AUGMENTED INTELLIGENCE

AI IN PERINATAL CARE; TAKING BABY STEPS

TIPQC
Tennessee Initiative for Perinatal Quality Care

TIPQC Annual Meeting Agenda
March 24-25, 2025
Franklin, TN

JAMES BARRY MD, MBA

PROFESSOR OF PEDIATRICS, SECTION OF NEONATOLOGY

UNIVERSITY OF COLORADO SCHOOL OF MEDICINE

Children's Hospital Colorado

School of Medicine
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

uchealth

Resources

AIMED: https://ai-med.io

Author: Anthony Chang, MD, MBA, MPH, MS

I am a pediatric cardiologist and have cared for children with heart disease for the past three decades. In addition, I have an educational background in business and finance as well as healthcare administration and global health – I gained a Masters Degree in Public Health from UCLA and taught Global Health there after I completed the program.

American Board of AI in Medicine (ABAIM). Multidisciplinary two-day **introductory** and **advanced courses** with educational certification as well as a one-day **AI primer** for everyone have been ongoing for almost two years.

The **Alliance for Centers of Artificial Intelligence in Medicine (ACAIM)** is a coalition of the centers around the world that have a dedicated leader and team within a health center with a focus on artificial intelligence in all dimensions of medicine and healthcare. We have now a **total** of over 50 centers, including more than 20 AI-focused efforts in pediatric health institutions.

Medical Intelligence Society (MIS). Clinicians and data scientists with interest and passion for AI in clinical medicine and healthcare with **monthly meeting** and **annual summit** in July. (MISociety.org)

Other AI Resources

Books:

1.“Artificial Intelligence: A Modern Approach” by Stuart Russell and Peter Norvig
2.“Deep Learning” by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3.“Artificial Intelligence with Python” by Prateek Joshi

Websites:

1. OpenAI (openai.com)
2. AI Conference (aiconf.org)
3. AI-Forum (ai-forum.org)
4. Stanford Artificial Intelligence Laboratory (ai.stanford.edu)

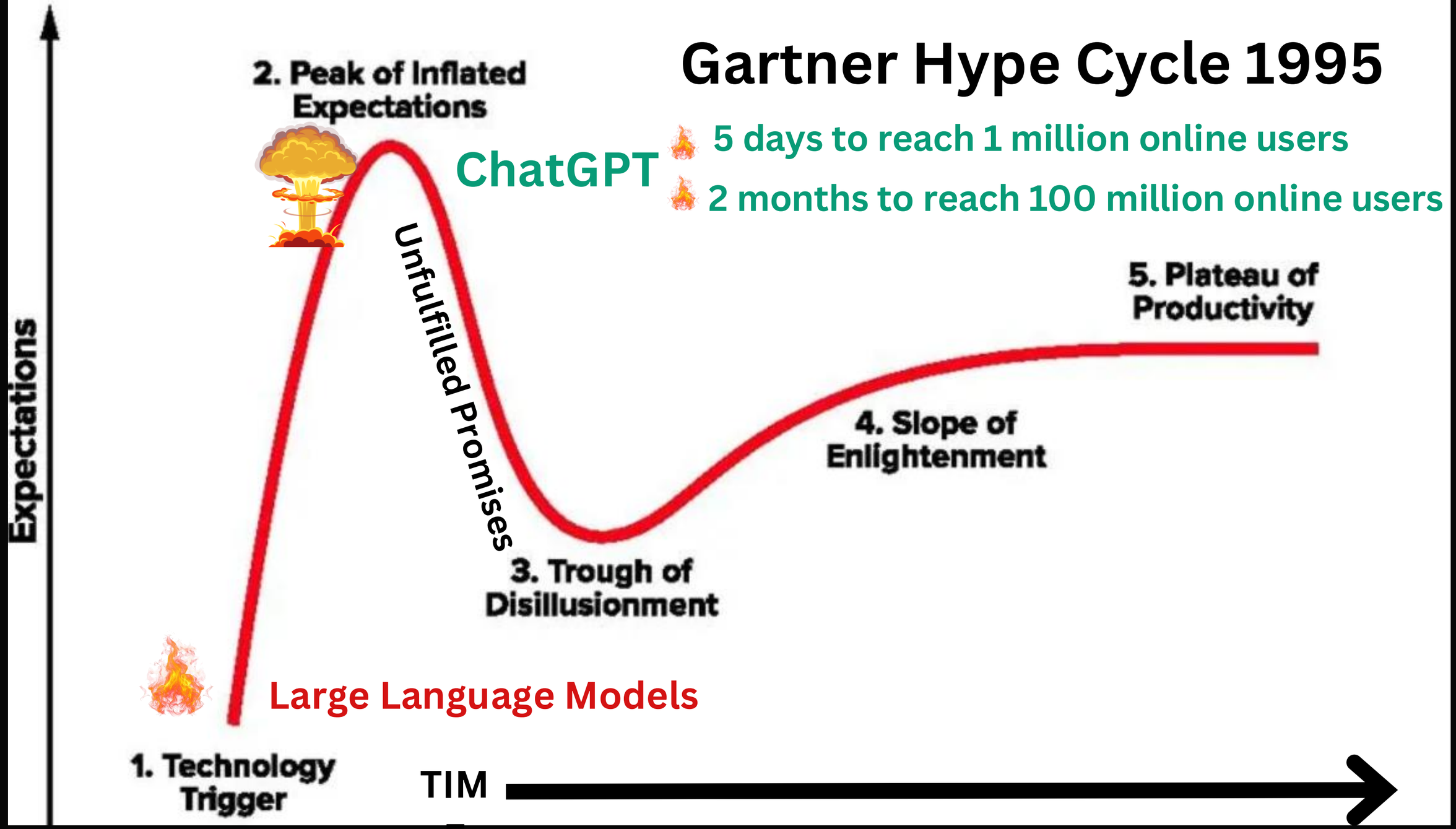
Medical Journals:

1.NEJMAI (https://ai.nejm.org)
2.JAMA+AI (https://jamanetwork.com/channels/ai)

Online Courses:

1.Coursera’s Introduction to Artificial Intelligence (coursera.org/learn/introduction-to-ai)
2.Udacity’s Artificial Intelligence Nanodegree (udacity.com/course/artificial-intelligence-nanodegree–nd898)
3.edX’s Artificial Intelligence Fundamentals (edx.org/learn/artificial-intelligence)

Gartner Hype Cycle 1995



Remove Some of These Thoughts from My/Our Minds about AI:

CAN’T

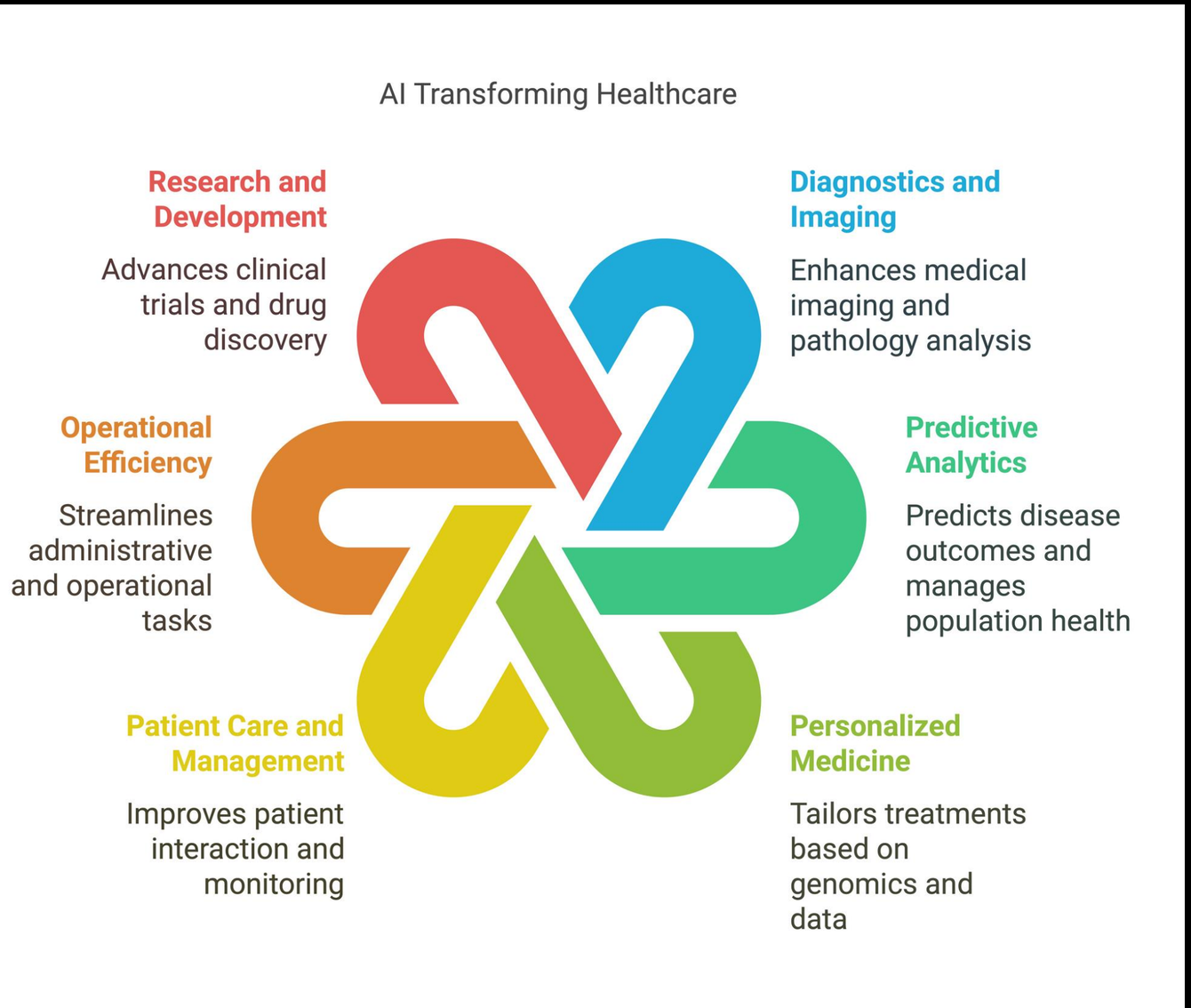
WON’T

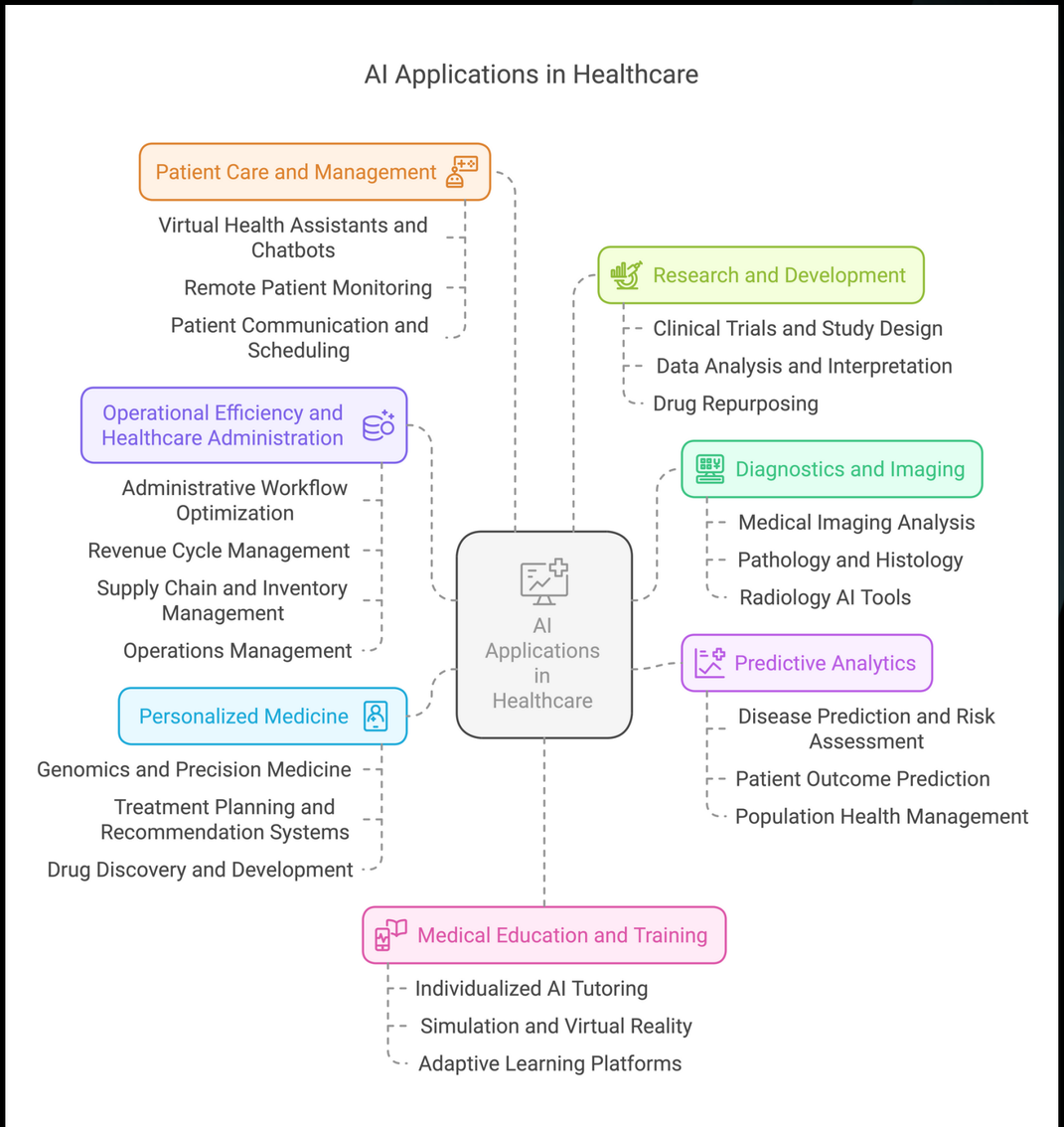
SHOULDN’T

COULDN’T

The Age of AI is Here

AI and Healthcare



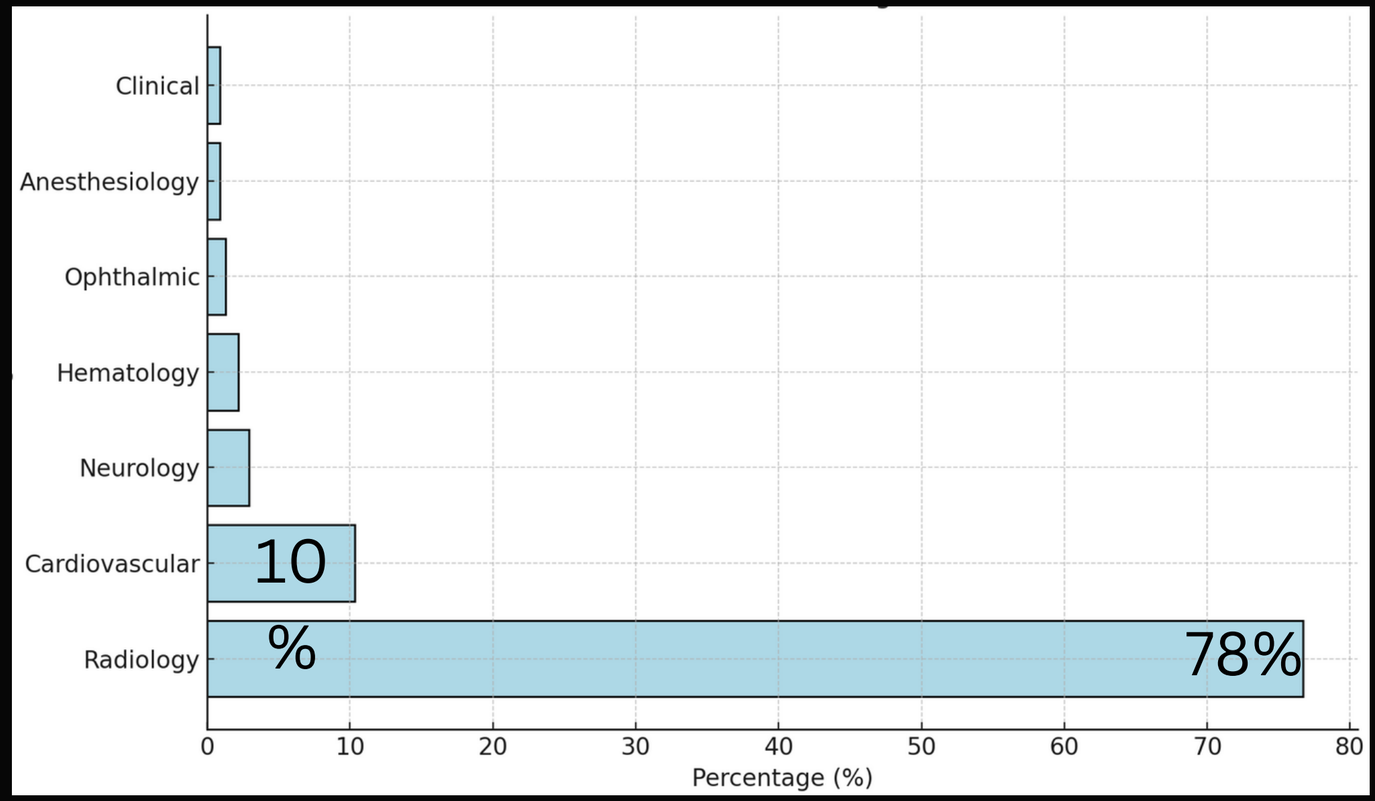


950 FDA Approved AI-enabled devices

As of August 2024 (529 in October 2022, 80% increase)

https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices

10
%

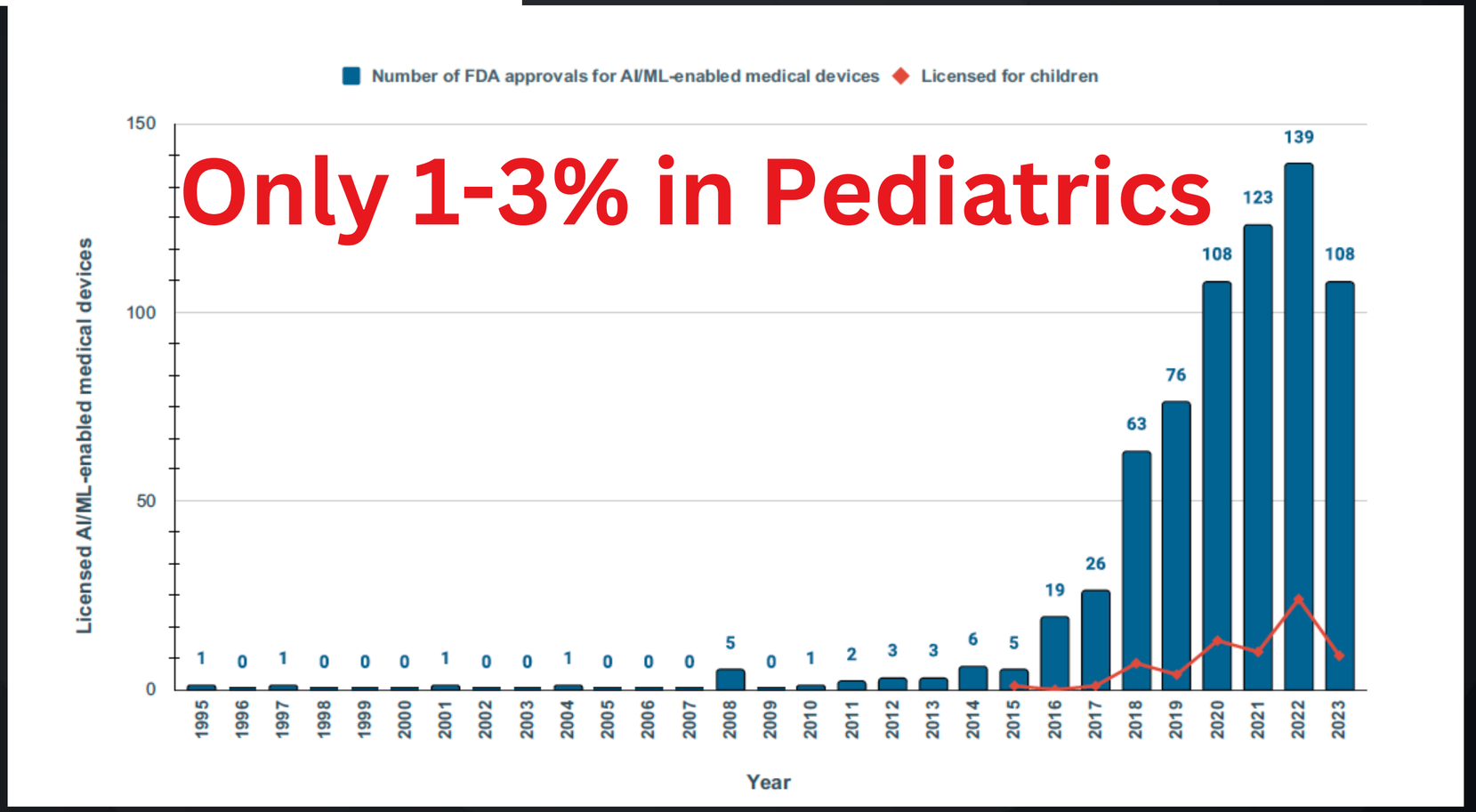


FDA APPROVED AI-ENABLED DEVICES

A scoping review of reporting gaps in FDA-approved AI medical devices

npj Digital Medicine | (2024)7:273

Vijaytha Muralidharan[1,13] ✉, Boluwatife Adeleye Adewale[2,3,13], Caroline J. Huang[4], Mfon Thelma Nta[5], Peter Oluwaduyilemi Ademiju[6], Pirunthan Pathmarajah[1], Man Kien Hang[7,8], Oluwafolajimi Adesanya[9], Ridwanullah Olamide Abdullateef[10,11], Abdulhammed Opeyemi Babatunde[10], Abdulquddus Ajibade[10], Sonia Onyeka[1], Zhou Ran Cai[1], Roxana Daneshjou[1,12,14] & Tobi Olatunji[6,14]



