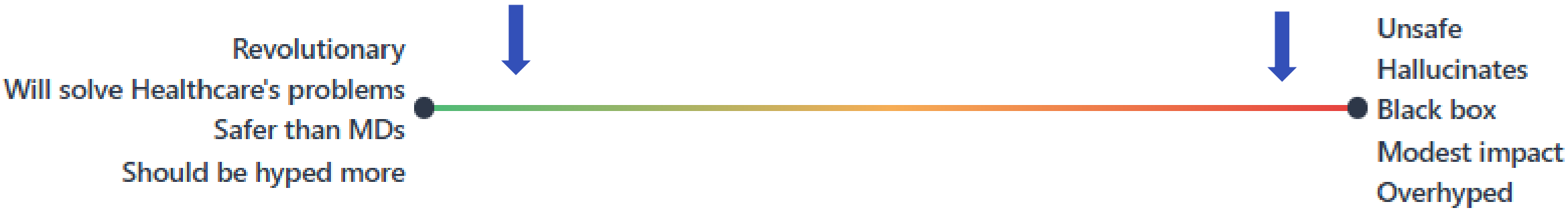
AI in Healthcare. What can we Expect, and When?

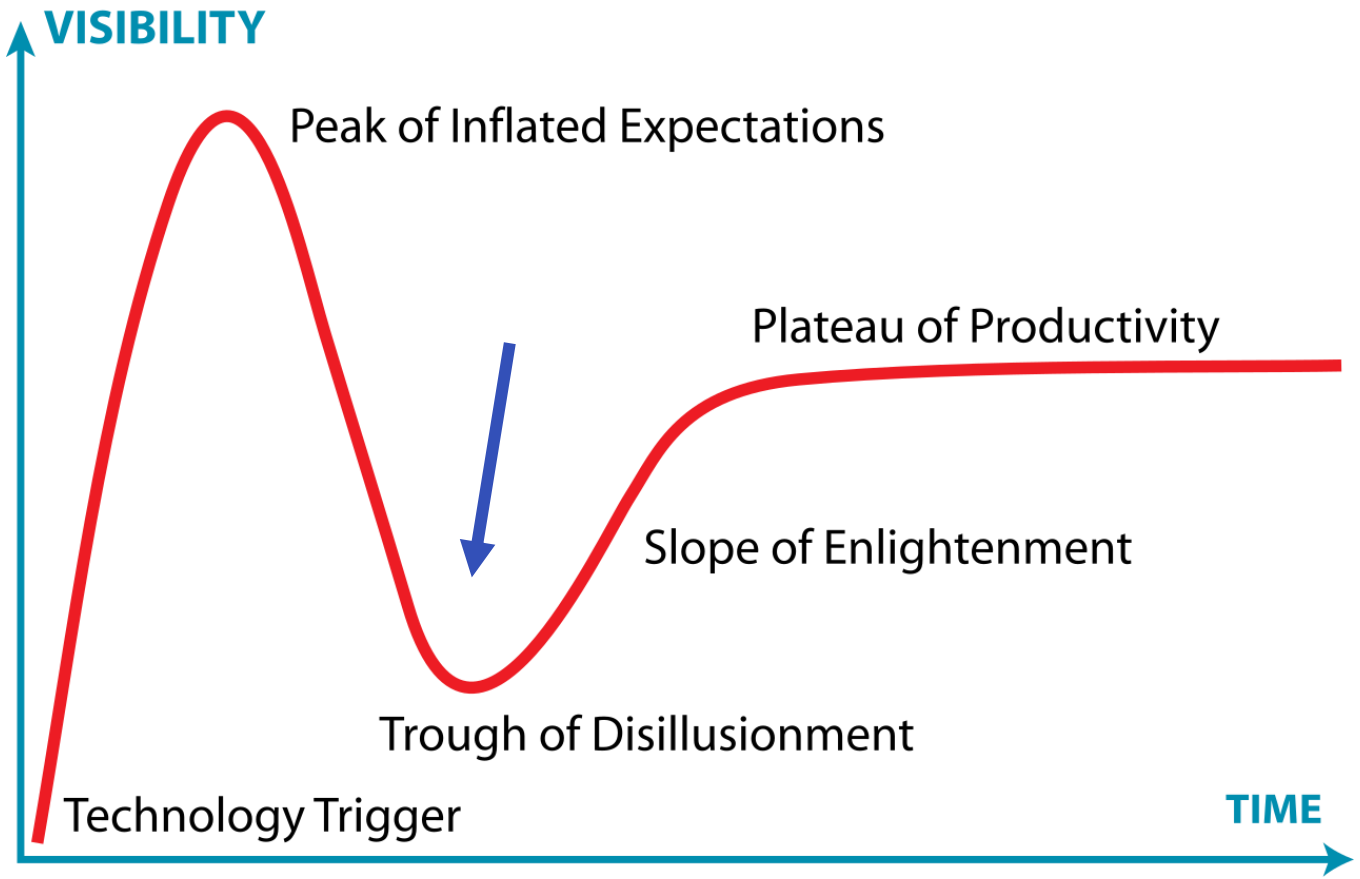
- **Dr Tim Meagher**, Munich Re, Canada

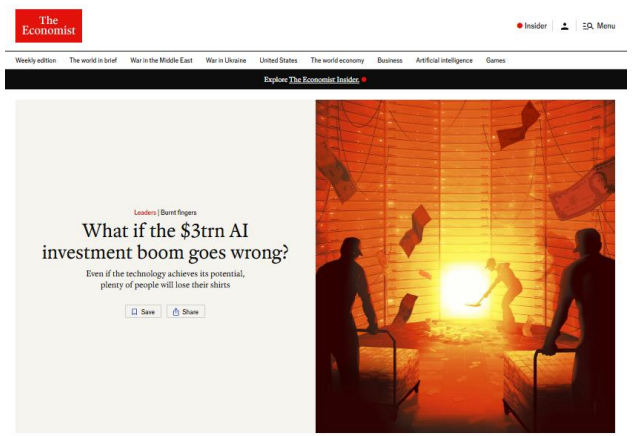
- AAIM Triennial Conference, San Diego, 19th October 2025

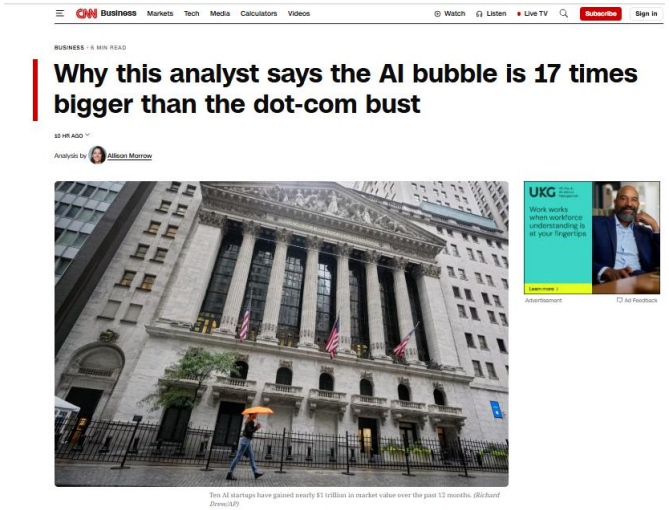
AI Line of Enthusiasm

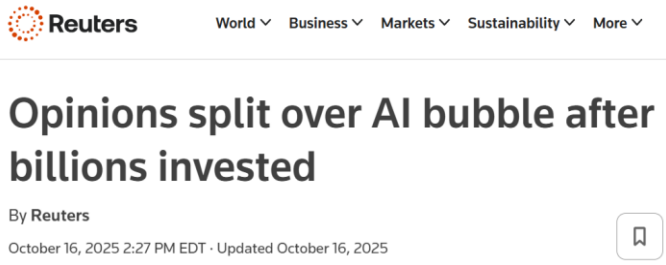


Where are we on the hype cycle?

