



AI Primer: AI in Healthcare and Biomedical Research

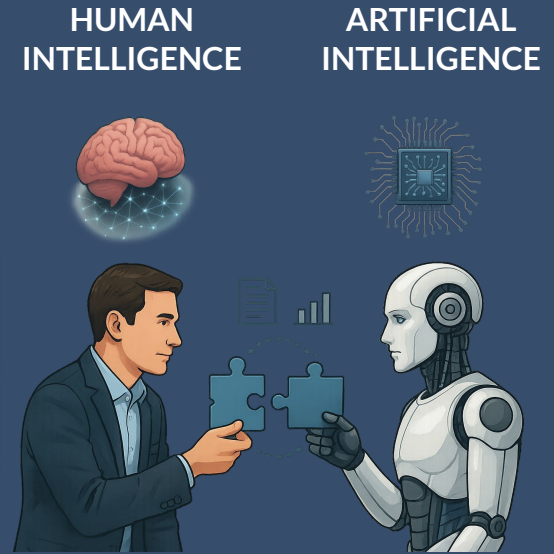
Sunday, July 20, 2025

Carrington Boyer, BA | Tiffany North Reid, MPH

2025 Robert Wood Johnson Foundation (RWJF)/
W. Montague Cobb Symposium: “Code, Context, and
Care: AI at the Crossroads of Healthcare, Research,
and Workforce Development”



The term “artificial intelligence” [AI] was first introduced by John McCarthy at the seminal 1956 Dartmouth Conference, where the vision of making “machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves”.



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Learning

Reasoning

**Problem-
Solving**

Planning

**Visual
Perception**

**Language
Processing**

Making Sense of Modern Medicine: AI as a Critical Tool

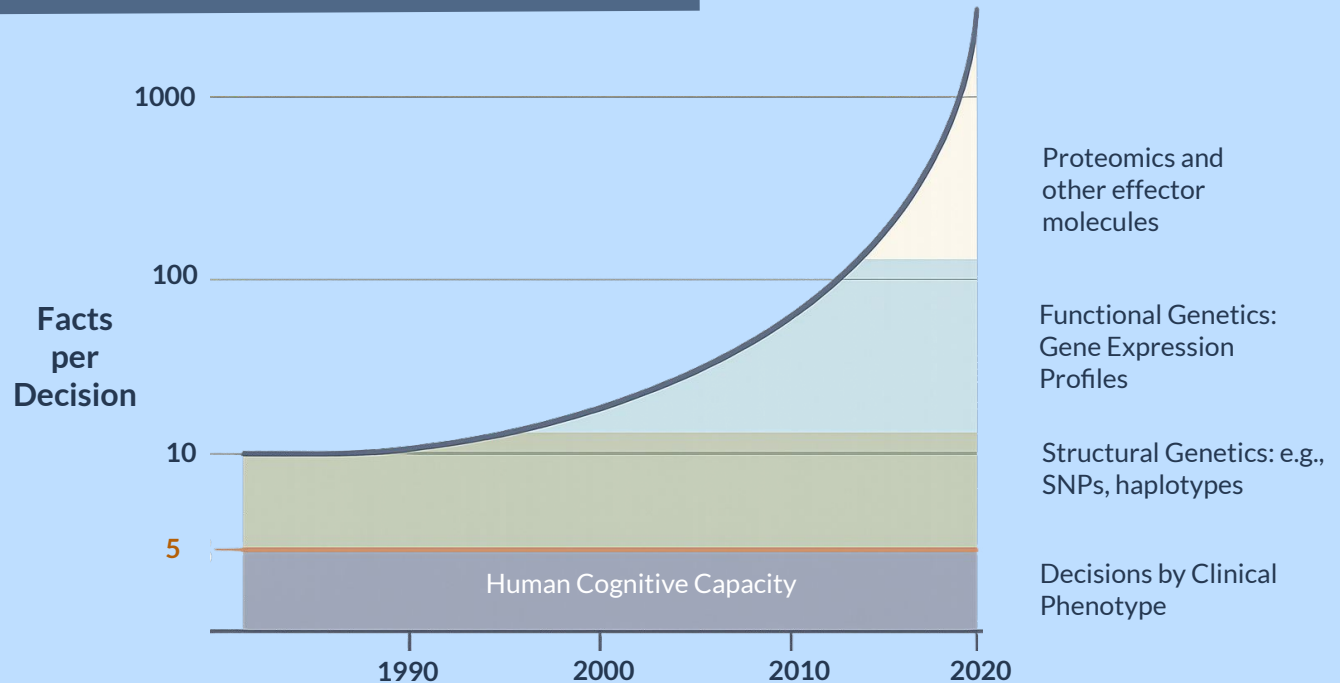


FIGURE 1 | Growth in facts affecting provider decisions versus human cognitive capacity.

SOURCE: Adapted from National Academy of Medicine. 2022. *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/27111>.