FDA APPROVED DEVICES AND BIAS

A scoping review of reporting gaps in FDA-approved AI medical devices

npj Digital Medicine | (2024)7:273

Vijaytha Muralidharan[1,13] ✉, Boluwatife Adeleye Adewale[2,3,13], Caroline J. Huang[4], Mfon Thelma Nta[5], Peter Oluwaduyilemi Ademiju[6], Pirunthan Pathmarajah[1], Man Kien Hang[7,8], Oluwafolajimi Adesanya[9], Ridwanullah Olamide Abdullateef[10,11], Abdulhammed Opeyemi Babatunde[10], Abdulquddus Ajibade[10], Sonia Onyeka[1], Zhou Ran Cai[1], Roxana Daneshjou[1,12,14] & Tobi Olatunji[6,14]

Year	Number of FDA approvals for AI/ML-enabled medical devices	Licensed for children (percentage relative to total FDA approvals %)
2015	5	1 (20.0)
2016	19	0 (0.0)
2017	26	1 (3.8)
2018	63	7 (11.1)
2019	76	4 (5.3)
2020	108	13 (12.0)
2021	123	10 (8.1)
2022	139	24 (17.3)
2023	108	9 (8.3)

-<1% of models provide socioeconomic data on studied populations

-Only 63% report on sample size for studies used to gain FDA approval

-Only 21% report risk to potential users

-Only 2% provide documentation on their safety and effectiveness

FDA APPROVED DEVICES AND CHILDREN

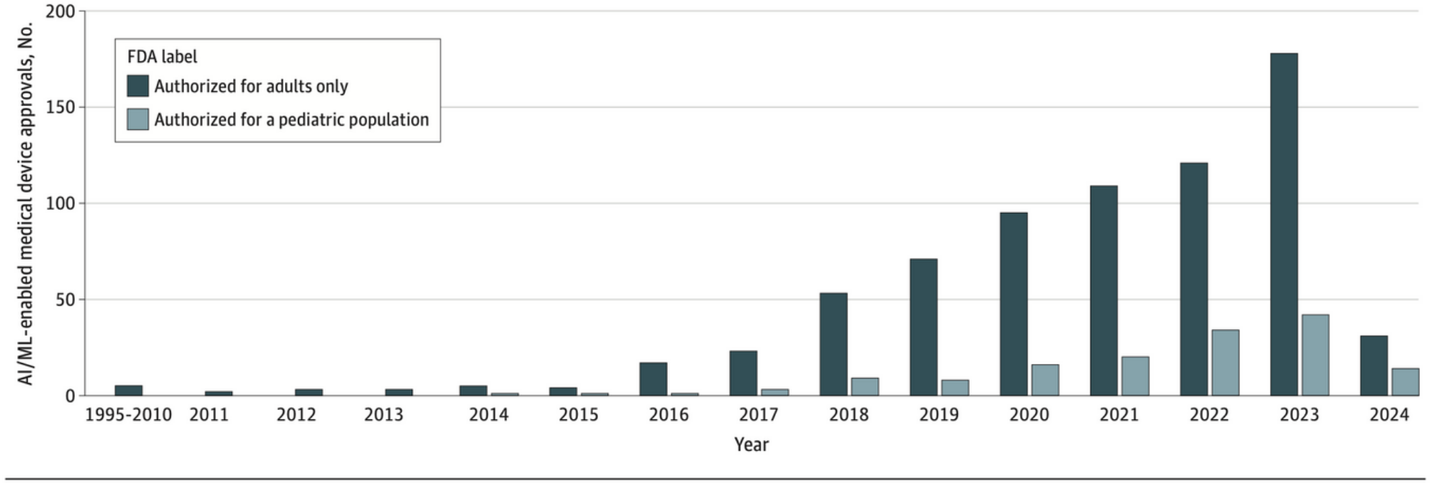
ARTIFICIAL INTELLIGENCE AND PEDIATRIC CARE

US FDA Approval of Pediatric Artificial Intelligence and Machine Learning–Enabled Medical Devices

JAMA Pediatrics Published online December 16, 2024

Ryan C. L. Brewster, MD
Matthew Nagy, MD, MPH
Susmitha Wunnava, PhD
Florence T. Bourgeois, MD, MPH

Figure. Trends in Annual US Food and Drug Administration (FDA) Authorization of Artificial Intelligence/Machine Learning (AI/ML)-Enabled Medical Devices



-Among devices labeled for pediatric patients, few device manufacturers disclosed information in regulatory documents on whether algorithm validation was performed in pediatric cohorts and **only 18.7% explicitly described validation using datasets that included children**.

Current FDA Approved AI-Enabled Devices, CMS reimburses with authorized AI-related CPT codes

Table 1. Selected AI devices that are reimbursed by US Medicare.

Manufacturer	Technology	Description	Payment mechanism	Year reimbursement granted
Digital diagnostics	IDX-DR	Deep learning algorithm to diagnose diabetic retinopathy from fundoscopic images in the outpatient setting	CPT	2020
viz.ai	Viz LVO	Radiological computer-assisted triage and notification software that analyzes CT images of the brain and notifies hospital staff when a suspected large-vessel occlusion (LVO) is identified	NTAP	2020
Rapid AI	Rapid LVO	AI-guided medical imaging acquisition system intended to assist medical professionals in the acquisition of cardiac ultrasound images.	NTAP	2020
Caption health	Caption guidance		NTAP	2021
viz.ai	Viz SDH	Radiological computer-assisted triage and notification software that analyzes CT images of the brain and notifies hospital staff when a suspected subdural hematoma is identified	NTAP	2022 (candidate)
Rapid AI	Rapid aspects	Computer-aided diagnostic device characterizing brain tissue abnormalities on brain CT images	NTAP	2022 (candidate)
AIDoc	Briefcase for PE	Radiological computer-assisted triage and notification software that analyzes CT images of the chest and notifies hospital staff when a suspected pulmonary embolism is identified	NTAP	2022 (candidate)
PROCEPT BioRobotics Corporation	The AQUABEAM system	Autonomous tissue removal robot for the treatment of lower urinary tract symptoms due to benign prostatic hyperplasia (BPH).	NTAP	2020

YOU CAN GET PAID FOR USING AI!!!