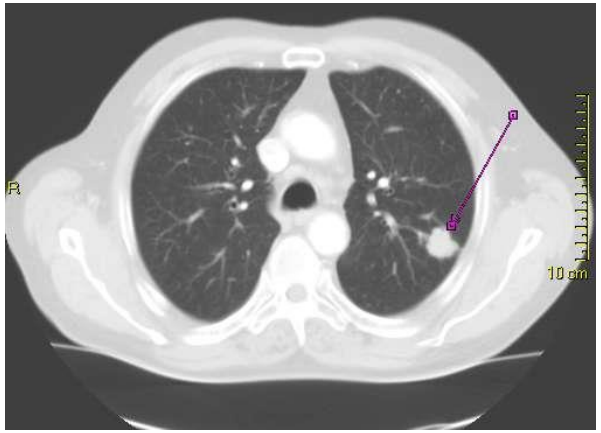


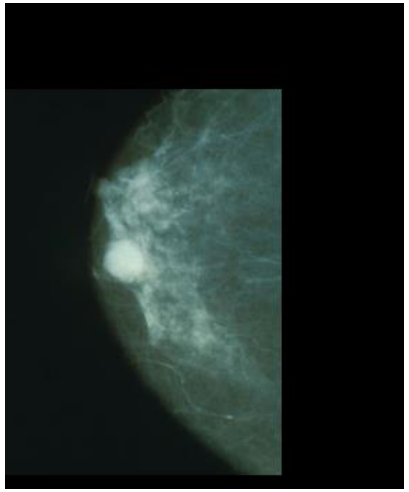


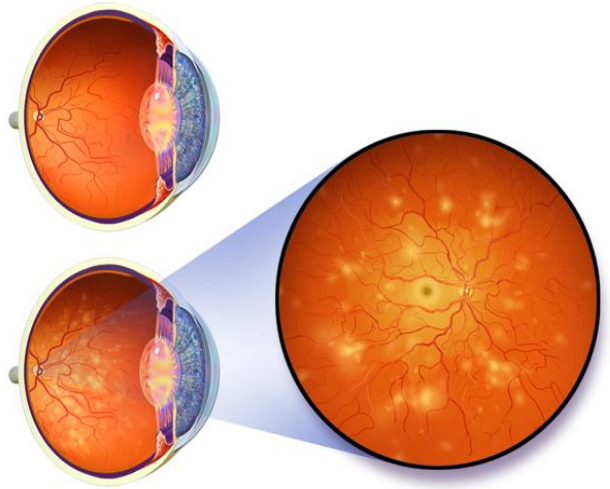


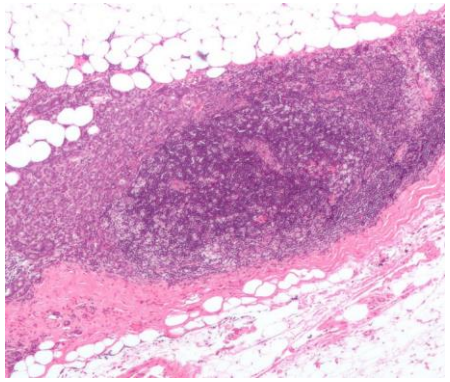


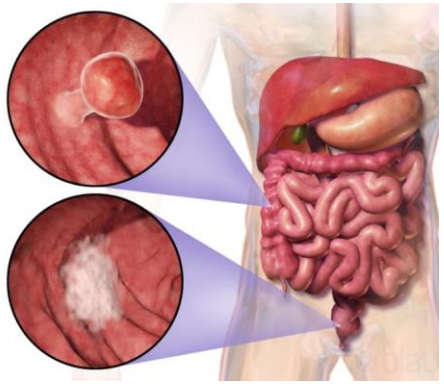
AI-assisted imaging…in 2025



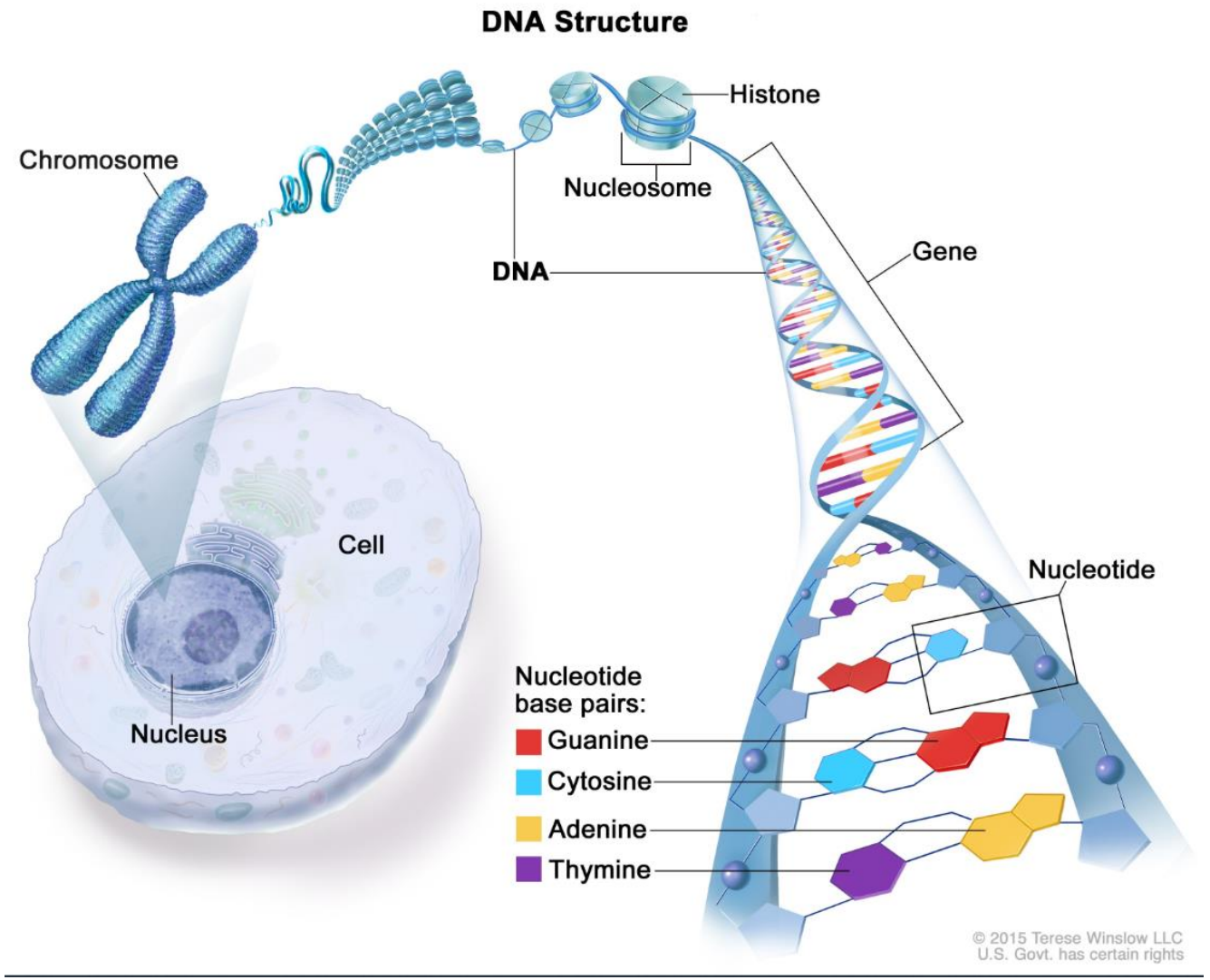








AI-assisted Genomics…



AI in Medicine: a 1-slide history…

Era	Years	Key Features	Milestones-examples
Rule-based system	1950-2000	Symbolic AI; 'if-then' rules; decision trees	Rules-based ECG interpretation Basic alerts in EHRs
Machine Learning/Deep Learning	2000-2022	Neural networks, especially CNNs AI radiology, pathology, dermatology	IDx-DR (2018)- retinal analysis AlphaFold (2020)- protein 3D prediction
Generative AI/LLM Agentic AI	2023-present	Answers queries, creates new content.	ChatGPT; Gemini; OpenEvidence Clinical scribes

Meagher T. *J. Ins. Med*, 2025. In press

The venerable Chest X-ray…!

nature › nature communications › articles › article

Article | Open access | Published: 07 July 2023

Opportunistic detection of type 2 diabetes using deep learning from frontal chest radiographs

Original Research | 26 March 2024

Deep Learning to Estimate Cardiovascular Risk From Chest Radiographs: A Risk Prediction Study

Authors: Jakob Weiss, MD, Vineet K. Raghu, PhD, Kaavya Paruchuri, MD, Aniket Zinzuwadia, AB, Pradeep Natarajan, MD, MMSc, Hugo J.W.L. Aerts, PhD, and Michael T. Lu, MD, MPH | AUTHOR, ARTICLE, & DISCLOSURE INFORMATION

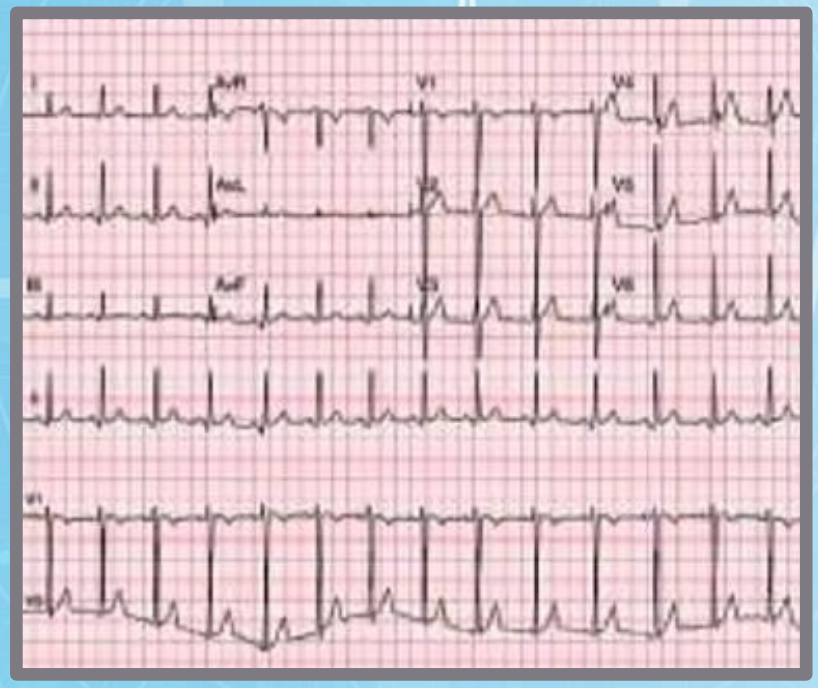
Publication: Annals of Internal Medicine • Volume 177, Number 4 • https://doi.org/10.7326/M23-1898

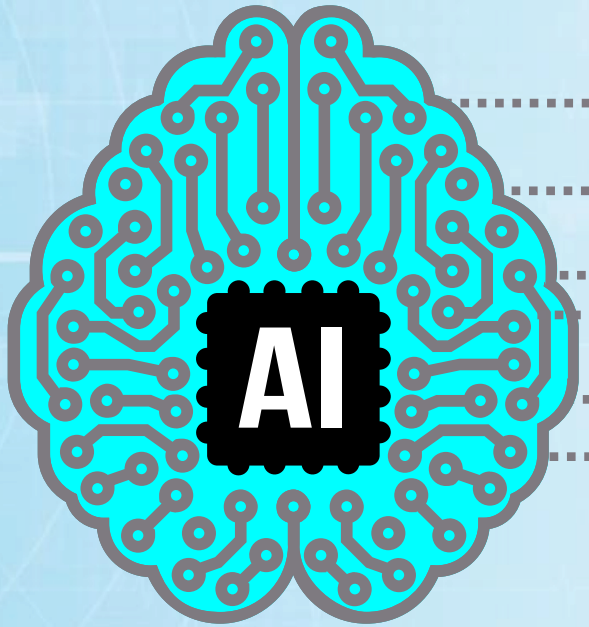
nature › nature communications › articles › article

Article | Open access | Published: 16 May 2023

Deep learning to estimate lung disease mortality from chest radiographs

AI-ECG





- Age/Sex
- AF in NSR
- Low Ejection Fraction
- Valvular Diseases
- Channelopathies
- Hypertrophic Cardiomyopathy

Posan E, Richie R. *J Insur Med* (2024) 51 (2): 64–76

Original Investigation | AI in Cardiology

JAMA Cardiol
Published Online: August 20, 2025
doi: 10.1001/jamacardio.2025.2522

Artificial Intelligence–Enhanced Electrocardiography for Complete Heart Block Risk Stratification

Arunashis Sau, PhD[1,2]; Henry Zhang, BSc[1]; Joseph Barker, MRes[1] ; et al

NEJM AI

CURRENT ISSUE RECENTLY PUBLISHED

ORIGINAL ARTICLE

An Electrocardiogram Foundation Model Built on over 10 Million Recordings

Authors: Jun Li, B.S. , Aaron D. Aguirre, M.D., Ph.D. , Valdery Moura Junior, Ph.D. , Jiarui Jin, B.S. , Che Liu, M.S. , Lanhai Zhong, B.S. , Chenxi Sun, Ph.D. , Gari Clifford, Ph.D. , M. Brandon Westover, M.D., Ph.D. , and Shenda Hong, Ph.D. Author Info & Affiliations

Published June 26, 2025 | NEJM AI 2025;2(7) | DOI: 10.1056/AIoa2401033 | VOL. 2 NO. 7 | Copyright © 2025