AI as a Tool for Providers and Researchers, Not a Replacement

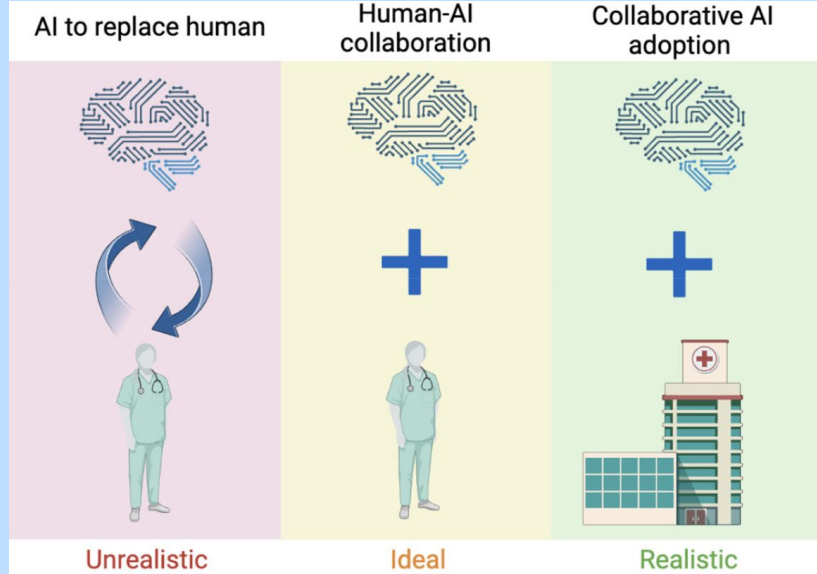


FIGURE 2 | AI adoption to enable doctor-AI collaboration and considerations. SOURCE: Sezgin E. Artificial intelligence in healthcare: Complementing, not replacing, doctors and healthcare providers. DIGITAL HEALTH. 2023;9. doi:10.1177/20552076231186520

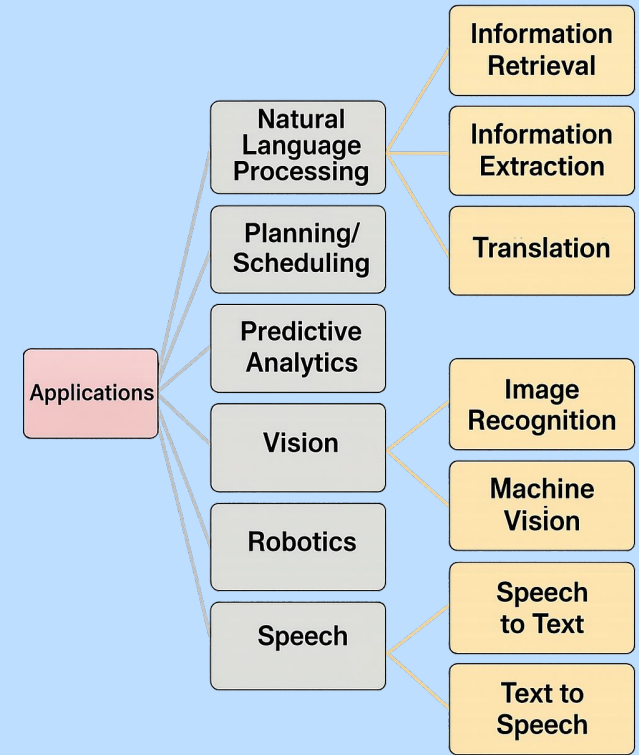


FIGURE 3 | A summary of the domains of artificial intelligence. SOURCE: National Academy of Medicine. 2025. *An Artificial Intelligence Code of Conduct for Health and Medicine: Essential Guidance for Aligned Action*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/29087>.

Overview

Defining AI/ML in Healthcare

Examples of Healthcare Applications

Key Findings from Literature Review:
Ethical and Social Challenges

Problems and Solutions

Key Takeaways

A Venn diagram consisting of three concentric ellipses on a light blue background. The outermost ellipse is light blue and labeled 'Artificial Intelligence (AI)'. Inside it is a medium blue ellipse labeled 'Machine Learning (ML)'. Inside that is a dark blue ellipse labeled 'Deep Learning'. The text for 'Deep Learning' is split into two lines: 'Learning in artificial neural' and 'networks (ANNs) with "hidden" layers'.

Artificial Intelligence (AI)

Machine Learning (ML)

Deep Learning

Learning in artificial neural
networks (ANNs) with
“hidden” layers”