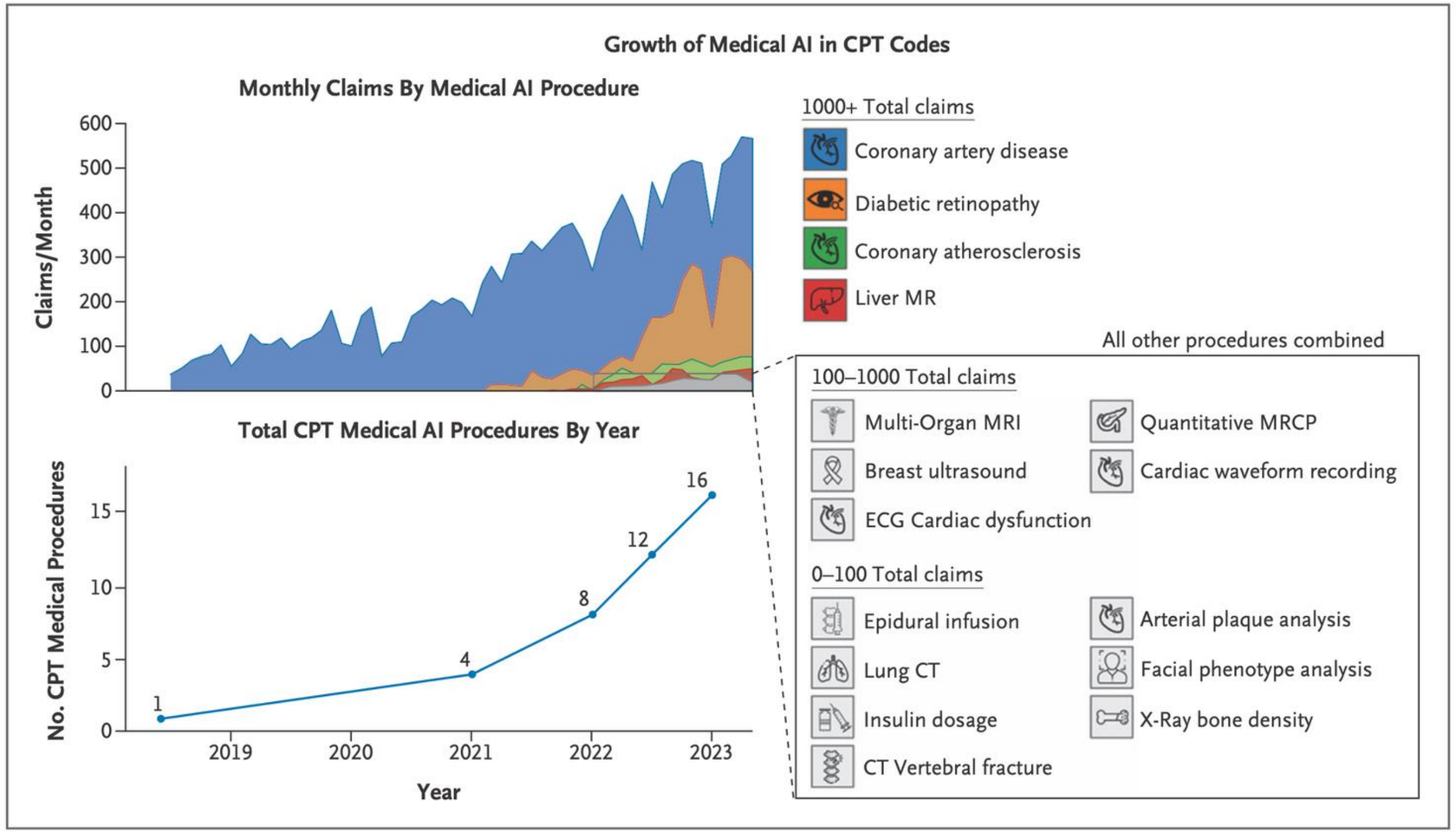
From Parikh RB, *Nature* 2022 5:63

Exponential Increase in AI-related CPT Code Use

Characterizing the Clinical Adoption of Medical AI Devices through U.S. Insurance Claims

