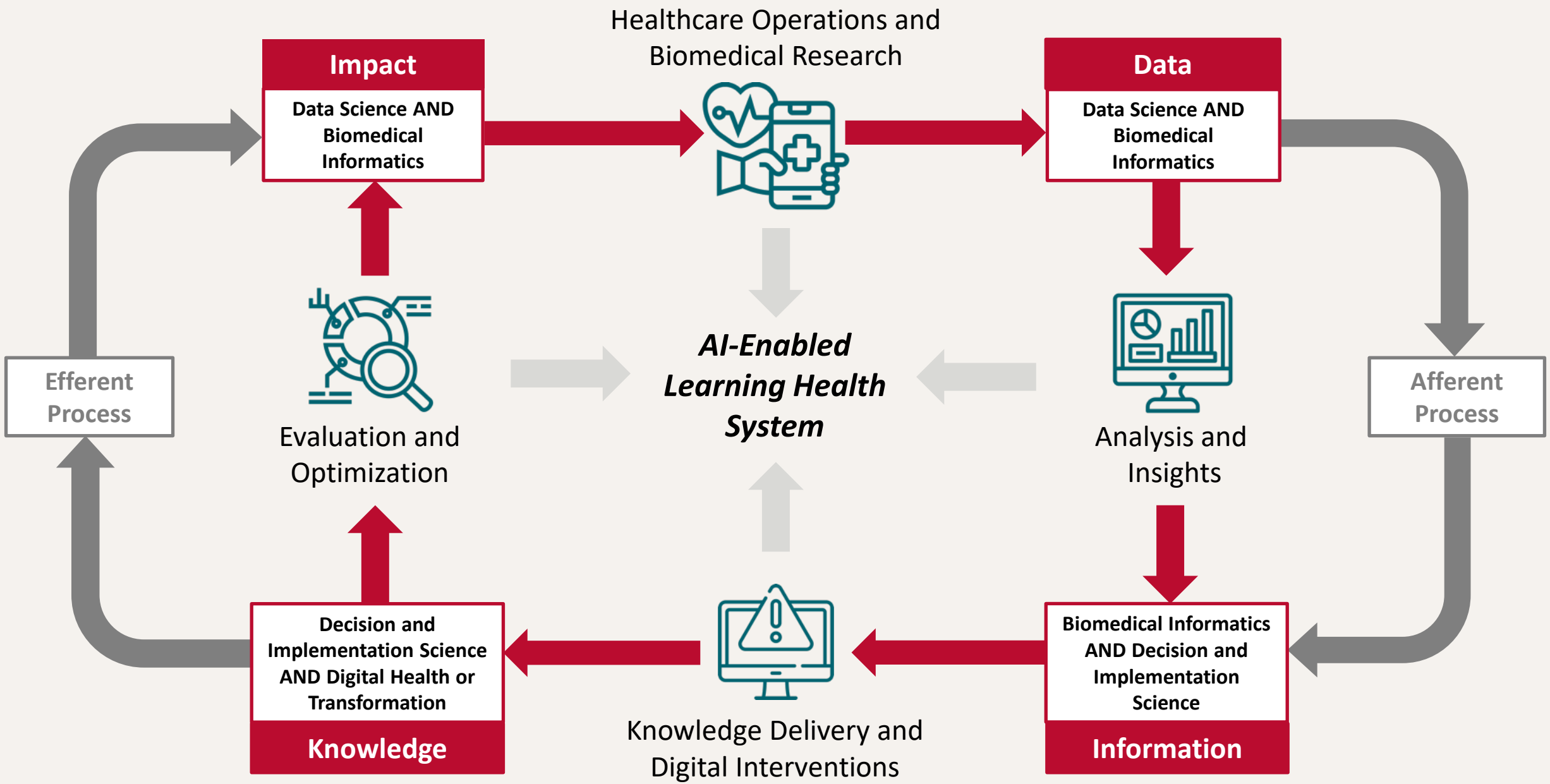
AI in medicine: enhancing human decision making

- Humans make sense of the world around them by recognizing and applying patterns
- Computers can identify patterns at a scale and speed that is greater than human capabilities
- However, AI algorithms need to be trained, introducing questions related to:
  - Availability of training data
  - Sources of bias
  - Computational costs
  - Integration into a dynamic environment

- **AI, today, is (mostly) a function of speed and scale, as opposed to innate intelligence**



Source: Friedman CP. A "fundamental theorem" of biomedical informatics. Journal of the American Medical Informatics Association. 2009 Mar 1;16(2):169-70.