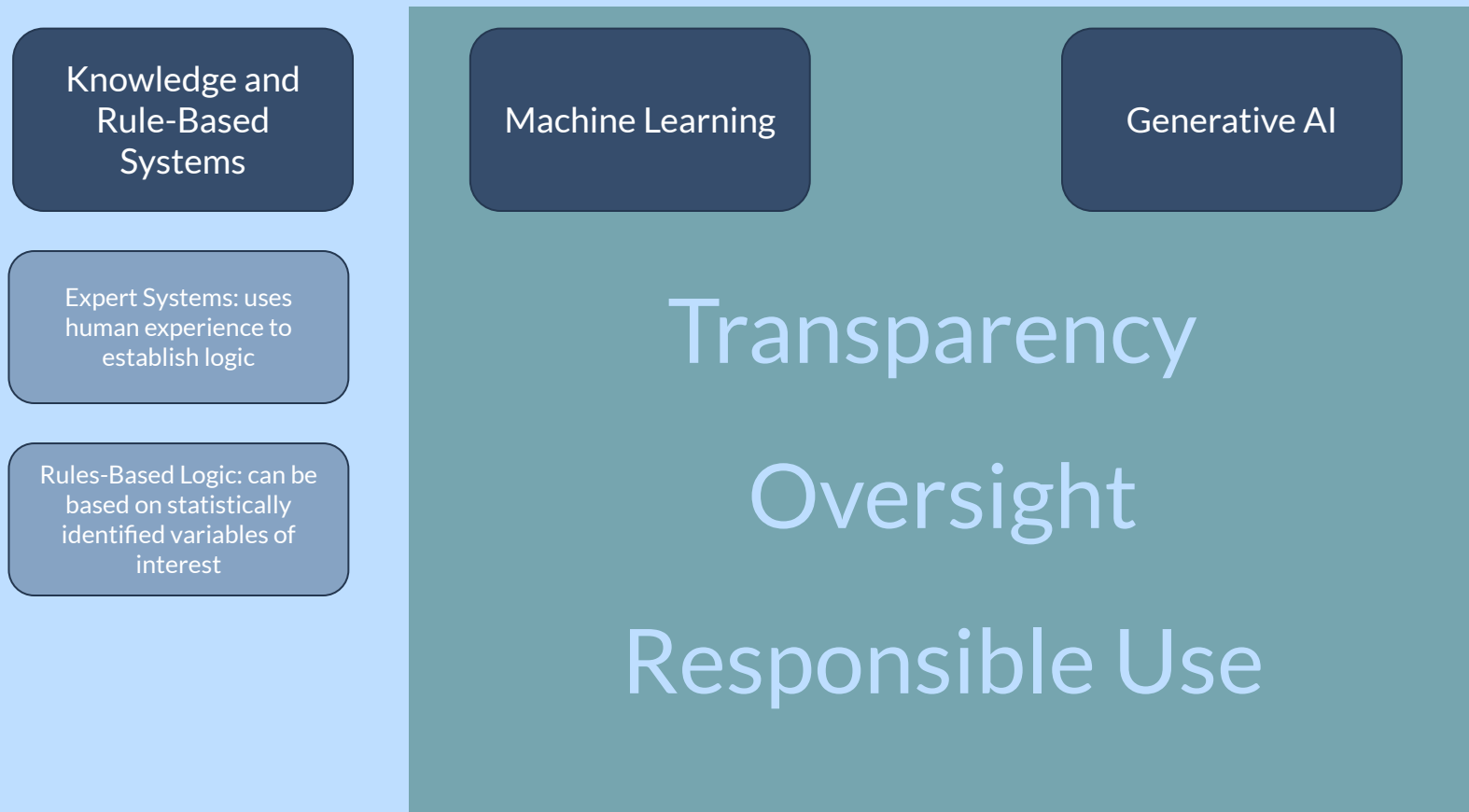


FIGURE 2 | High-level categories of AI. Adapted from: National Academy of Medicine. 2025. *An Artificial Intelligence Code of Conduct for Health and Medicine: Essential Guidance for Aligned Action*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/29087>.

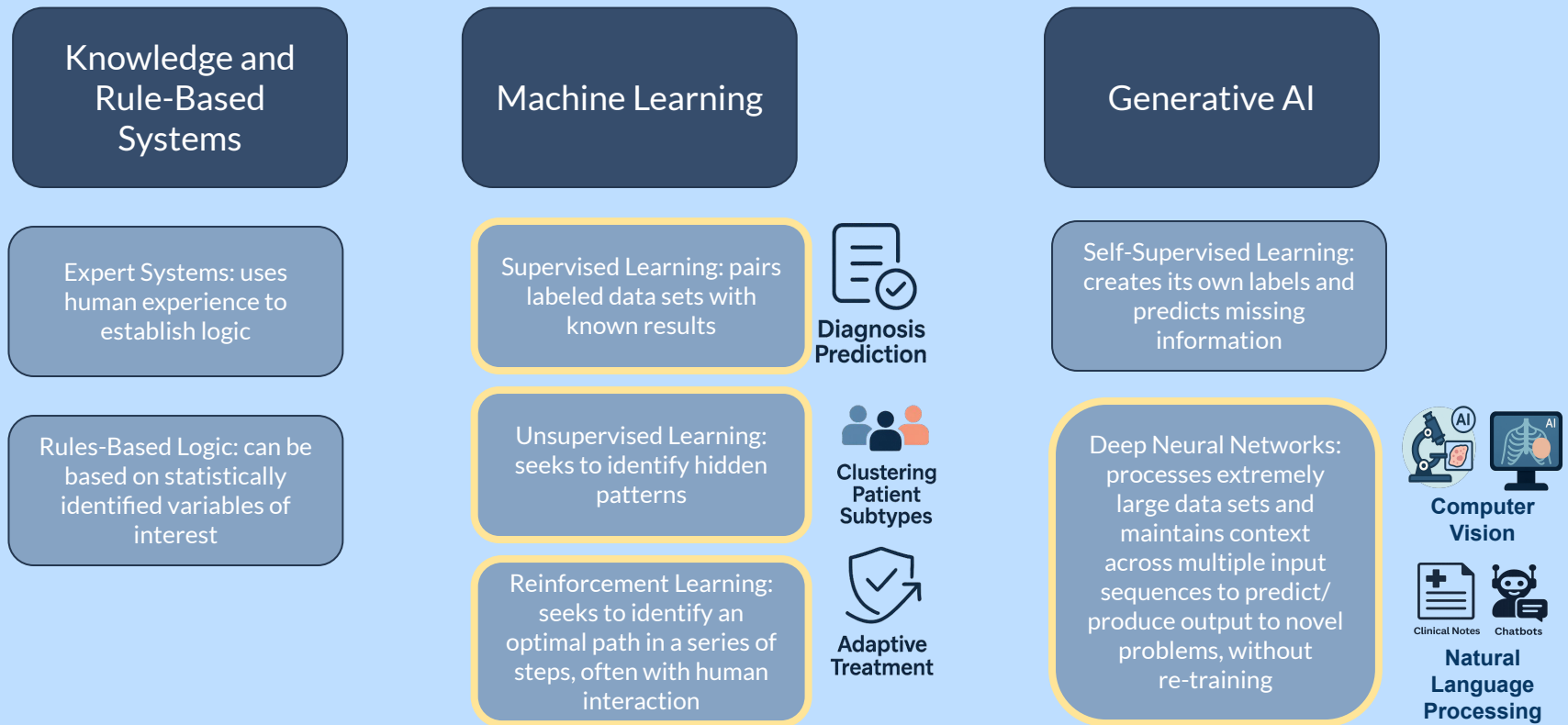
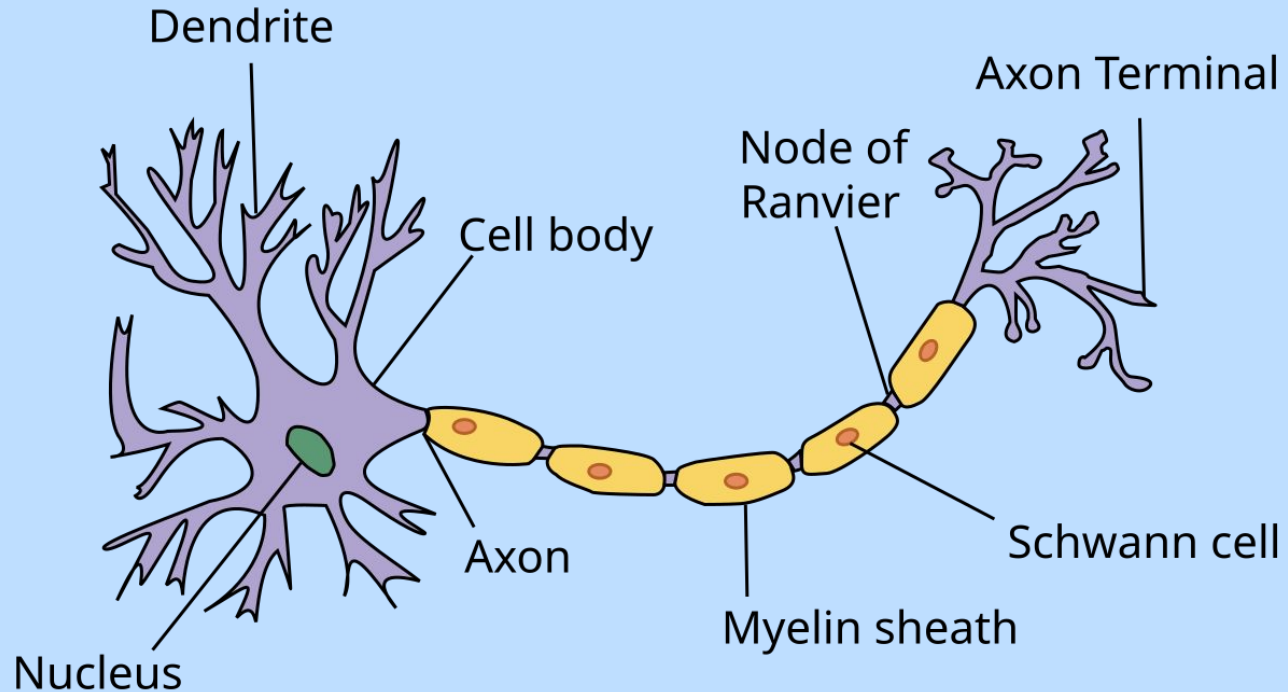