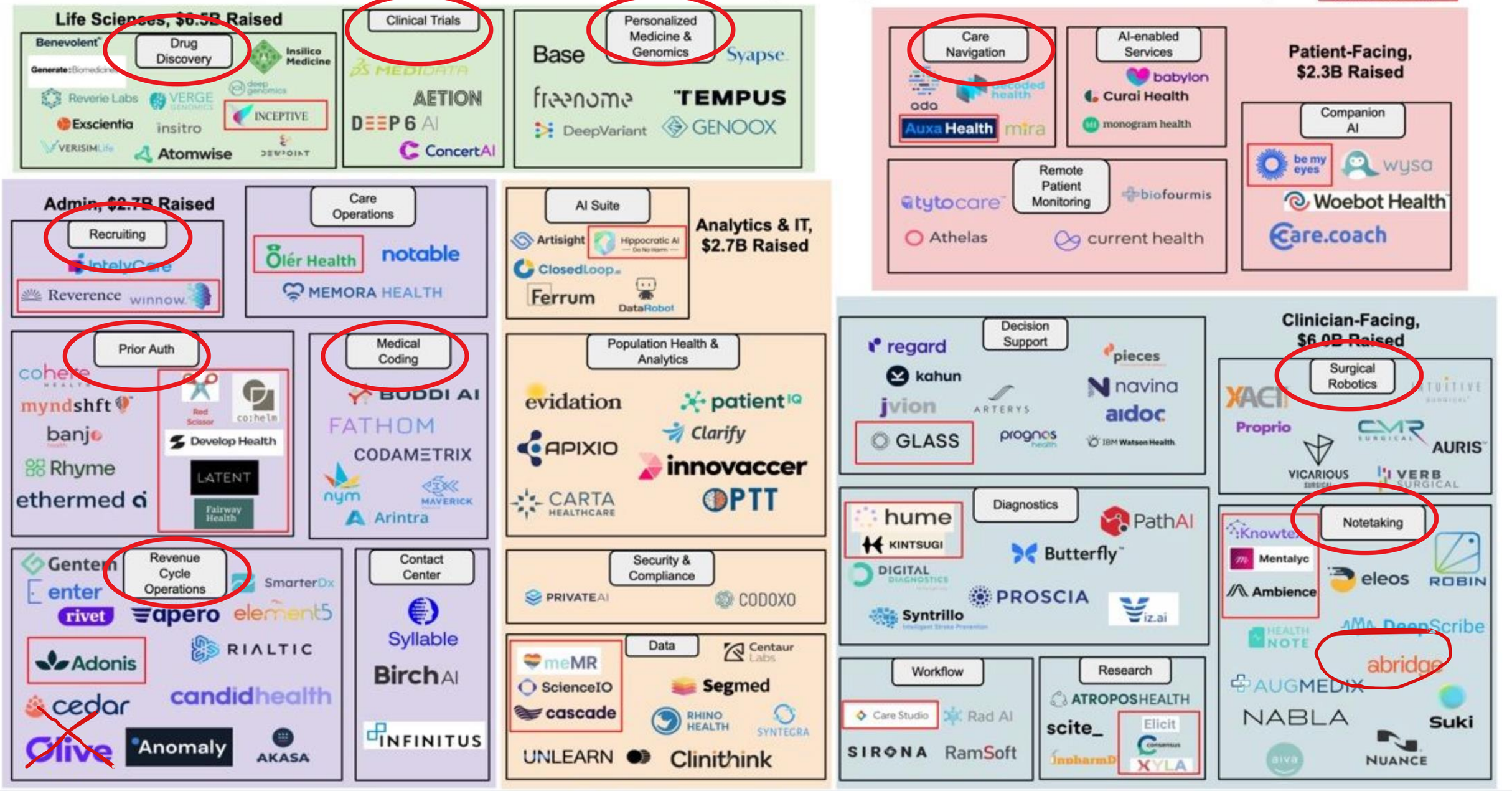
Kevin Wu, M.S.,[1] Eric Wu, M.S.,[2] Brandon Theodorou,[3] Weixin Liang, M.S.,[4] Christina Mack, Ph.D.,[5] Lucas Glass, Ph.D.,[5] Jimeng Sun, Ph.D.,[3,6] and James Zou, Ph.D.[1,2,4]

NEJM AI 2023; 1 (1)
DOI: 10.1056/AIoa2300030



Where Generative AI Meets Healthcare: Updating The Healthcare AI Landscape

red box = launched product after 2020



https://aicheckup.substack.com/p/where-generative-ai-meets-healthcare, Norden J et al.

June

https://theconversation.com/ai-was-central-to-two-of-2024s-nobel-prize-categories-its-a-sign-of-things-to-come-240954

Geoffrey Hinton and **John Hopfield** won the **Nobel Prize in Physics** for their work that provided the foundation of artificial neural networks which are the building blocks of today's AI revolution

Demis Hassabis, co-founder and CEO of Google DeepMind, and **John Jumper**, won the **Nobel Prize in Chemistry** for their work on protein structure prediction.