Annals of Internal Medicine

IDEAS AND OPINIONS

Meeting the Artificial Intelligence Needs of U.S. Health Systems

Patrick G. Lyons, MD, MSc; David A. Dorr, MD, MS; Gene
and Philip R.O. Payne, PhD

Artificial intelligence (AI) is being adopted to addr
many ubiquitous problems facing clinicians
health systems (1). Concurrent with improvements in
capabilities largely demonstrated outside of health c
(for example, prediction, transcription, summarizati
empirical evidence for AI improving health system
comes is growing (2). For these research findings
translate into better care quality, health systems ne
to have in place the right structural elements and pr
esses to evaluate, implement, and monitor AI techn
gies, as well as mechanisms to measure and impr
related health outcomes (**Table**) (3). Clinicians and he
systems must therefore prepare for AI involvemen
clinical care and operations with some urgency.

Structural requirements for effectively integrat
AI into clinical care include organizational strategy, social

create a hierarchy of ability to adopt AI, with negative

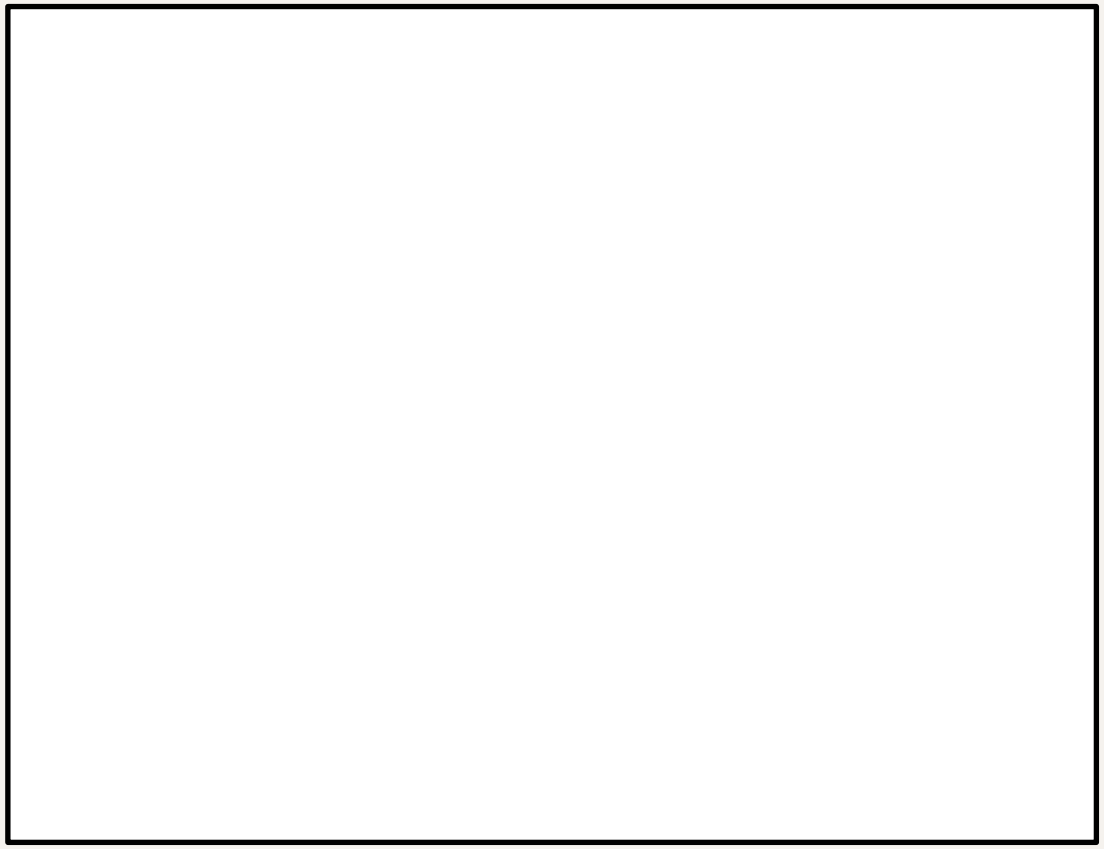
Leading AI: People, Technology, and Learning