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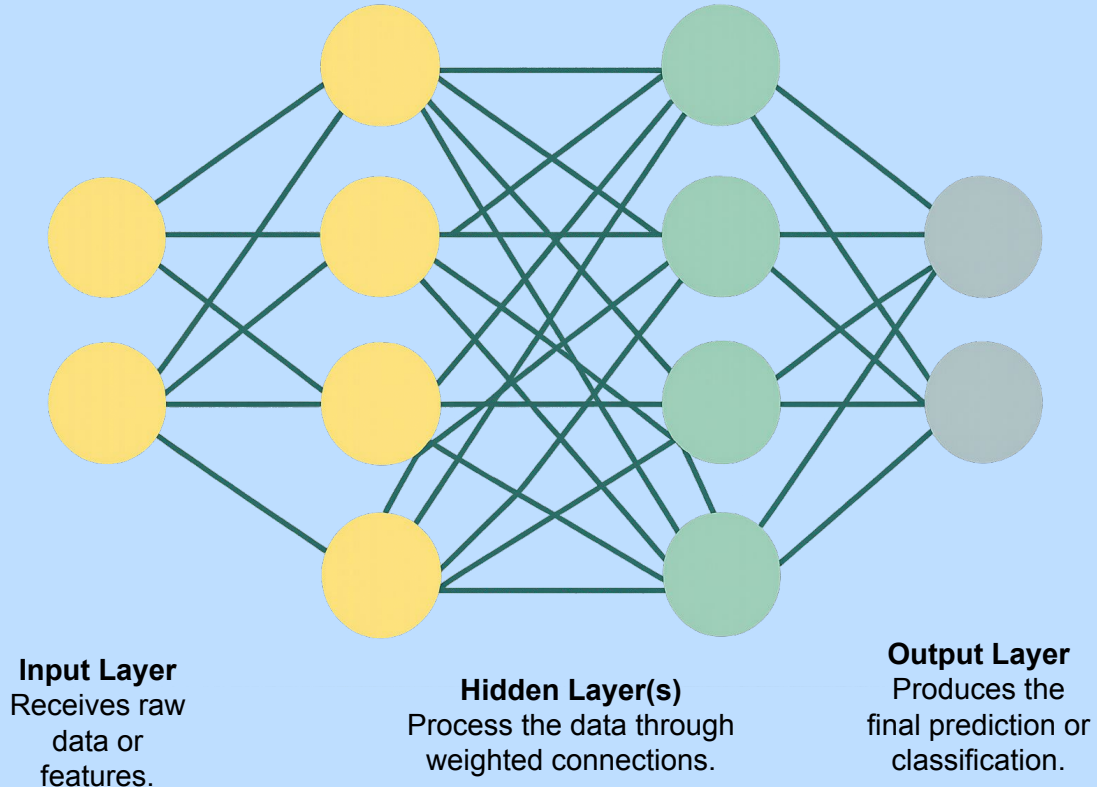
Artificial Neural Network [ANN] Architecture and “Deep Learning”