JAMA

Original Investigation | AI in Medicine

Published Online: June 23, 2025
doi: 10.1001/jama.2025.8731

Complete AI-Enabled Echocardiography Interpretation With Multitask Deep Learning

Gregory Holste, MSE[1,2,3]; Evangelos K. Oikonomou, MD, DPhil[2,3]; Márton Tokodi, MD, PhD[4]; et al

NEJM AI

CURRENT ISSUE RECENTLY PU

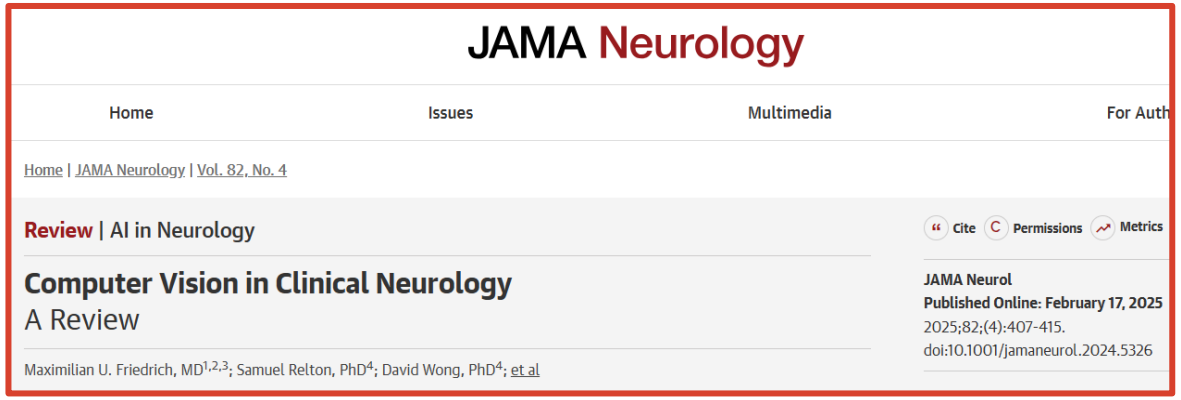
THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW | ALREAD

ORIGINAL ARTICLE

AI-Enabled Parkinson's Disease Screening Using Smile Videos

Authors: Tariq Adnan, M.Sc. , Md Saiful Islam, M.Sc. , Sangwu Lee, B.Sc. , E.M. Wasifur Rahman Chowdhury, Ph.D. , Sutapa Dey Tithi, B.Sc. , Kazi Noshin, B.Sc. , Md Rayhanul Islam, M.Sc. , +5 , and Ehsan Hoque, Ph.D. Author Info & Affiliations

Published June 26, 2025 | NEJM AI 2025;2(7) | DOI: 10.1056/AIoa2400950 | VOL. 2 NO. 7 | Copyright © 2025



JAMA Neurology

Home Issues Multimedia For Auth

Home | JAMA Neurology | Vol. 82, No. 4

Review | AI in Neurology

Computer Vision in Clinical Neurology
A Review

Maximilian U. Friedrich, MD[1,2,3]; Samuel Relton, PhD[4]; David Wong, PhD[4]; et al

Cite Permissions Metrics

JAMA Neurol
Published Online: February 17, 2025
2025;82;(4):407-415.
doi:10.1001/jamaneurol.2024.5326

JAMA Neurology

Home Issues

JAMA Neurol
Published Online: November 18, 2024
2025;82;(2):117-118.
doi:10.1001/jamaneurol.2024.3835

Home | JAMA Neurology | Vol. 82, No. 2

Viewpoint | AI in Neurology

AI Devices in Neurology—Moving From Diagnosis to Prognosis

James M. Hillis, MBBS, DPhil[1,2]; Edward R. Scheffer Cliff, MBBS, MPH[2,3]; Kerstin N. Vokinger, MD, JD, PhD[4,5]

npj | digital medicine

Explore content About the journal Publish with us

nature > npj digital medicine > articles > article

Article | Open access | Published: 24 August 2025

CARE-AD: a multi-agent large language model framework for Alzheimer's disease prediction using longitudinal clinical notes

Rumeng Li, Xun Wang, Dan Berlowitz, Jesse Mez, Honghuang Lin & Hong Yu

Home | JAMA Network Open | Vol. 8, No. 6

JAMA Netw Open
Published Online: June 13, 2025
2025;8;(6):e2515672. doi:10.1001/jamanetworkopen.2025.15672

Original Investigation | Oncology

AI-Assisted vs Unassisted Identification of Prostate Cancer in Magnetic Resonance Images

Jasper J. Twilt, MSc[1]; Anindo Saha, MSc[1,2]; Joeran S. Bosma, MSc[2]; et al

nature cancer

Article | Published: 02 September 2025

An MRI–pathology foundation model for noninvasive diagnosis and grading of prostate cancer

Lizhi Shao, Chao Liang, Ye Yan, Haibin Zhu, Xiaoming Jiang, Meiling Bao, Pan Zang, Xiazi Huang, Hongyu Zhou, Pei Nie, Liang Wang, Jie Li, Shudong Zhang & Shancheng Ren

Nature Cancer (2025) | Cite this article

JAMA

Home | Issues | Multimedia

Home | JAMA | Vol. 333, No. 14

JAMA
Published Online: March 7, 2025
2025;333;(14):1189-1191. doi:10.1001/jama.2025.0387

Medical News & Perspectives | AI in Medicine

Machine Learning Model Shows Promise in Early Detection of Serious Mental Illness

Roy Perlis, MD, MSc[1,2,3,4]; Kate Schweitzer[5]

NEJM AI

CURRENT ISSUE RECENTLY PUBLISHED

Scheduled maintenance: From Fri. 6/27 through Sat. 6/28, My Account and some transactions will be offline or delayed. We apologize fo

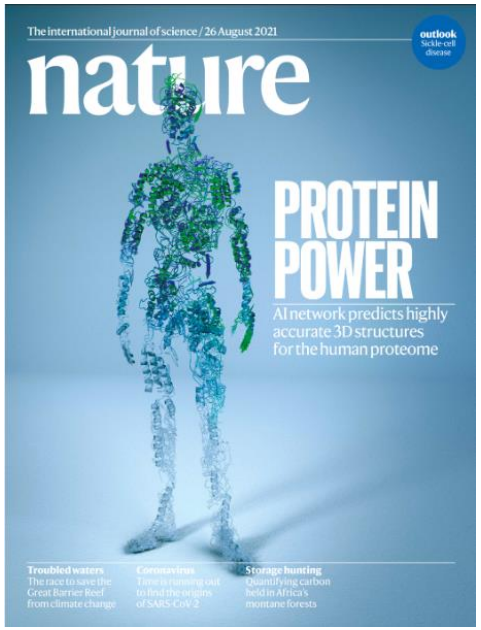
THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW | ALREADY A SU

EDITORIAL

A New Foundation Model for Multimodal Ophthalmic Images: Advancing Disease Detection and Prediction

Authors: Mark A. Chia, Ph.D , Yukun Zhou, Ph.D , and Pearse A. Keane, M.D. Author Info & Affiliations

Published November 27, 2024 | NEJM AI 2024;1(12) | DOI: 10.1056/AIe2401024 | VOL. 1 NO. 12



nature

Nature **630**, 493–500 (2024).

Article | Open access | Published: 08 May 2024

Accurate structure prediction of biomolecular interactions with AlphaFold 3

nature

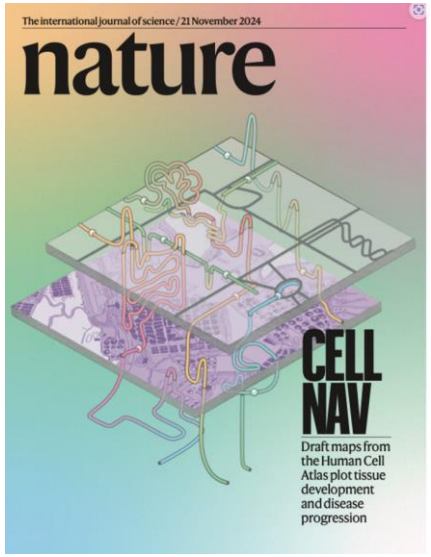
Explore content | About the journal | Publish with us | Subscribe