- **Build AI-Ready Health System Workforces:** Health systems must invest in recruiting, training, and retaining professionals with both clinical and technical expertise to manage AI integration, governance, and evaluation.
- **Educate Clinicians for AI-Enabled Practice:** Developing AI-ready clinicians through structured education, workshops, and mentorship programs is essential. These initiatives should combine clinical acumen with competencies in algorithm performance, ethics, bias, privacy, and change management.
- **Embed Continuous Learning into AI Implementation:** Ongoing workforce development should be linked to organizational processes for monitoring AI performance, measuring outcomes, and adapting workflows, ensuring clinicians, patients, and health systems evolve together with rapidly advancing AI technologies.

https://doi.org/10.7326/ANNALS-24-00396

Designing AI: engineering vs. human-computer systems

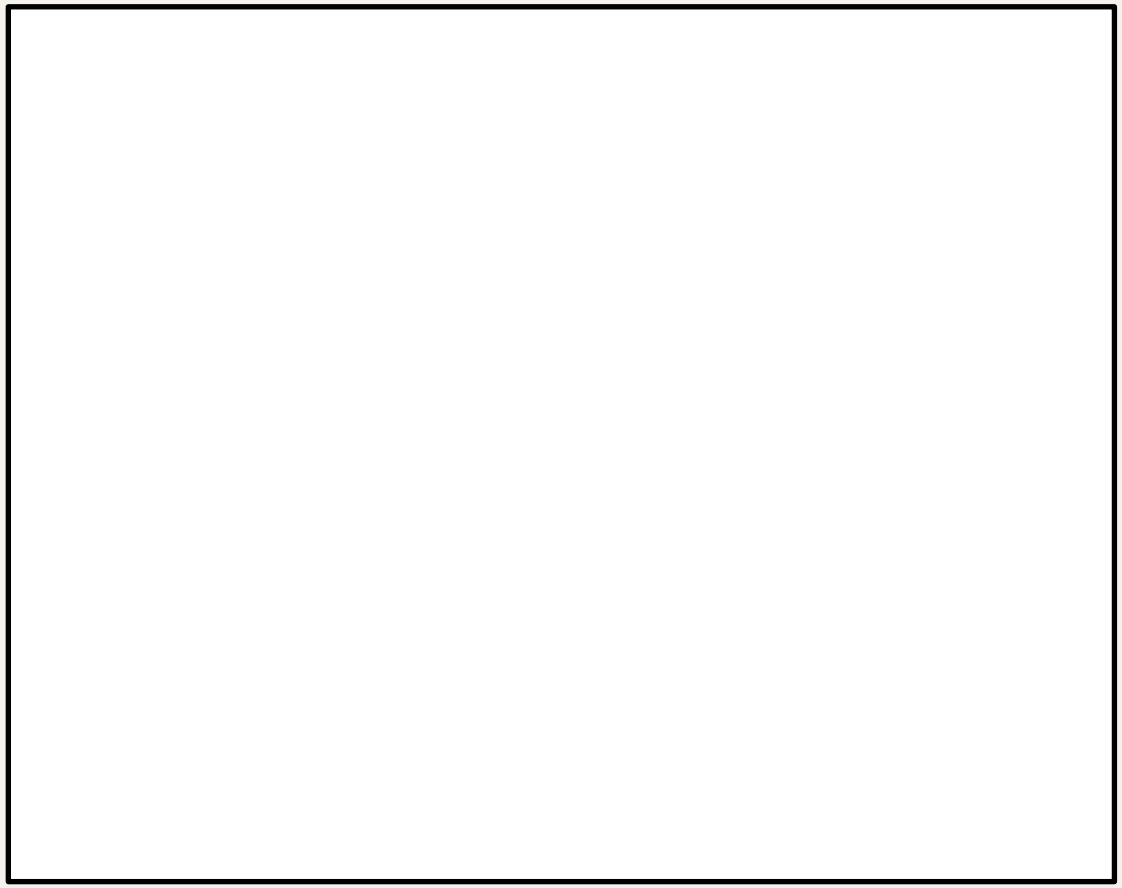
- **Integrate Process Metadata:** EHRs and other clinical systems produce substantial “signals” concerning opportunities to improve clinical performance and outcomes using AI and should drive priorities.
- **Surface Latent Indicators:** Using "behavioral traces," such as frequent chart reviews or rapid navigation, can serve as early proxies for workflows that require re-engineering to achieve desired optimization.
- **Boosting AI Performance:** Incorporating clinician workflow and performance into AI design processes can significantly increase diagnostic accuracy and make AI output more useful and durable.
- **Monitoring Workforce Impact:** Analyzing post-deployment metadata can identify "friction points" like cognitive overload, automation bias, or shifts in team collaboration over time.