Typical Neuron

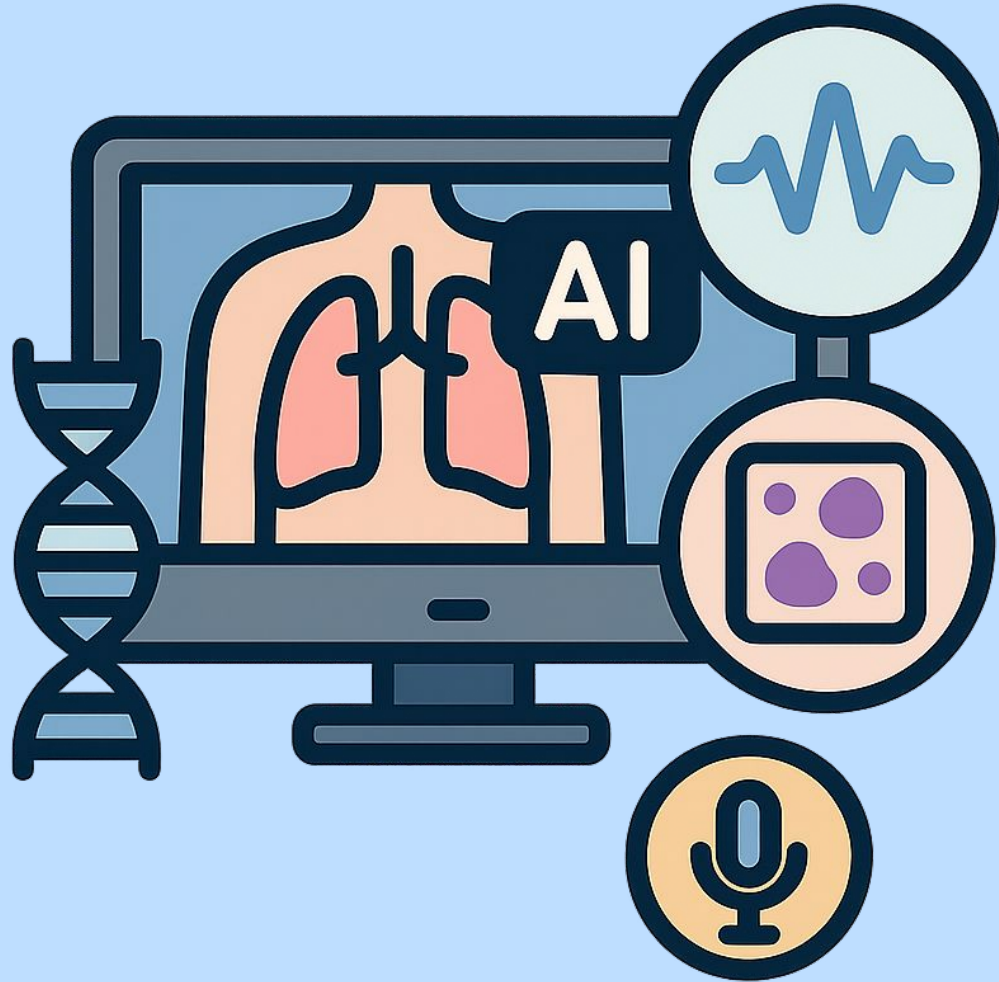


Artificial Neural Network [ANN] Architecture and “Deep Learning”

ANN Schematic

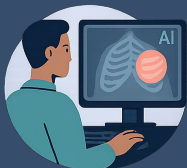


Artificial Neural Network [ANN] Architecture and “Deep Learning”