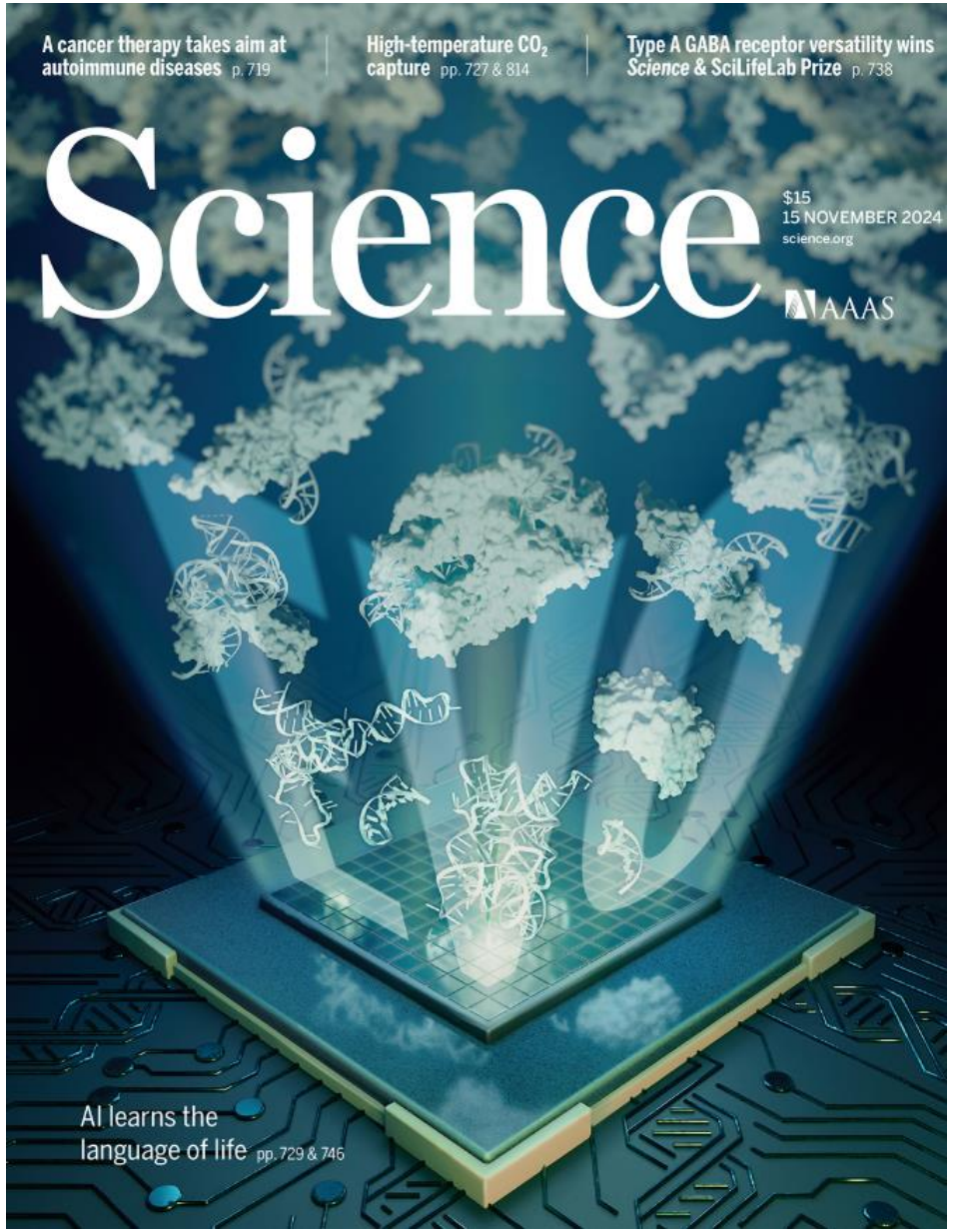
nature > news > article

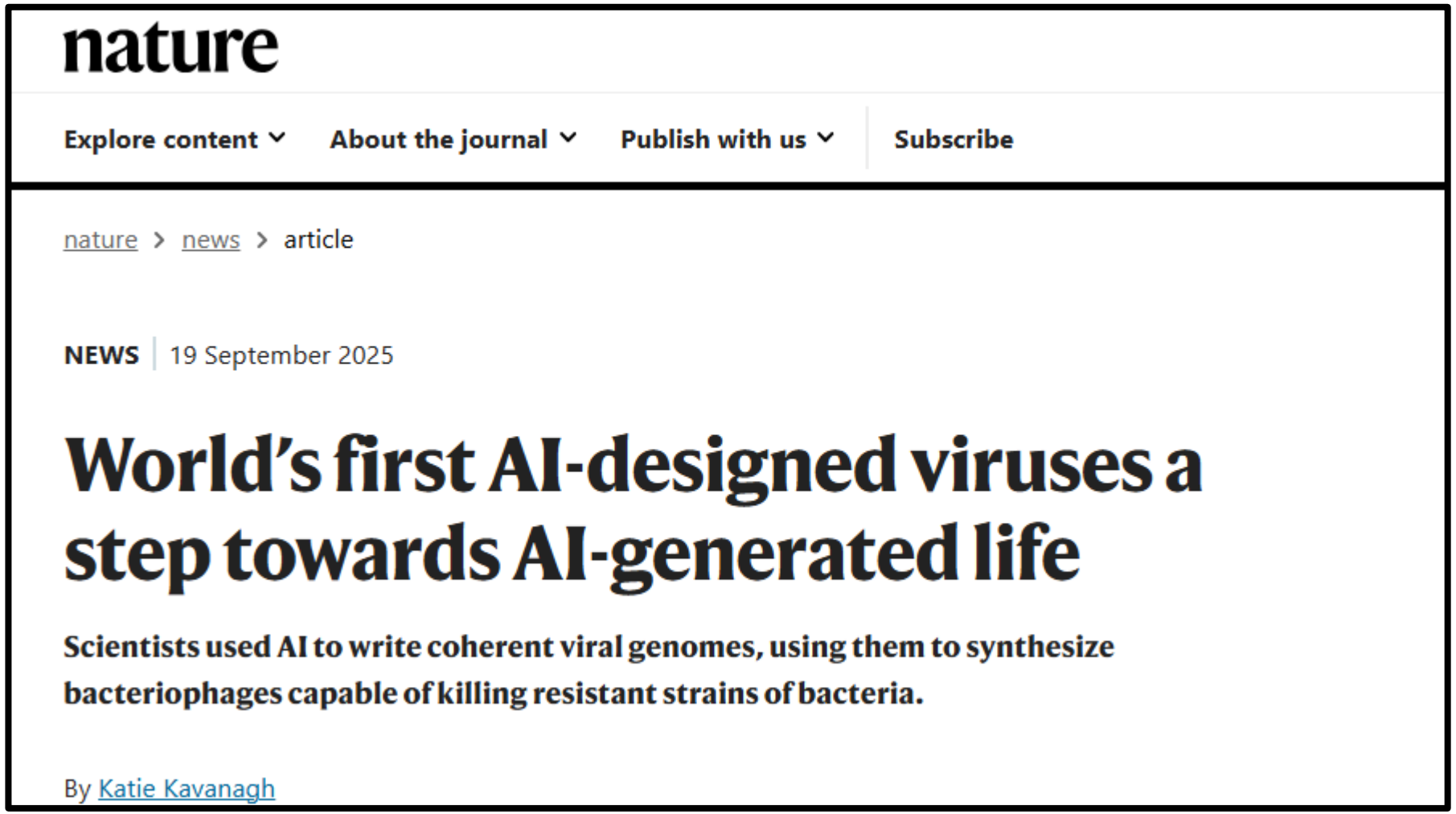
NEWS | 25 June 2025

DeepMind's new AlphaGenome AI tackles the 'dark matter' in our DNA

Tool aims to solve the mystery of non-coding sequences – but is still in its infancy.







nature

Explore content | About the journal | Publish with us | Subscribe

nature > news > article

NEWS | 19 September 2025

World's first AI-designed viruses a step towards AI-generated life

Scientists used AI to write coherent viral genomes, using them to synthesize bacteriophages capable of killing resistant strains of bacteria.

By Katie Kavanagh

King, S. H. *et al.* Preprint at bioRxiv https://doi.org/10.1101/2025.09.12.675911 (2025).

Nature **(2025). https://doi.org/10.1038/s41586-025-09529-3**

Is AI as good as doctors?

Research Letter

FREE

April 1, 2024

Clinical Reasoning of a Generative Artificial Intelligence Model Compared With Physicians

Stephanie Cabral, MD[1]; Daniel Restrepo, MD[2]; Zahir Kanjee, MD, MPH[1]; et al

» Author Affiliations | Article Information

JAMA Intern Med. 2024;184(5):581-583. doi:10.1001/jamainternmed.2024.0295

NEJM AI

CURRENT ISSUE RECENTLY PUB

THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW | ALREADY

ORIGINAL ARTICLE

Towards Generalist Biomedical AI

Authors: Tao Tu, Ph.D., Shekoofeh Azizi, Ph.D., Danny Driess, M.S., Mike Schaekermann, Ph.D., Mohamed Amin, B.S., Pi-Chuan Chang, Ph.D., Andrew Carroll, Ph.D., +25, and Vivek Natarajan, M.S.

Author Info & Affiliations

Published February 22, 2024 | NEJM AI 2024;1(3) | DOI: 10.1056/AIoa2300138 | VOL. 1 NO. 3

NEJM AI

CURRENT ISSUE RECENTLY PUBL

EDITORIAL

The Generalist–Specialist Paradox of Medical AI

Author: V. L. Murthy, M.D., Ph.D. Author Info & Affiliations

Published June 26, 2025 | NEJM AI 2025;2(7) | DOI: 10.1056/AIe2500529 | VOL. 2 NO. 7 | Copyright © 2025

NEJM AI

CURRENT ISSUE RECENTLY PUBLISHED

PERSPECTIVE

Raging against the Machine: The Human Side of the Story

Author: Daniel Restrepo, M.D. Author Info & Affiliations

Published September 25, 2025 | NEJM AI 2025;2(10) | DOI: 10.1056/AIp2500439 | VOL. 2 NO. 10

Copyright © 2025

Viewpoint | AI in Medicine

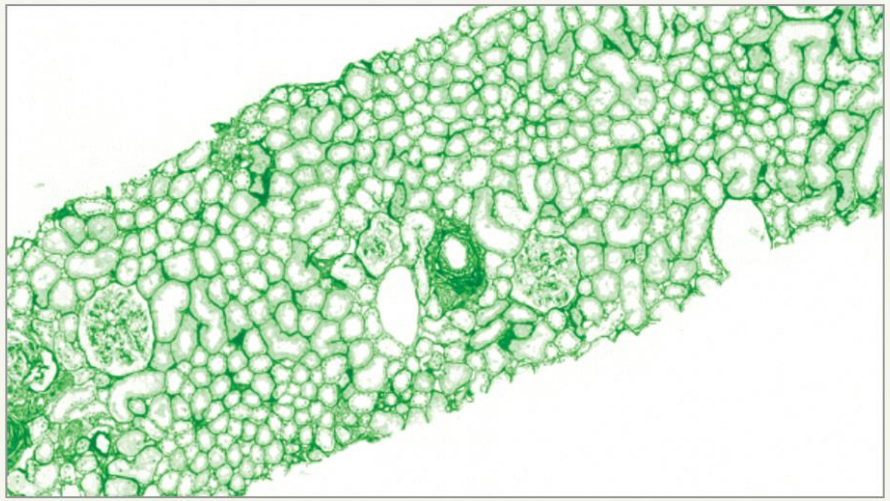
January 19, 2024

AI's Threat to the Medical Profession

Agnes B. Fogo, MD[1]; Andreas Kronbichler, MD, PhD[2]; Ingeborg M. Bajema, MD, PhD[3]

» Author Affiliations | Article Information

JAMA. 2024;331(6):471-472. doi:10.1001/jama.2024.0018



No. of glomeruli:	23
Global sclerosis:	4
Segmental sclerosis detected:	No
GBM changes detected:	No
Crescents detected:	No
Endocapillary hypercellularity:	2%
Podocyte density:	86.8 (below normal value)
Mesangial hypercellularity (maximum):	5
Adhesions:	No
Interstitial fibrosis:	17.4%
Tubular atrophy:	13.9%
Inflammation, area:	12.1%
Inflammatory cells detected:	Lymphocytes (82%) Granulocytes (1.2%) Plasma cells (3.5%) Undetermined (13.3%)
IF/IH:	Still in process
EM:	Still in process

What about implementation?