Source: Yan C, Zhang X, Kannampallil TG, Adler-Milstein J, Chen Y. Reimagining clinical AI: from clickstreams to clinical insights with EHR use metadata. npj Health Syst. 2025;2(33). doi:10.1038/s44401-025-00040-5

Evaluating AI: idealized standards or pragmatic improvements?

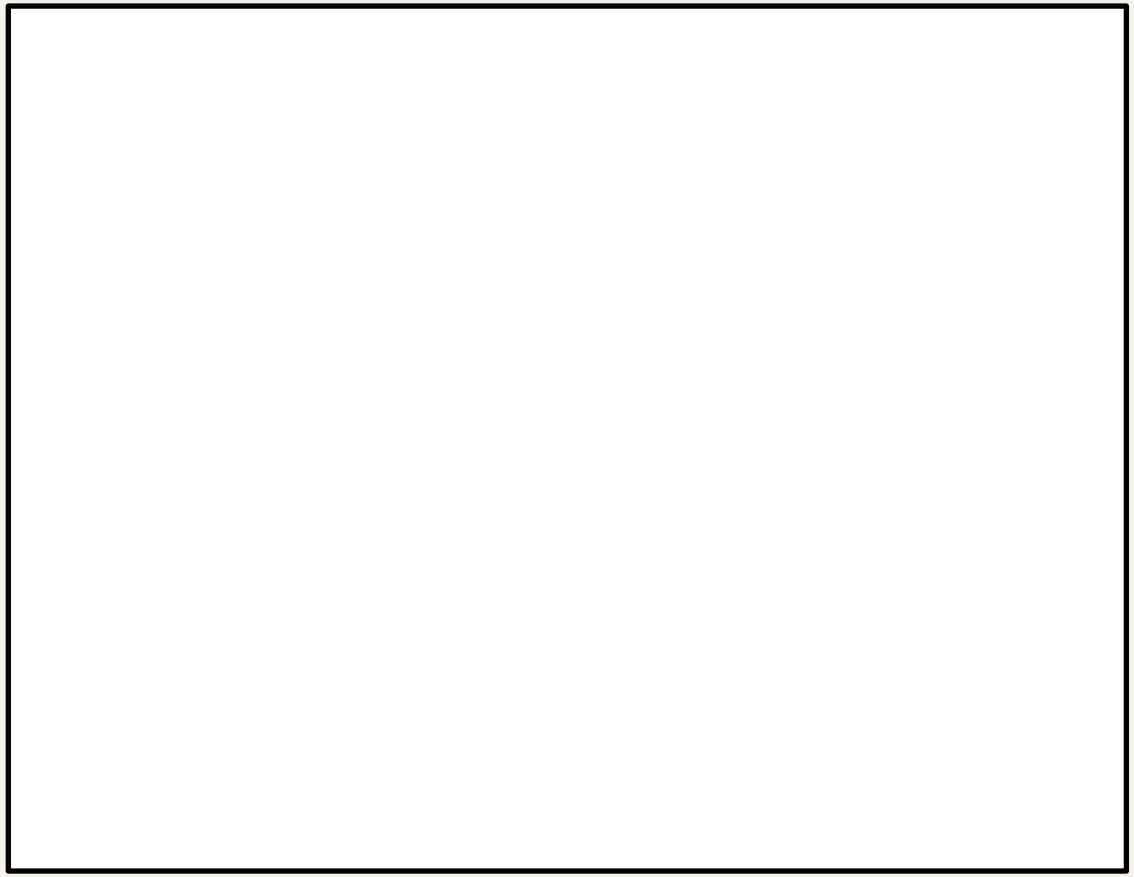
- **The "Actual Alternative" vs. Idealized Care:** Evaluation should not measure AI output against an ideal system with unlimited time and resources. Instead, it should be compared to the status quo.
- **Alignment with Distributions, Not Exemplars:** AI alignment should be measured against the distribution of human decisions rather than a single expert or a small set of guidelines, as human clinicians often disagree on complex cases.
- **Implicit Values and Framing:** AI performance varies significantly based on its "persona", whether it is prompted to act as a clinician, an insurer, or a patient advocate, and these hidden alignments can substantially impace performance.
- **Urgent Need for Rigorous Trials:** Trials that objectively assess the impact of AI are critical, comparing those outcomes directly to gaps in current care systems.