CLINICAL
DECISION
SUPPORT



IMAGING
INTERPRETATION



PREDICTIVE
MODELING

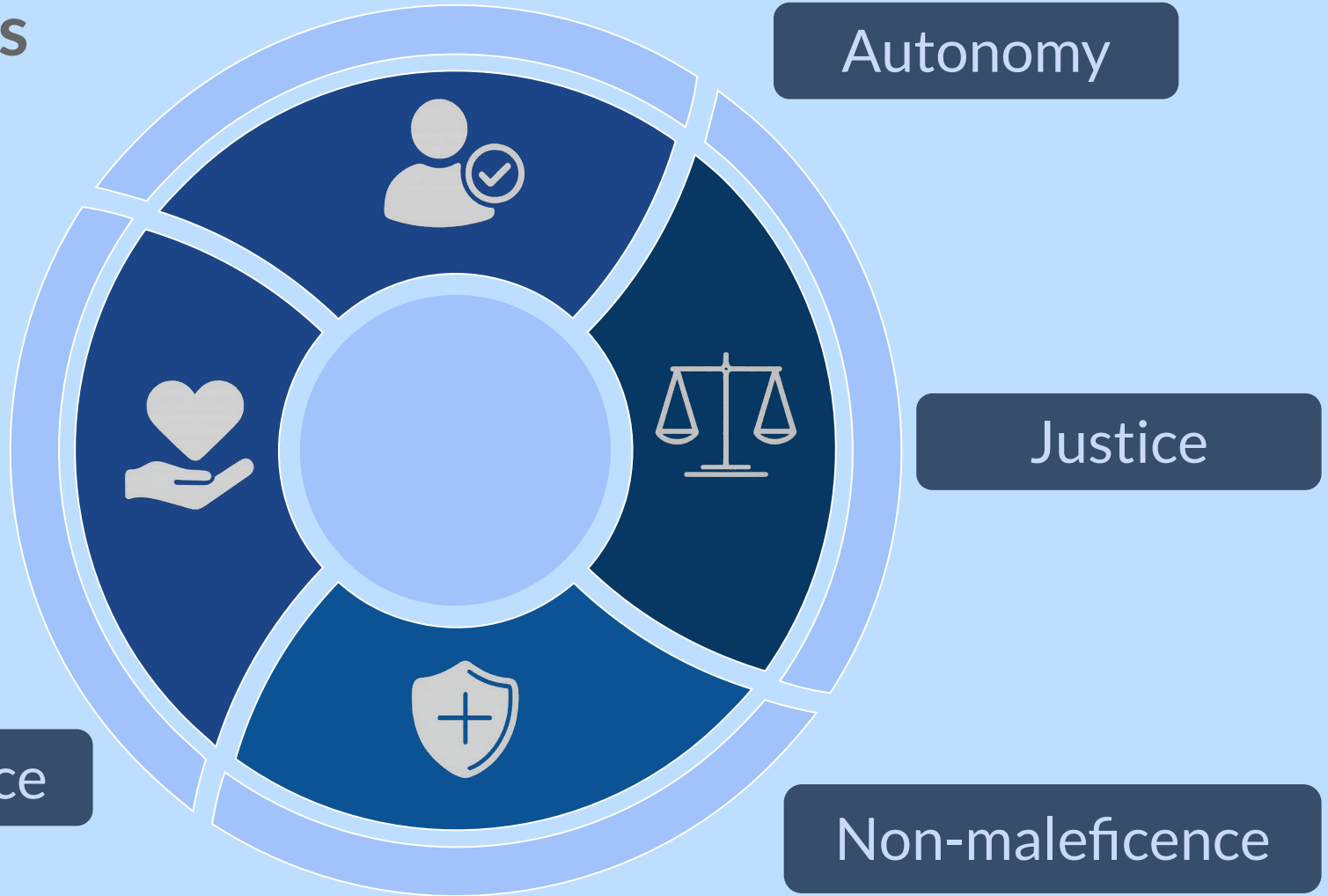


PATIENT
TRIAGE

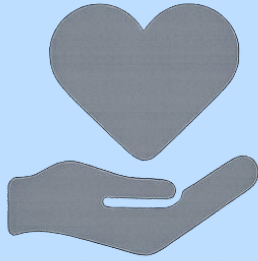
AI and ML applications are transforming healthcare delivery, diagnostics, and research—but without proper oversight, risks

reinforcing **bias** and **inequity**, and potentially, **workforce displacement**, among other challenges.

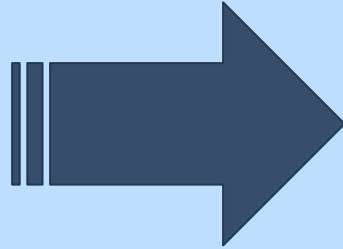
Bioethics for AI



Bioethics for AI

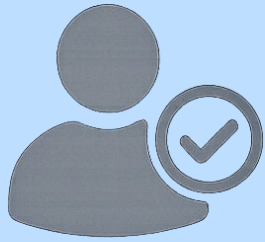


Beneficence

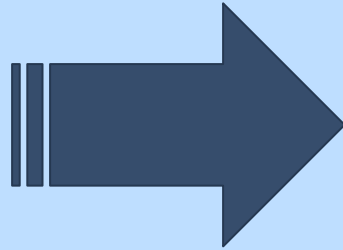


Do no harm and promote wellbeing.
Use accurate and representative **training datasets**.

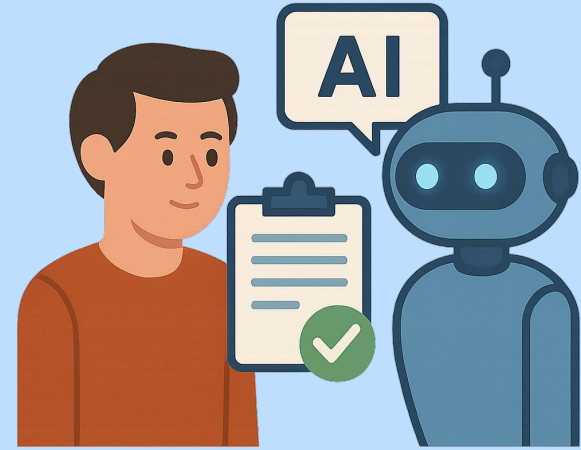
Bioethics for **AI**



Autonomy



INFORMED CONSENT

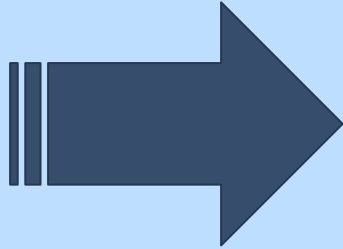


Respect patient choice.
Be transparent about AI use.

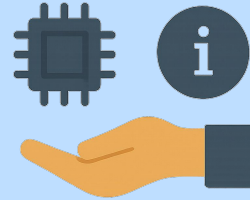
Bioethics for AI



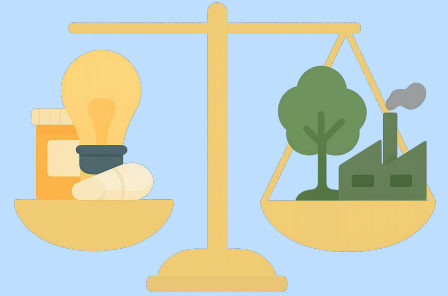
Justice



EQUITABLE
ACCESS

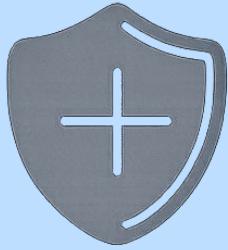


FAIR
DISTRIBUTION
OF BENEFITS AND RISKS

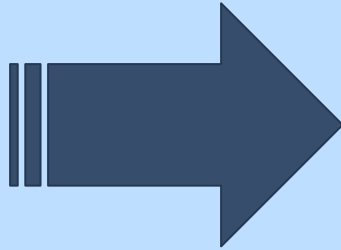


Fair distribution of benefits and risks.
Ensure equitable access and fair burden.