Journal of the American Medical Informatics Association, 2025, **32(7)**, 1093–1100
https://doi.org/10.1093/jamia/ocaf065
Advance access publication 5 May 2025
Research and Applications

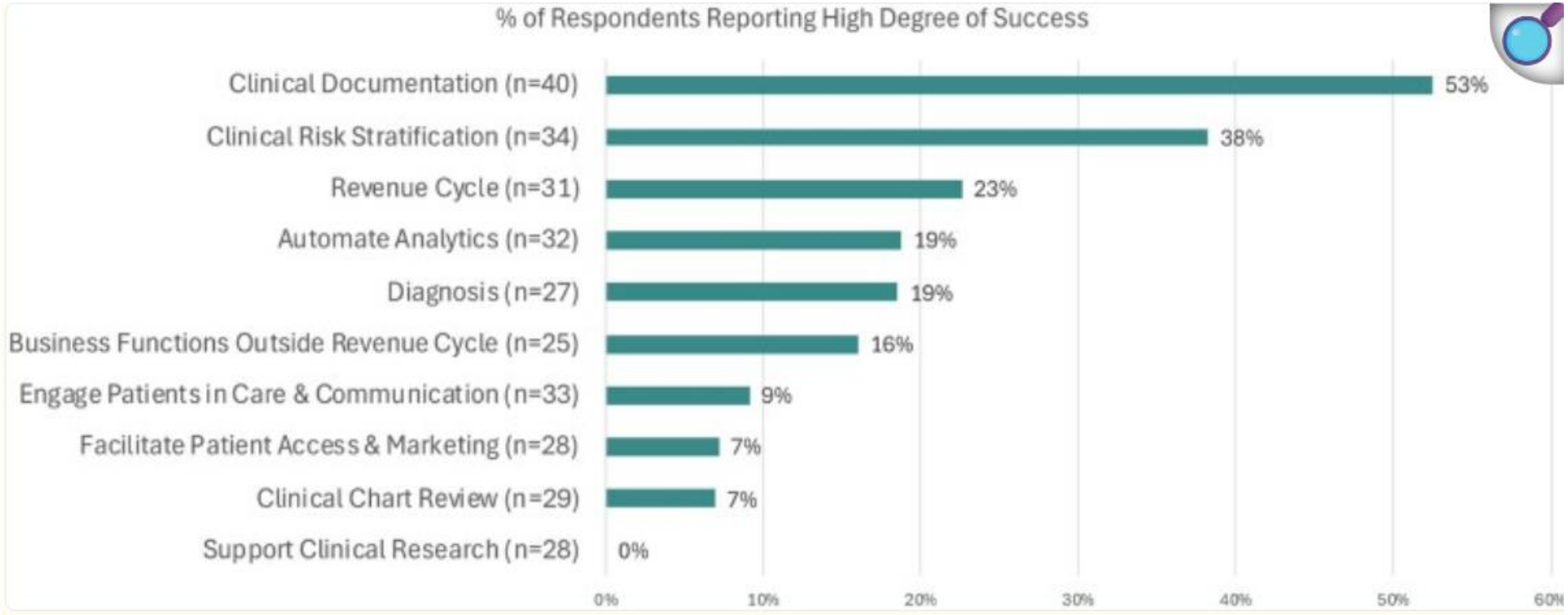
Research and Applications

Adoption of artificial intelligence in healthcare: survey of health system priorities, successes, and challenges

Eric G. Poon, MD, MPH[1,2,3,*], Christy Harris Lemak, PhD[4,5], Juan C. Rojas, MD, MS[6], Janet Guptill, MPH[5], David Classen, MD, MS[7]

[1]Duke University Health System, Durham, NC, United States, [2]Department of Medicine, Duke University School of Medicine, Durham, NC,

- Scottsdale Institute: 67 Health Systems
- Ambient Notes: 100% adoption; 53% satisfaction



State of Global AI Adoption in Healthcare

Right Now, AI Is Most Often Used With Administrative Tasks

Transcribing patient notes	36%
Transcribing business meetings	32%
Creating routine patient communications	29%
Performing patient-related recordkeeping tasks (eg, clinical notes and coding)	27%
Reviewing patient EHRs	26%
Analyzing x-rays, CT scans, and other images	26%
Reviewing and analyzing relevant medical literature and data	24%
Creating patient scheduling tasks (eg, appointments, lab tests)	22%
Using chatbots to interact with patients	21%
Analyzing non-imaging patient data and test results	20%
Assisting in patient diagnosis	20%
Performing business-related recordkeeping tasks	19%
Evaluating business performance	19%
Predicting patient census	19%
Tailoring patient treatment plans	19%
Creating staff schedules	18%
Predicting workforce needs	18%
Assisting in patient prognosis	17%
Coaching physicians on improving patient care	17%

Table 4. Top 6 Obstacles to AI Adoption in Healthcare

		Description	Impact
1	**Data Quality**	Fragmented healthcare data. EHRs, health systems do not communicate; AI training may be flawed	Inaccurate AI performance
2	**Regulatory**	FDA, Health Canada, EU- AI rules in flux; Lengthy approval process	Uncertainty reduces interest of healthcare organizations
3	**Algorithmic bias, Ethical concerns**	Training data not representative of diverse demographic groups; consent, privacy, transparency, autonomy not enshrined in AI algorithms	Bias may perpetuate disparities and health inequities; conflict with healthcare's commitment to equitable health for all.
4	**Clinical Integration**	Poor fit into clinical workflow	Clinician resistance; poor adoption rates; wasted tech investments
5	**Costs**	Costly upfront investment, expensive maintenance and upgrades; ROI not clear	Too expensive for smaller centers; Not attractive in 'for-profit' settings
6	**Trust and Liability**	Black-box problem No real-word validation; clinical liability unclear	Clinician resistance; risk aversion.

Meagher T. *J. Ins. Med*, 2025. In press

NEJM AI

CURRENT ISSUE RECENTLY PUBLISHED

Scheduled maintenance: From Fri. 6/27 through Sat. 6/28, My Account and some transactions will be offline or delayed. We apologize fo

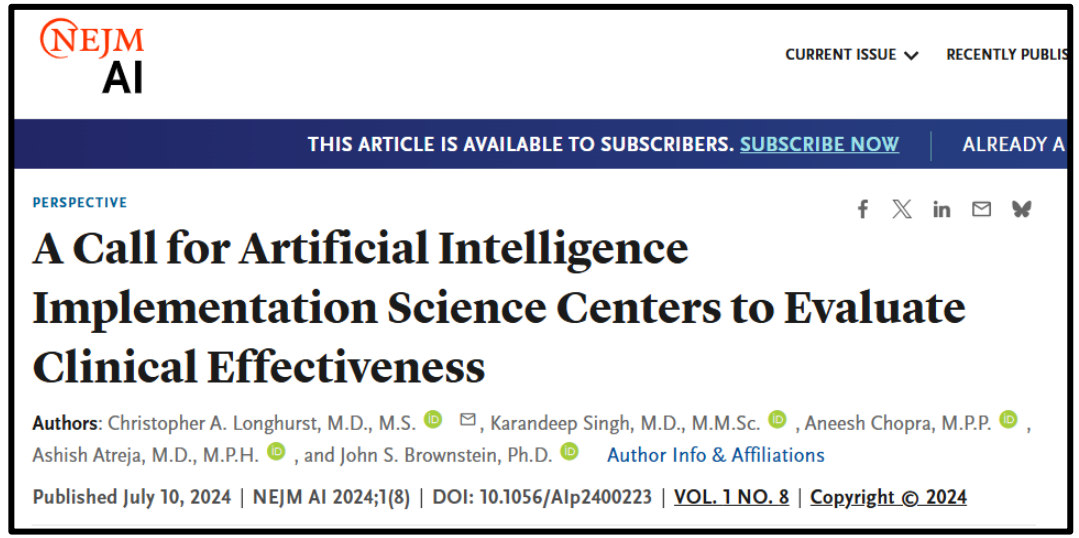
THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW | ALREADY A SU

EDITORIAL

We Need More Randomized Clinical Trials of AI

Authors: David Ouyang, M.D. , and Joseph Hogan, Sc.D. Author Info & Affiliations

Published October 18, 2024 | NEJM AI 2024;1(11) | DOI: 10.1056/AIe2400881 | VOL. 1 NO. 11 | Copyright © 2024



NEJM AI

CURRENT ISSUE RECENTLY PUBLIS

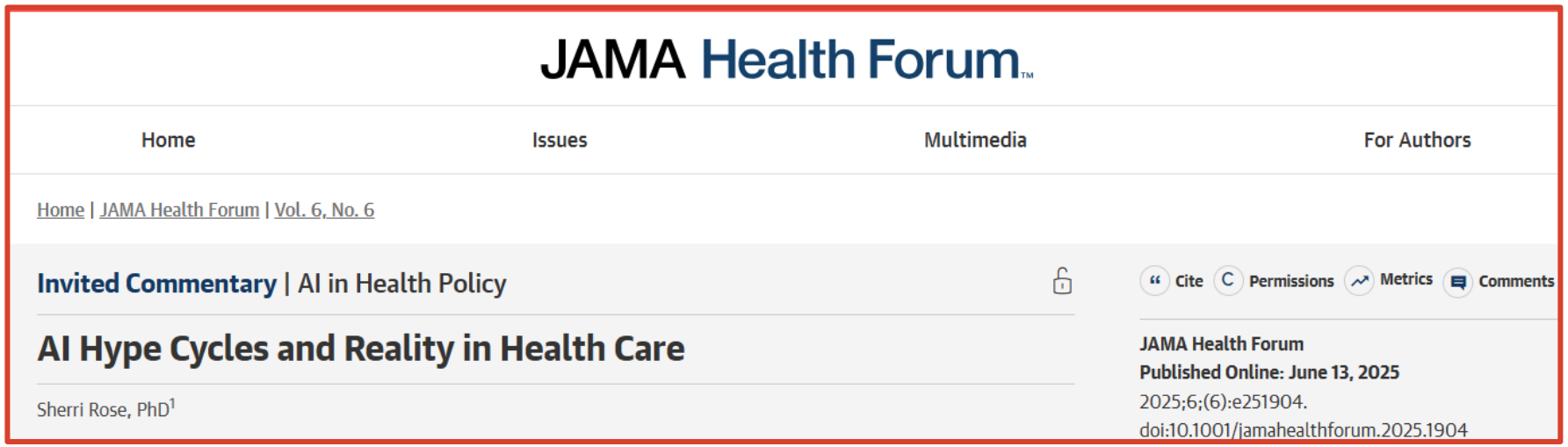
THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW | ALREADY A

PERSPECTIVE

A Call for Artificial Intelligence Implementation Science Centers to Evaluate Clinical Effectiveness

Authors: Christopher A. Longhurst, M.D., M.S. , Karandeep Singh, M.D., M.M.Sc. , Aneesh Chopra, M.P.P. , Ashish Atreja, M.D., M.P.H. , and John S. Brownstein, Ph.D. Author Info & Affiliations

Published July 10, 2024 | NEJM AI 2024;1(8) | DOI: 10.1056/AIp2400223 | VOL. 1 NO. 8 | Copyright © 2024



JAMA Health Forum

Home Issues Multimedia For Authors

Home | JAMA Health Forum | Vol. 6, No. 6

Invited Commentary | AI in Health Policy

AI Hype Cycles and Reality in Health Care

Sherri Rose, PhD[1]

Cite Permissions Metrics Comments

JAMA Health Forum
Published Online: June 13, 2025
2025;6;(6):e251904.
doi:10.1001/jamahealthforum.2025.1904

STAT+ | HEALTH TECH

AI-based mammography is here, and it has a trust problem

Radiologists' skepticism is in part driven by the limited evidence on how the new technology improves cancer outcomes

CANCER CARE | September 23, 2025

UC Davis Health to co-lead $16 million study examining AI's role in reading mammograms

By Stephanie Winn

Nationwide research seeks to examine impact of AI on mammogram accuracy and patient experience

The Economist

Weekly edition | The world in brief | War in the Middle East | War in Ukraine | United States | The world economy | Business | Artificial intelligence

Britain | Labour and the NHS

Where next for Britain's broken National Health Service?