Source: Kohane IS. Compared with What? Measuring AI against the Health Care We Have. NEJM AI. 2024 Oct;1(10). doi: 10.1056/AIp2400511.

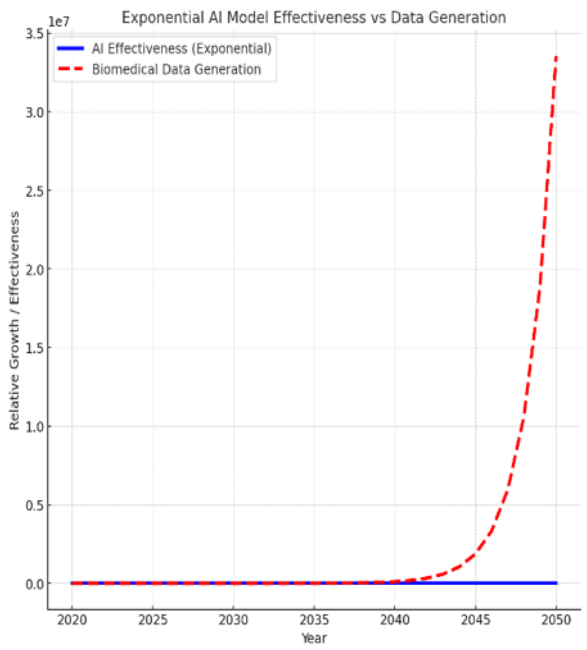
Monitoring AI: build trust, then verify

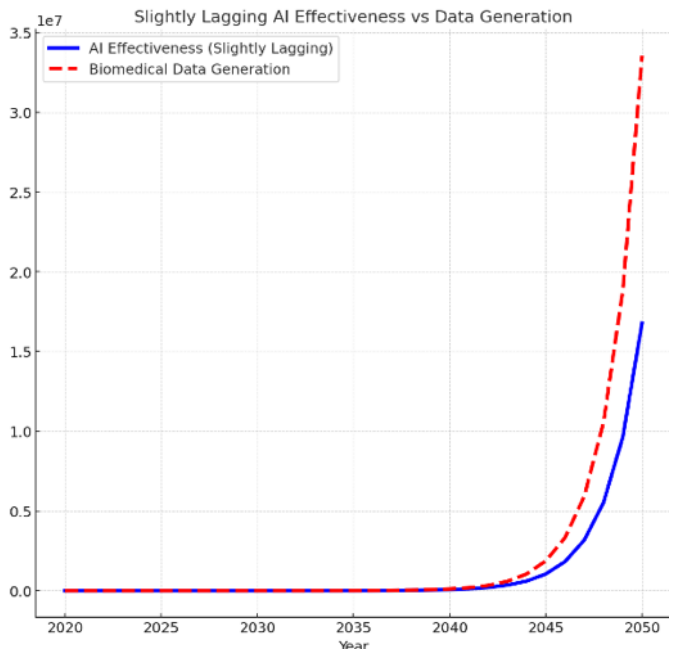
- **Defining Algorithmovigilance:** Applying "pharmacovigilance" principles to AI can be achieved by systematically monitoring and preventing algorithmic adverse effects throughout their entire lifecycle.
- **The Equity Imperative:** Actively using debiasing methods rather than ”feature-blindness" is needed to correct for systemic disparities inherent in real-world healthcare data.
- **Dynamic Performance:** Monitoring methods must account for the reality that AI effectiveness shifts continuously based on how it is deployed, who uses it, and where it sits in the clinical workflow.
- **Addressing the "Human Element":** Mitigating and explaining risks related to human-computer interaction, such as "black-box" distrust or dangerous over-reliance on automated outputs (de- or un-skilling) are foundational to building trust in AI.