Bioethics for **AI**



Non-maleficence



**AVOID
HARM**



Avoid harm.
Acknowledge limitations and correct errors.



FIGURE S-1 | Advancing to the Quintuple Aim.

National Academy of Medicine.
2022. *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril.*
Washington, DC: The National Academies Press.
<https://doi.org/10.17226/27111>.

Key Findings from Literature Review: Ethical and Social Challenges

1. Systematic Disadvantage

Flawed proxies and lack of representation can worsen inequities as AI use expands.

2. Sources of AI Bias

Data imbalance, algorithmic assumptions, and real-world deployment with poor safeguards.

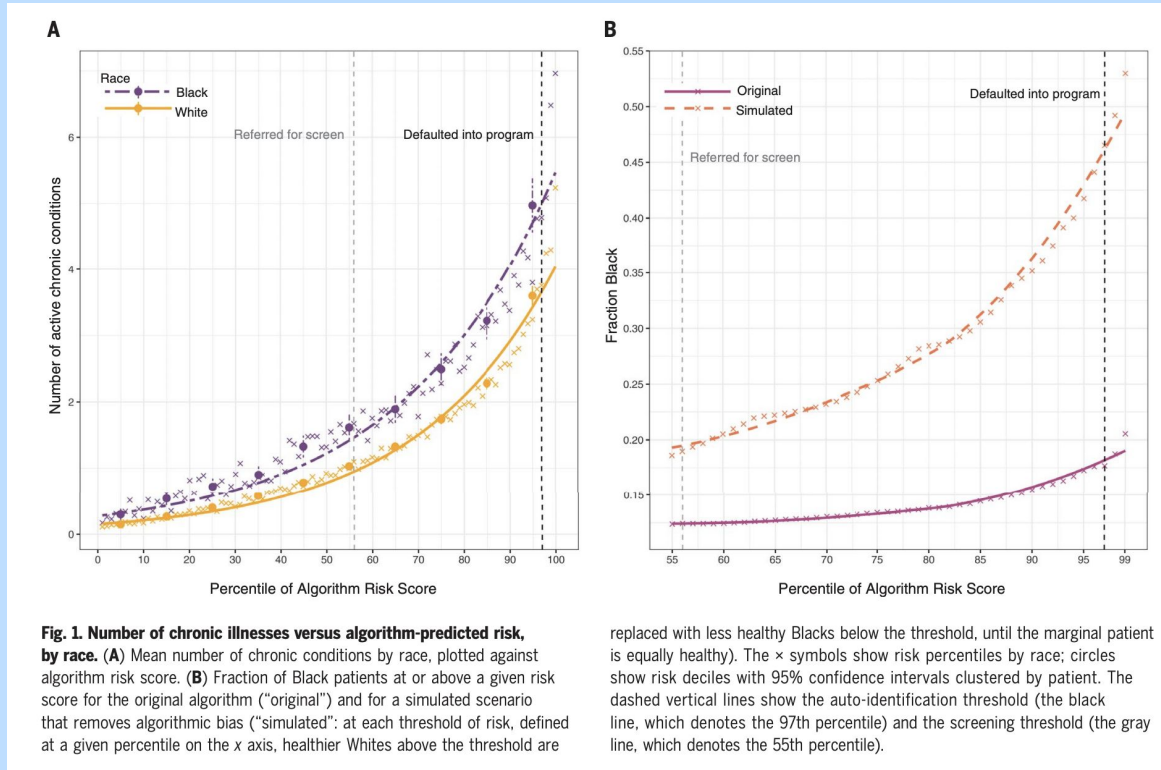
3. Mitigation Strategies

Prioritize diverse data, transparent models, clinician or expert insights, patient input, and bioethical oversight.