To save itself, the party that founded Britain's health service must rescue it

ILLUSTRATION: CARL GODFREY

May 29th 2025 | Save | Share | Give

---

thebmj | Research | Education | News & Views | Campaigns | Jobs | Archive

Opinion

NHS 10 year plan: Can using AI offer a solution to the NHS' problems?

X Post

BMJ 2025 ; 390 doi: https://doi.org/10.1136/bmj.r1407 (Published 08 July 2025)
Cite this as: *BMJ* 2025;390:r1407

Article | Related content | Metrics | Responses

W David Strain, professor [1], Joshua Cronin-Lampe, operational researcher [2], Marc Evans, consultant diabetologist [3], Cerys Mitchell, associate director [2], Thomas Padgett, principal operational researcher [2], Phil McEwan, chief executive officer [2]

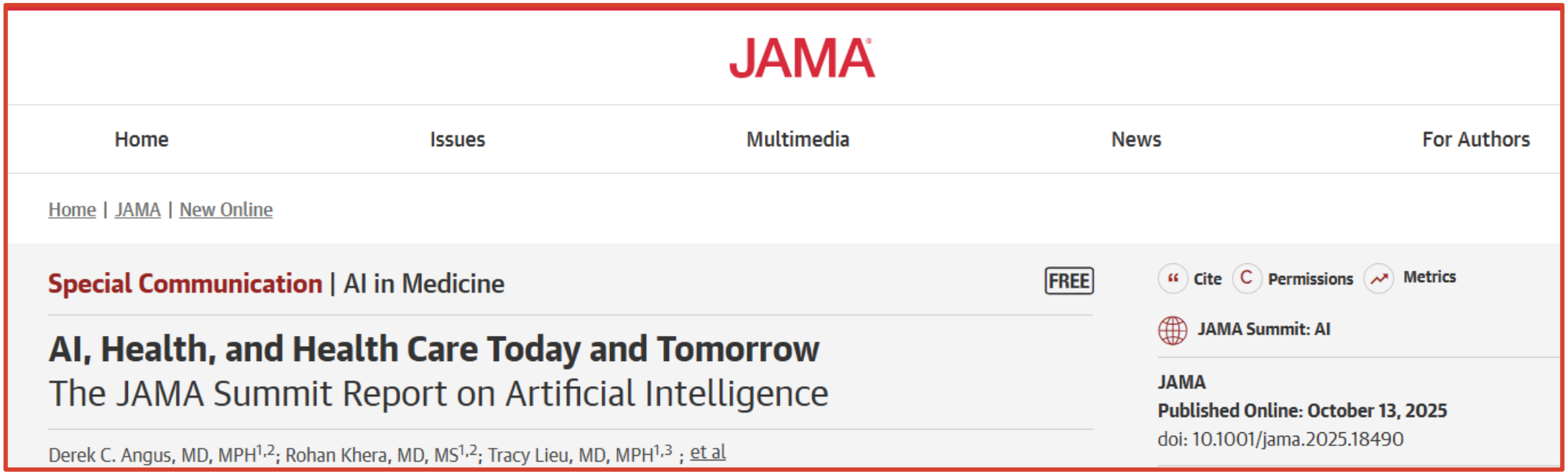
Viewpoint | AI in Health Policy

Artificial Intelligence and Health Care Waste—Promise or Peril?

William H. Shrank, MD, MSHS[1,2]; Suhas Gondi, MD, MBA[3]; David J. Brailer, MD, PhD[4]

» Author Affiliations | Article Information

JAMA Health Forum
Published Online: June 13, 2025


JAMA
Home
Issues
Multimedia
News
For Authors
Home | JAMA | New Online
Special Communication | AI in Medicine
FREE
Cite
Permissions
Metrics
JAMA Summit: AI
AI, Health, and Health Care Today and Tomorrow
The JAMA Summit Report on Artificial Intelligence
Derek C. Angus, MD, MPH[1,2]; Rohan Khera, MD, MS[1,2]; Tracy Lieu, MD, MPH[1,3] ; et al
JAMA
Published Online: October 13, 2025
doi: 10.1001/jama.2025.18490

AI in Healthcare is a like a Ferrari, but…

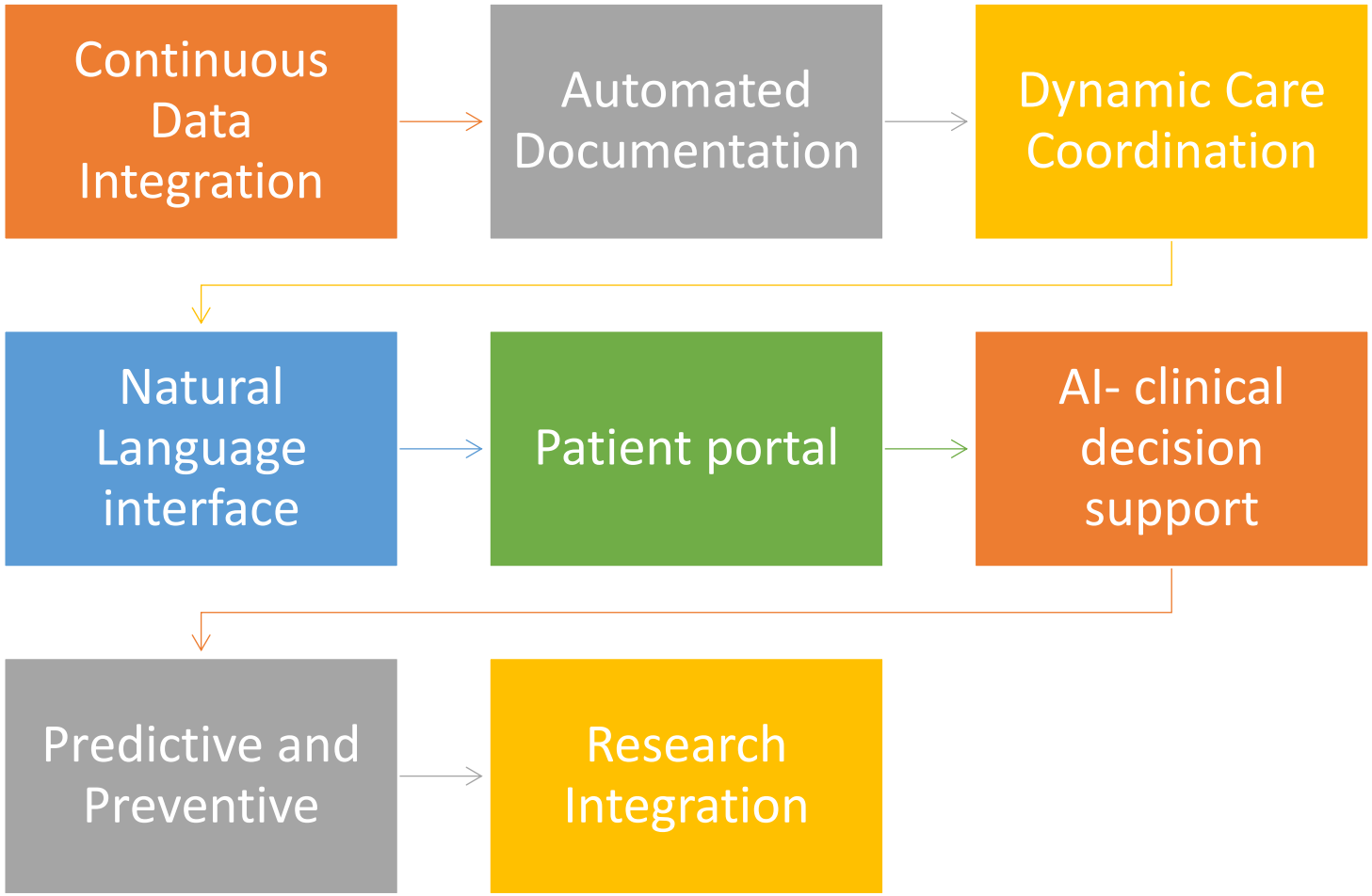
No rules of the road

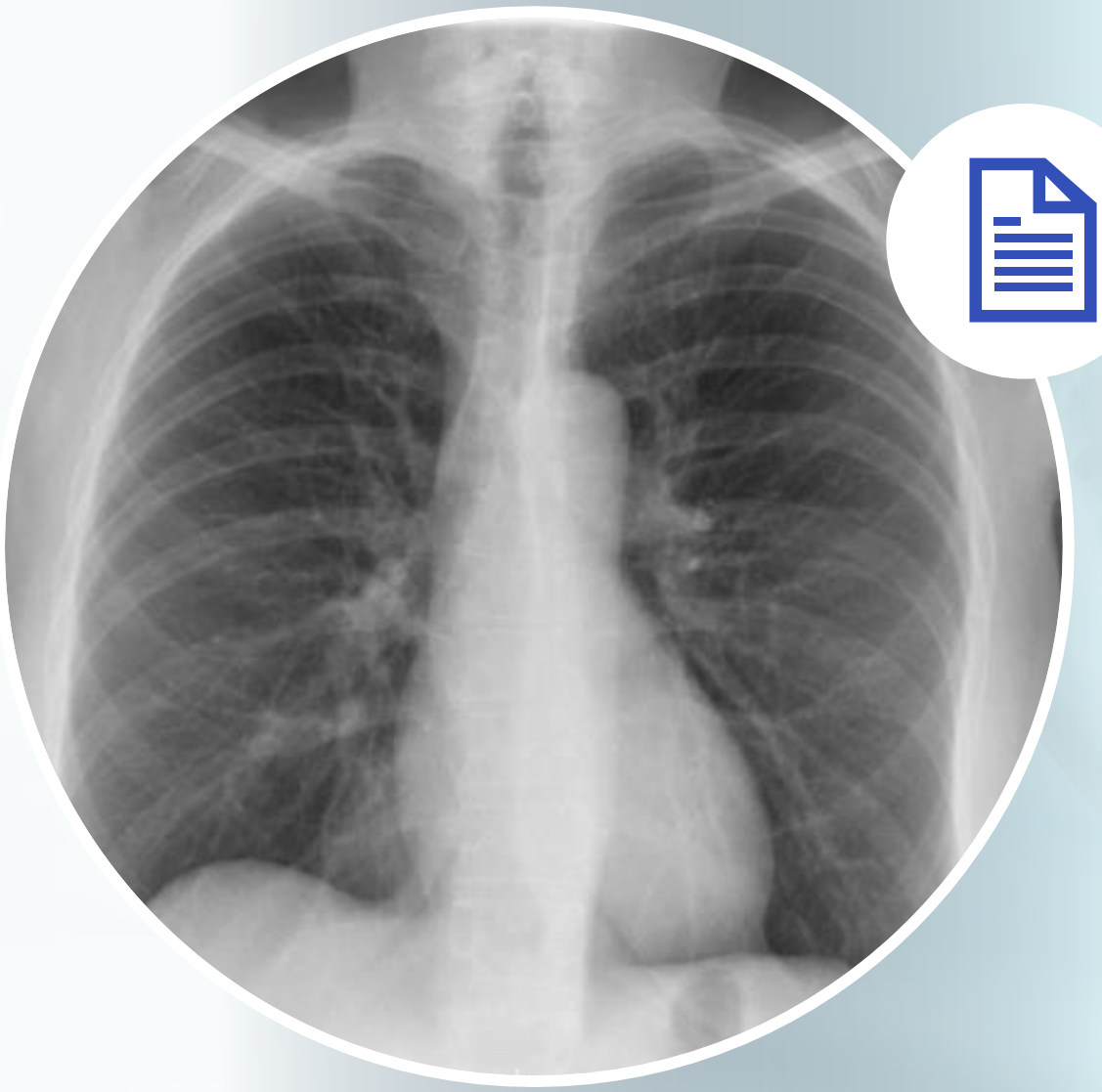
No roads

You haven’t been taught to drive.