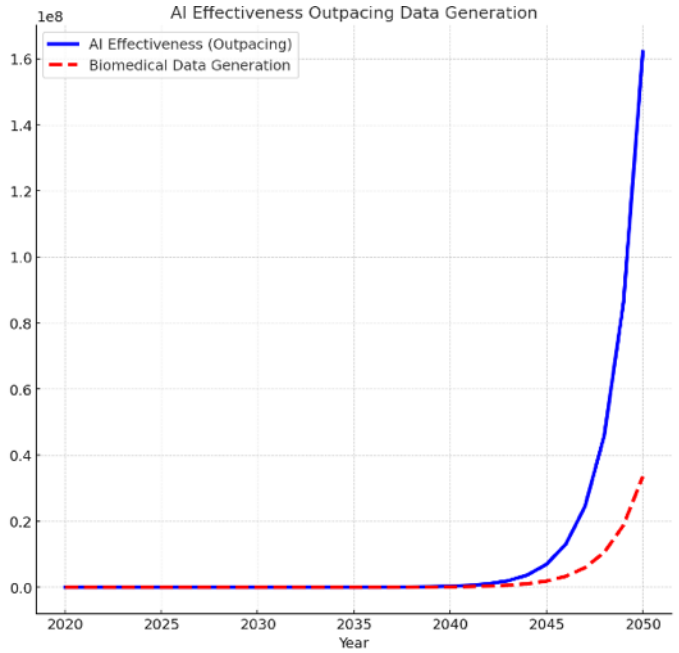


Source: Advancing Methods to Analyze and Monitor Artificial Intelligence–Driven Health Care for Effectiveness and Equity. JAMA Netw Open. 2021;4(4):e214622. doi:10.1001/jamanetworkopen.2021.4622

Achieving balance and delivering the promise of AI







Scenario 1:

- Data growth outpaces model effectiveness
- Growth in model effectiveness plateaus as a function of computation and/or human constraints (potentially by design)

Scenario 2:

- Data growth and model effectiveness grow at comparable paces
- Growth in model effectiveness is less constrained by computation and/or human constraints

Scenario 3:

- Model effectiveness grows at a more rapid rate than data
- This scenario would require the identification of new data sources for training

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WashU Medicine

AI *in the* Electronic Health Record

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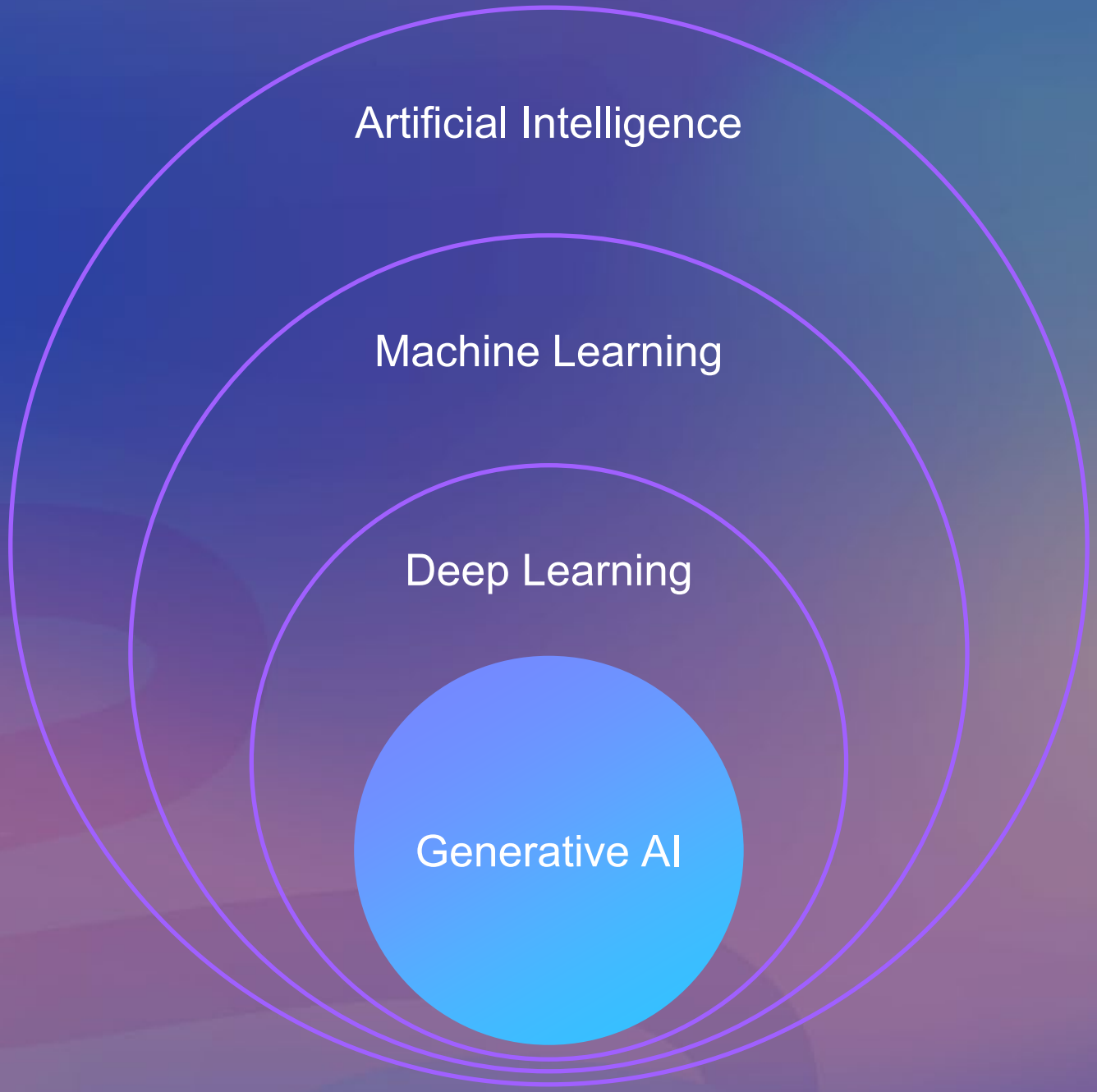
. . . with the patient at the heart