4. Critical Gaps

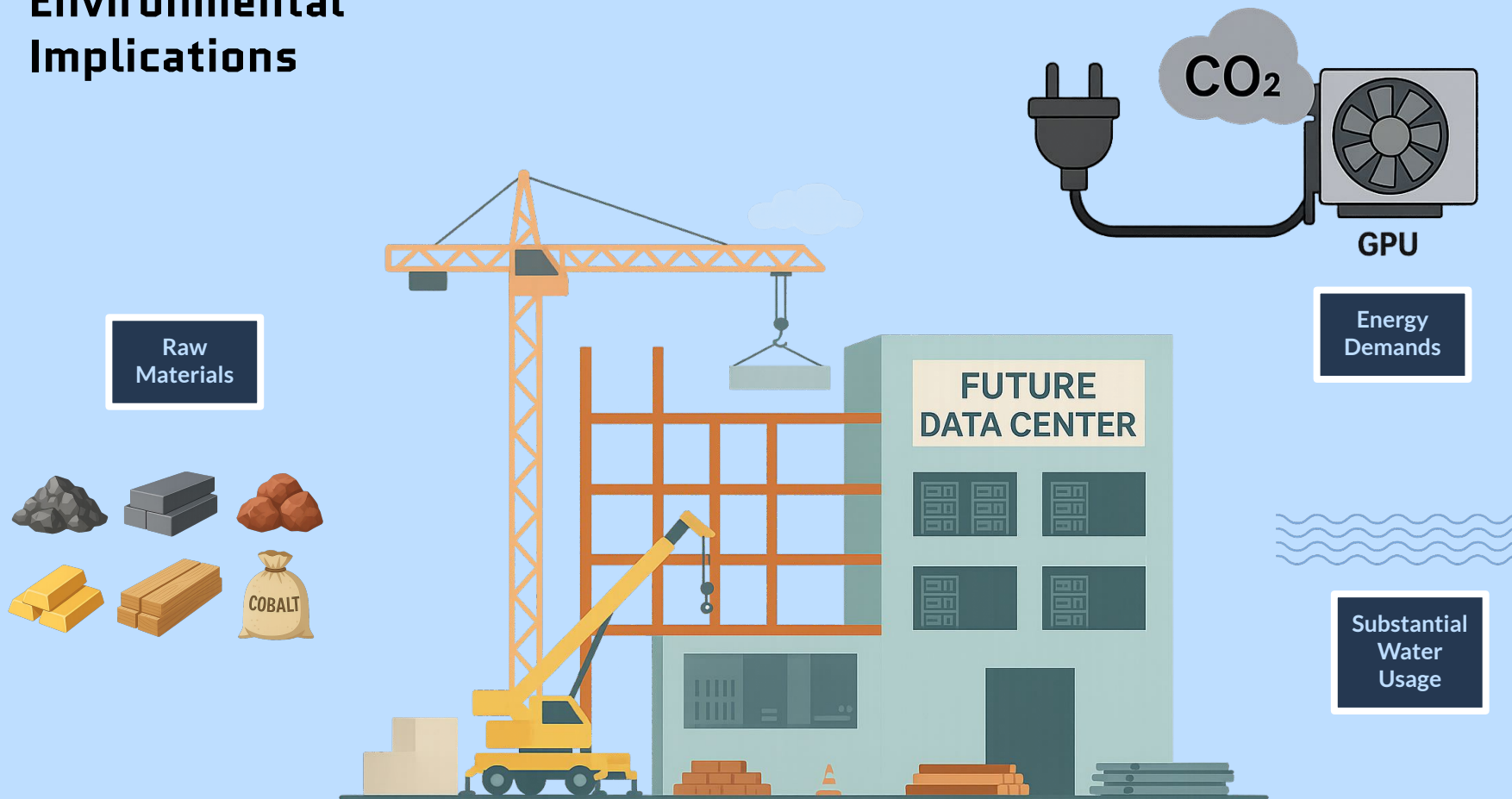
Few studies explicitly address racial bias or equity concerns, and less examine environmental impacts of AI use in healthcare.

Case Example: Racial Bias in Algorithms



Obermeyer, Ziad, et al. "Dissecting racial bias in an algorithm used to manage the health of populations." *Science* 366.6464 (2019): 447-453.

Environmental Implications



< PREVIOUS

NEXT >

Reviews and Commentary
Review

Free Access

Environmental Sustainability and AI in Radiology: A Double-Edged Sword

 Florence X. Doo,  Jan Vosshenrich,  Tessa S. Cook,  Linda Moy,  Eduardo P.R.P. Almeida,  Sean A. Woolen, Judy Wawira Gichoya, Tobias Heye,  Kate Hanneman 

Author Affiliations

Published Online: Feb 27 2024 | <https://doi.org/10.1148/radiol.232030>

 Sections  PDF

 Tools  Share

Figure 4: Diagram shows top 10 actions to improve the sustainability of artificial intelligence (AI) in radiology, with a focus on decreasing greenhouse gas (GHG) emissions and using AI tools to optimize image acquisition and processing.

DECREASE AI-RELATED GHG EMISSIONS

-  Use energy efficient configuration for AI models
-  Develop calculators for radiology AI specific GHG emission estimates
-  Encourage collaboration to decrease redundancy and improve external validity
-  Optimize data compression to minimize storage requirements
-  Partner with vendors that prioritize renewable energy sources

AI TOOLS TO IMPROVE SUSTAINABILITY

-  Implement AI tools to decrease scan times including de-noising of accelerated images
-  Develop AI tools to decrease energy waste during idle scanner time
-  Build AI-powered clinical decision support tools to reduce low-value imaging
-  Use AI tools to minimize the need for contrast administration
-  Optimize patient schedules using AI to decrease travel-related emissions

Closing Thoughts



PROBLEM

1. Bias and Representation

2. Historical Mistrust

3. Environmental Challenges

4. Relationship Dynamics



SOLUTION

Train models on diverse, balanced datasets and audit for bias.

Engage communities and ensure transparent data practices.

Use sustainable systems and enforce clear regulations.

Design AI with clinical input and user- centered workflows.



**CONSISTENT
AUDITING**



**DATA
SECURITY**



**REPRESENTATIVE
DATA**



**WORKFORCE
UPSKILLING**



**HUMAN
OVERSIGHT**



**IMPROVED
DATA QUALITY**



**TRANSPARENT
DECISIONS**



**CLEAR
REGULATIONS**



**MINDFUL
IMPLEMENTATION**

Thank You!

Contact treid@thecobbinstitute.org for feedback or questions.



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Bachelor of Arts Honors Interdisciplinary
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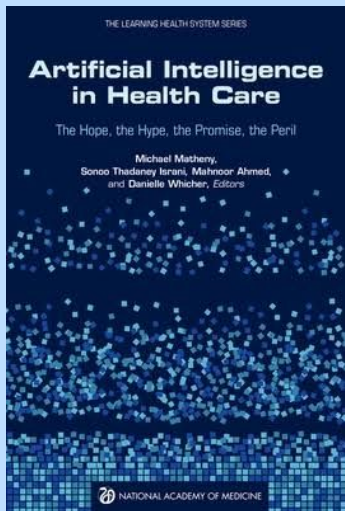
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QR Code Available Until July 24th!