You may kill someone

The EHR of the Future

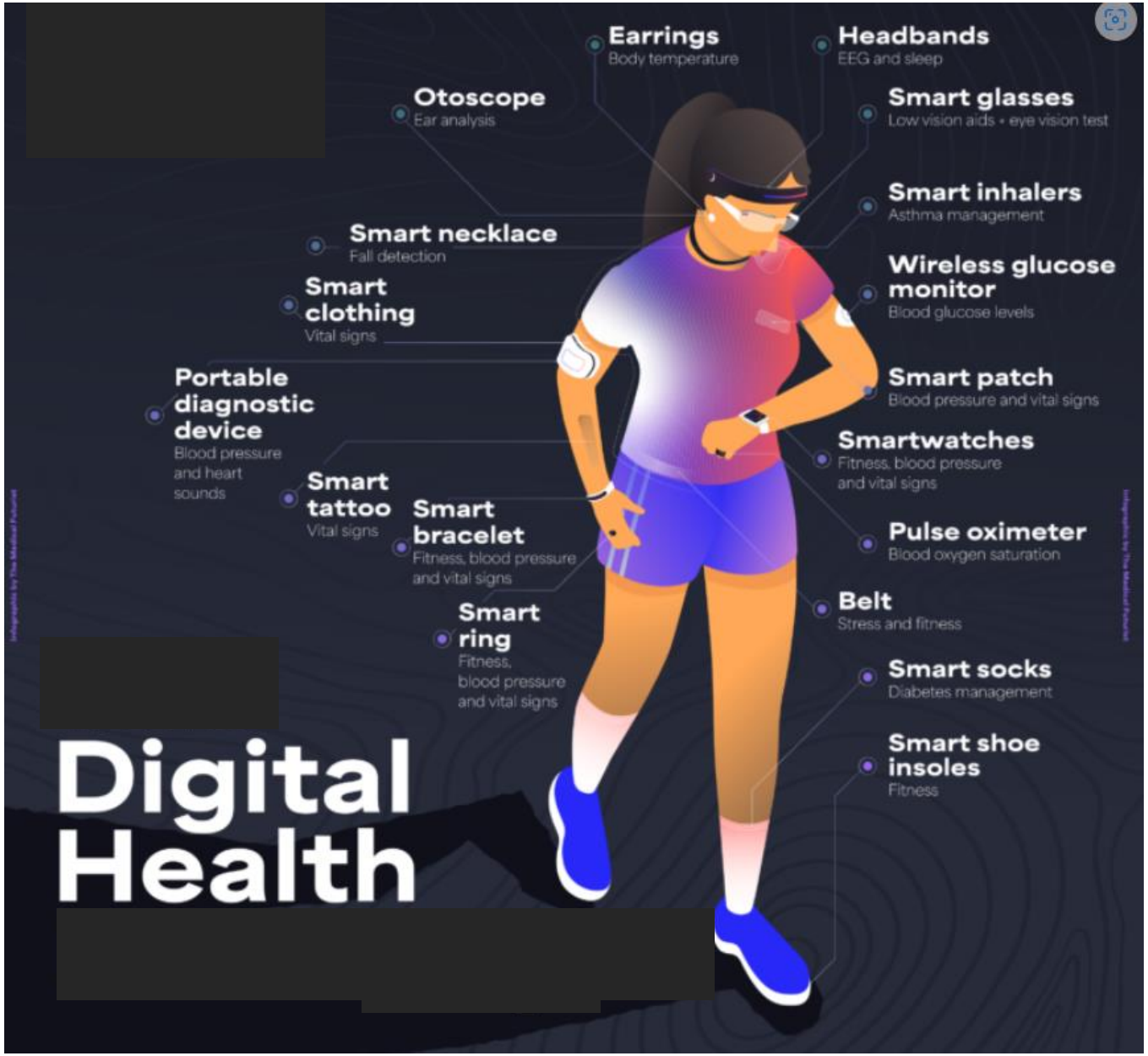




CXR Report of the Future

Your chest x-ray indicates that...

- You may have type 2 diabetes
- Your coronary calcium score is 976
- Your ejection fraction is normal
- Your 10-year cardiovascular risk of a heart attack, stroke, or death from cardiovascular disease is 14.1%


Earrings
Body temperature
Headbands
EEG and sleep
Otoscope
Ear analysis
Smart glasses
Low vision aids + eye vision test
Smart inhalers
Asthma management
Smart necklace
Fall detection
Wireless glucose monitor
Blood glucose levels
Smart clothing
Vital signs
Smart patch
Blood pressure and vital signs
Portable diagnostic device
Blood pressure and heart sounds
Smartwatches
Fitness, blood pressure and vital signs
Smart tattoo
Vital signs
Smart bracelet
Fitness, blood pressure and vital signs
Pulse oximeter
Blood oxygen saturation
Belt
Stress and fitness
Smart ring
Fitness, blood pressure and vital signs
Smart socks
Diabetes management
Smart shoe insoles
Fitness
Digital Health


NEJM AI
CURRENT ISSUE
RECENTLY PUB
THIS ARTICLE IS AVAILABLE TO SUBSCRIBERS. SUBSCRIBE NOW
ALREADY
PERSPECTIVE
Patient Portal — When Patients Take AI into Their Own Hands
Author: Carey Goldberg
Author Info & Affiliations
Published April 19, 2024 | NEJM AI 2024;1(5) | DOI: 10.1056/AIp2400283 | VOL. 1 NO. 5 | Copyright © 2024

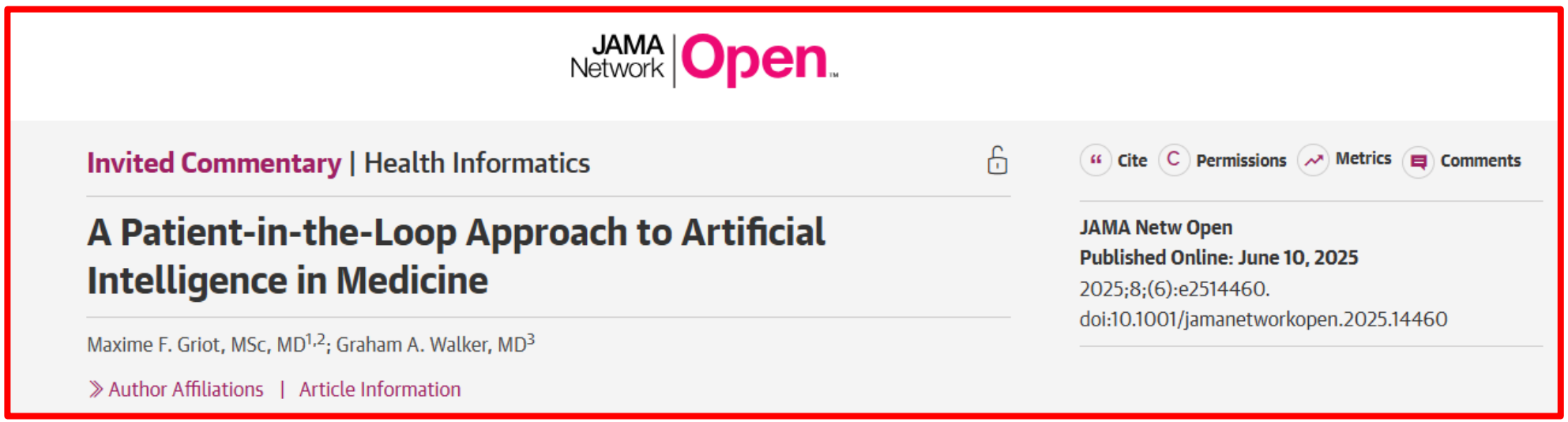
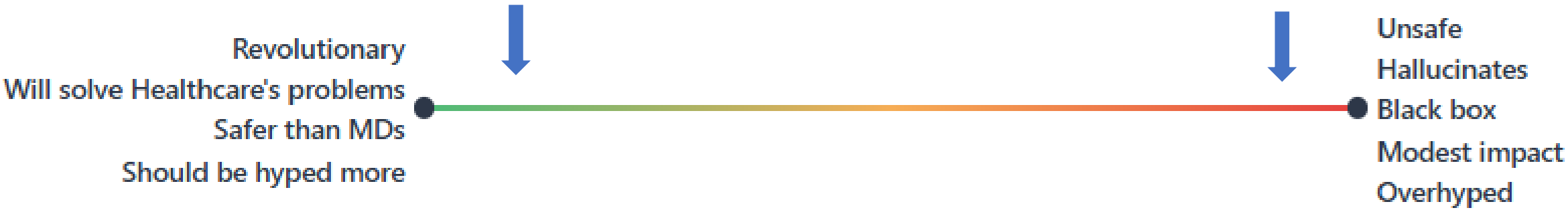

JAMA Network Open
Invited Commentary | Health Informatics
A Patient-in-the-Loop Approach to Artificial Intelligence in Medicine
Maxime F. Griot, MSc, MD[1,2]; Graham A. Walker, MD[3]
Author Affiliations | Article Information
Cite
Permissions
Metrics
Comments
JAMA Netw Open
Published Online: June 10, 2025
2025;8;(6):e2514460.
doi:10.1001/jamanetworkopen.2025.14460

Table 3. Top 5 AI-healthcare impact areas in next 10 years

	Impact Area	Description	Key benefits
1	**Precision Medicine**	Analysis of multimodal data (genetic profile, lifestyle and environment factors)	Individualized treatments, better outcomes
2	**Predictive/Preventive Healthcare**	Analysis of multimodal data to predict risk and disease progression	Targeted prevention, earlier diagnoses, earlier interventions
3	**Cancer care**	Analysis of images, histology, patient and tumour genomes	Personalized treatments; adapted screening; accurate predictions
4	**Biomedical Research**	Analysis of high-dimensional datasets in systems, cell, and structural biology	New foundational knowledge. Drug discovery
5	**Healthcare systems**	Chatbots, personal assistants, Better documentation, patient flow, scheduling, billing	Patient and staff satisfaction; Reduction of inefficiencies, overdiagnosis, overtreatment

Meagher T. *J. Ins. Med*, 2025. In press

AI Line of Enthusiasm



Thank You!