Epic

- *Founded in 1979 in Madison, WI*
- *195 million patients worldwide use* MyChart
- *Using AI for decades*



1950s

Artificial Intelligence

Early attempts to create intelligent machines simulating human intellect

1990s

Machine Learning

Focused on learning from existing data to predict likely events

2010s

Deep Learning

Machine learning approach using neural networks to process data & make predictions

2020s

Generative AI

Creating new content given prompts or other multi-modal inputs

The Spectrum of Artificial Intelligence

Rule-Based Logic

Expert-defined and explicitly coded

Predictive Analytics

Statistically-derived to predict a pre-defined event

Generative AI (Large Language Models)

Generally-trained to generate novel content

Deterministic
Targeted

Probabilistic
More generalized

Rapid AI Adoption

AI FEATURES

85% Organizations Live with Generative AI today

Spring — Art
First healthcare organizations live with In Basket Art

Summer
First Outpatient Summaries

Spring
First Inpatient Summaries

Spring
Dashboard Insights
Radiology Follow-Ups
First Global Customer in Netherlands

Summer
IP Insights
AI Text Assistant
Sidekick
Discharge Summary
Ambient Flowsheets
End of Shift Notes
PB Coding Assistant
all live
Penny

Spring
Announced 20+ **Agent Capabilities** under development

Fall
Emmie
Conversational Assistant in MyChart

2023 | 2024 | 2025 | 2026

Fall
Live demo of MyChart Patient Experience Agent built with Agent platform
Emmie

Summer
Chart with Art

January
Agent FACTORY
Create your own agents

Epic AI *is* Streamlining Care

Art

A cancer ***caught sooner***

50% **Higher rate** of early cancer detection

(vs US national lung cancer average)

The Christ Hospital™

Emmie

A patient ***scheduled faster***

11,500 AI-scheduled visits

saved 576 hours

of call center time

OchsnerHealth

Penny

A medication ***authorized earlier***

19 hour **reduction** in turnaround time for Prior Auth completion

BaylorScott&White

Chart with Art

25% less time writing notes

40% decrease in chart closure time

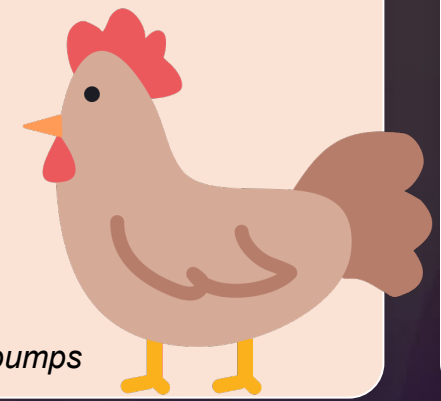
“

I love it.

You can pull it from my cold dead hands.

“

I've got **chicken skin!**



Dutch phrase for goosebumps

“

Reading the AI-generated note really helps me **process my thoughts**.

The note really **got to the essence** of a very long conversation.

Responsible AI

Promote AI Literacy

Start with personal use

Evaluate Use Cases

Evaluate use cases

Establish Trust

Test locally; assess errors and biases

Create Ongoing Governance

Technology is evolving quickly