Extra slides

The arrival of large language models (LLM)

JOURNAL OF INSURANCE MEDICINE

J Insur Med 2023;50:000–000

OPINION

ChatGPT: How Closely Should We Be Watching?

Timothy Meagher, MB FRCP(C)

ChatGPT is about to make major inroads into clinical medicine. This article discusses the pros and cons of its use.

Address of Correspondent:
Munich Re, 1000 Rue de la Gauchetière Ouest, 20e étage, Montréal Québec, H3B 4W5; 514-392-5069; tmeagher@munichre.ca

And when…?

2025-2027

NEAR TERM - FOUNDATION

Enhanced Clinical Decision Support

AI assistants become mainstream in clinical workflows, helping with documentation, diagnostic suggestions, and treatment planning. Specialized models for medical imaging reach superhuman performance in specific domains.

KEY DEVELOPMENTS

- AI scribes automate 80%+ of clinical documentation
- FDA approves dozens of AI diagnostic tools for radiology and pathology
- Personalized treatment recommendations for cancer become standard
- AI drug discovery accelerates with first AI-designed drugs entering Phase II trials
- Remote patient monitoring with AI alerts becomes widespread

2027-2030

MID TERM - INTEGRATION

AI-Powered Precision Medicine

Integration of multimodal health data enables truly personalized medicine. AI systems analyze genomics, lifestyle, and environmental factors to predict disease risk and optimize treatments years in advance.

KEY DEVELOPMENTS

- Predictive models identify disease risk 5-10 years before symptoms
- First AI-discovered drugs reach market approval
- Virtual health assistants manage chronic conditions with minimal human oversight
- AI pathology becomes standard of care in developed nations
- Real-time surgical guidance systems with AI achieve widespread adoption
- Mental health AI therapists show efficacy comparable to human therapists for mild-moderate conditions

2030-2035

ADVANCED - TRANSFORMATION

Autonomous Diagnostic Systems

AI systems operate semi-autonomously in many diagnostic and treatment scenarios. Continuous health monitoring through wearables and implants enables proactive intervention before illness manifests.

KEY DEVELOPMENTS

- AI diagnoses most common conditions with >95% accuracy without physician review
- Automated drug discovery reduces development time from 10+ years to 3-5 years
- AI-designed biologics and gene therapies enter mainstream use
- Robot-assisted surgeries with AI planning become majority of procedures
- Digital twins of patients enable testing treatments virtually before administration
- Early cancer detection rates approach 90% through AI screening
- Healthcare costs begin to decline in regions with full AI integration

2035-2040

FUTURE - REVOLUTION

Preventive & Regenerative Medicine

Healthcare shifts from reactive treatment to proactive optimization. AI enables true preventive medicine, catching nearly all diseases in early stages. Regenerative therapies designed by AI restore function to damaged organs.

KEY DEVELOPMENTS

- Most major diseases caught in Stage 0 or preclinical stages
- AI-guided CRISPR therapies cure previously untreatable genetic diseases
- Organ regeneration through AI-designed stem cell therapies
- Fully autonomous robotic surgery for routine procedures
- Brain-computer interfaces enable AI assistance for neurological conditions
- Life expectancy in developed nations increases by 10-15 years
- Personalized vaccines designed by AI within hours of pathogen emergence

Comparison of DeepMind/Arc Institute AI Biology Models

Table 1: Basic Information & Purpose

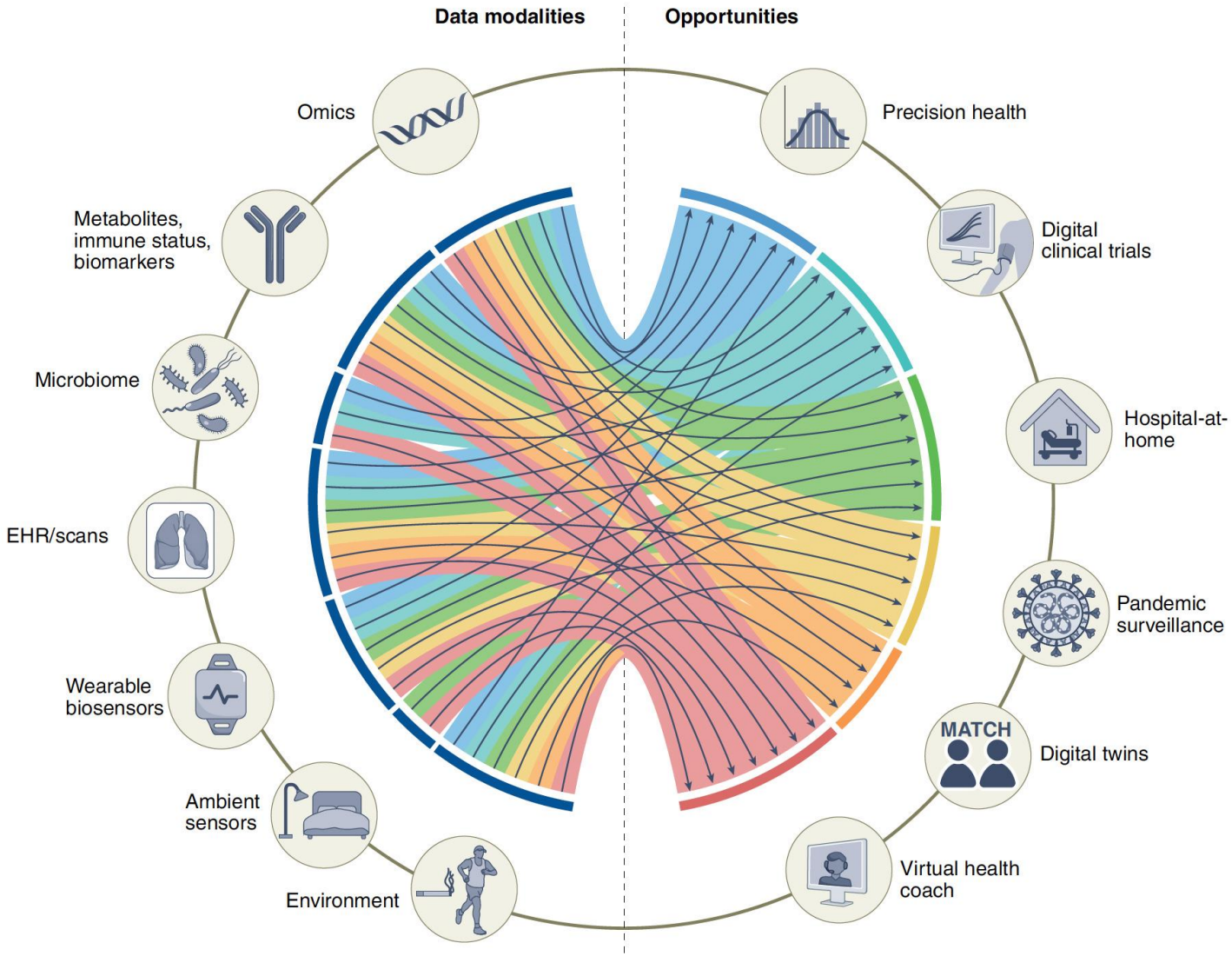
Feature	AlphaFold 2	AlphaFold 3	AlphaMissense	AlphaGenome	Evo
Release Year	2020	2024	2023	2023	2024 (Evo 2: 2025)
Primary Purpose	Protein structure prediction	Biomolecular complex structure prediction	Predict pathogenicity of protein variants	Predict DNA regulatory activity	General-purpose genomic foundation model
Input	Amino acid sequence	Protein, DNA, RNA, ligand sequences	Amino acid sequence with variant position	DNA sequences (up to 1M base pairs)	DNA, RNA, protein sequences
Output	3D protein structure	3D structure of multi-molecular complexes	Pathogenicity score for mutations	Regulatory activity predictions, variant effects	Function predictions, generated sequences
Molecule Types	Proteins only	Proteins, DNA, RNA, small molecules, ligands, ions	Proteins only	DNA only	DNA, RNA, and proteins
Primary Use Case	Understand protein folding	Model biomolecular interactions	Identify disease mutations	Understand gene regulation	Multi-purpose genomics (prediction + generation)

Table 2: Technical Architecture & Capabilities

Feature	AlphaFold 2	AlphaFold 3	AlphaMissense	AlphaGenome	Evo
Key Architecture	Evoformer module	Improved Evoformer + diffusion network	Two-stage: AlphaFold-like structure prediction + pathogenicity training	Transformer-based	7B parameter model with 131kb context length
Training Approach	Supervised learning on known structures	Enhanced supervised + diffusion model	Two-stage: structure then pathogenicity	Supervised on genomic data	Foundation model trained on genomic sequences
Context Length	Single protein	Multi-molecular complex	Single protein variant	Up to 1 million base pairs	131 kilobases at single-nucleotide resolution
Handles Complexes	Single chains (AlphaFold-Multimer for protein-protein)	Yes - multi-molecular complexes including protein-drug	No - single variants only	No - DNA sequence analysis	Yes - multi-modal across molecule types
Post-translational Modifications	Limited	Yes (glycosylation, etc.)	No	N/A	Can predict effects
Zero-shot Capability	Limited	Limited	No - requires structure prediction first	Limited	Yes - generalizes across tasks

Table 3: Applications & Performance

Feature	AlphaFold 2	AlphaFold 3	AlphaMissense	AlphaGenome	Evo
Drug Discovery Applications	Protein target structures	Protein-drug interactions, binding site prediction	Identify disease-causing mutations	Regulatory variant effects	Generate functional proteins, predict variant impacts
Generative Capabilities	No - prediction only	No - prediction only	No - prediction only	No - prediction only	Yes - can generate novel functional sequences
Accuracy Improvement over Predecessor	Revolutionary (~90% accuracy)	Slightly better for proteins, much better for complexes	N/A - new capability	N/A - new capability	State-of-art for long-range predictions



Topol.E Nature Medicine | VOL 28 | September 2022 | 1773–1784