Accurate structure prediction of biomolecular interactions with AlphaFold 3

Nature | Vol 630 | 13 June 2024 | 493

https://doi.org/10.1038/s41586-024-07487-w

Received: 19 December 2023

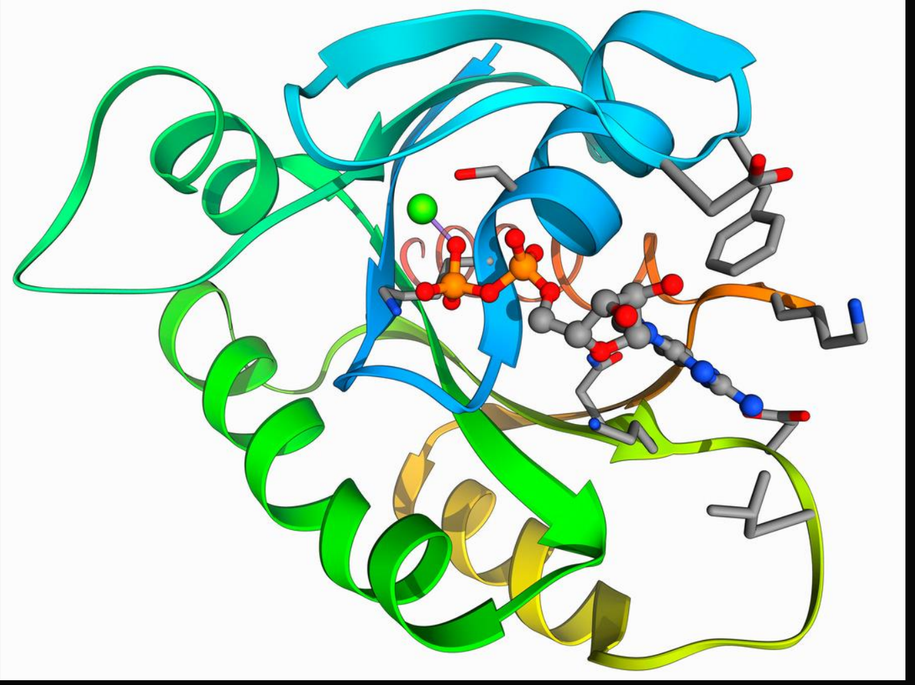
Accepted: 29 April 2024

Published online: 8 May 2024

Open access

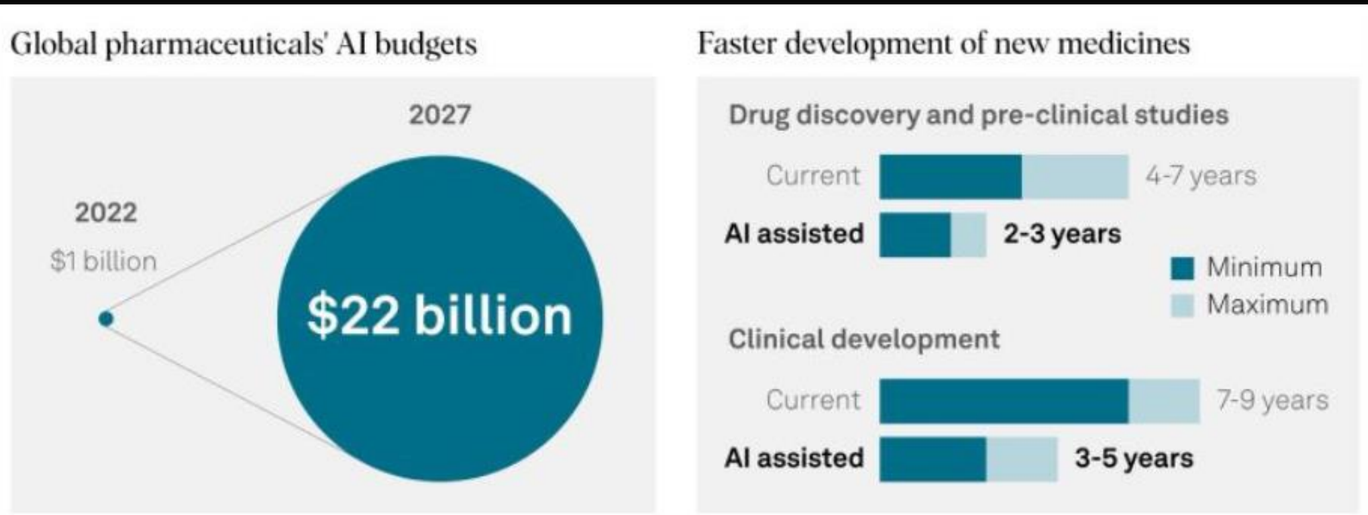
Check for updates

Josh Abramson[1,7], Jonas Adler[1,7], Jack Dunger[1,7], Richard Evans[1,7], Tim Green[1,7], Alexander Pritzel[1,7], Olaf Ronneberger[1,7], Lindsay Willmore[1,7], Andrew J. Ballard[1], Joshua Bambrick[2], Sebastian W. Bodenstein[1], David A. Evans[1], Chia-Chun Hung[2], Michael O'Neill[1], David Reiman[1], Kathryn Tunyasuvunakool[1], Zachary Wu[1], Akvilė Žemgulytė[1], Eirini Arvaniti[3], Charles Beattie[3], Ottavia Bertolli[3], Alex Bridgland[3], Alexey Cherepanov[4], Miles Congreve[4], Alexander I. Cowen-Rivers[3], Andrew Cowie[3], Michael Figurnov[3], Fabian B. Fuchs[3], Hannah Gladman[3], Rishub Jain[3], Yousuf A. Khan[3,5], Caroline M. R. Low[4], Kuba Perlin[3], Anna Potapenko[3], Pascal Savy[4], Sukhdeep Singh[3], Adrian Stecula[4], Ashok Thillaisundaram[3], Catherine Tong[4], Sergei Yakneen[4], Ellen D. Zhong[3,6], Michal Zielinski[3], Augustin Žídek[3], Victor Bapst[1,8], Pushmeet Kohli[1,8], Max Jaderberg[2,8]✉, Demis Hassabis[1,2,8]✉ & John M. Jumper[1,8]✉



Alphafold 3-AI system that excels at **predicting the 3D structure of proteins** based on their amino acid sequence **and function at a molecular level**, **paving the way for more targeted drug design and development by identifying potential binding sites and mechanisms of disease-causing proteins.**

AI and the Pharmaceutical Industry



https://www.spglobal.com/ratings/en/research/articles/241001-ai-in-pharmaceuticals-promises-innovation-speed-and-savings-13254002

Ihsane Mesrar, October 1, 2024

Company	AI-technology provider	What they are doing
AstraZeneca	BenevolentAI	Target identification optimization using AstraZeneca's proprietary data.
Lilly	CytoReason	Development of disease models and creation of high-resolution models.
GSK	Insilico Medicine	Identification of novel biological targets and pathways.
MERCK	BenevolentAI and Exscientia	Development of small molecule drug candidates for pre-clinical and clinical trials.
novo nordisk	Valo Health Inc.	Discovery and development of drug candidates and prediction of compound safety. Includes access to real-world patient data, AI-enabled small molecule discovery, and human tissue modelling for cardiometabolic diseases.
Pfizer	Genetic Leap	Development of RNA genetic drug candidates.
sanofi	Aqemia	Discovery of small-molecule drug candidates through modelling of molecular interactions.

DIGITAL TWINS AND CLINICAL TRIALS

Generative artificial intelligence empowers digital twins in drug discovery and clinical trials

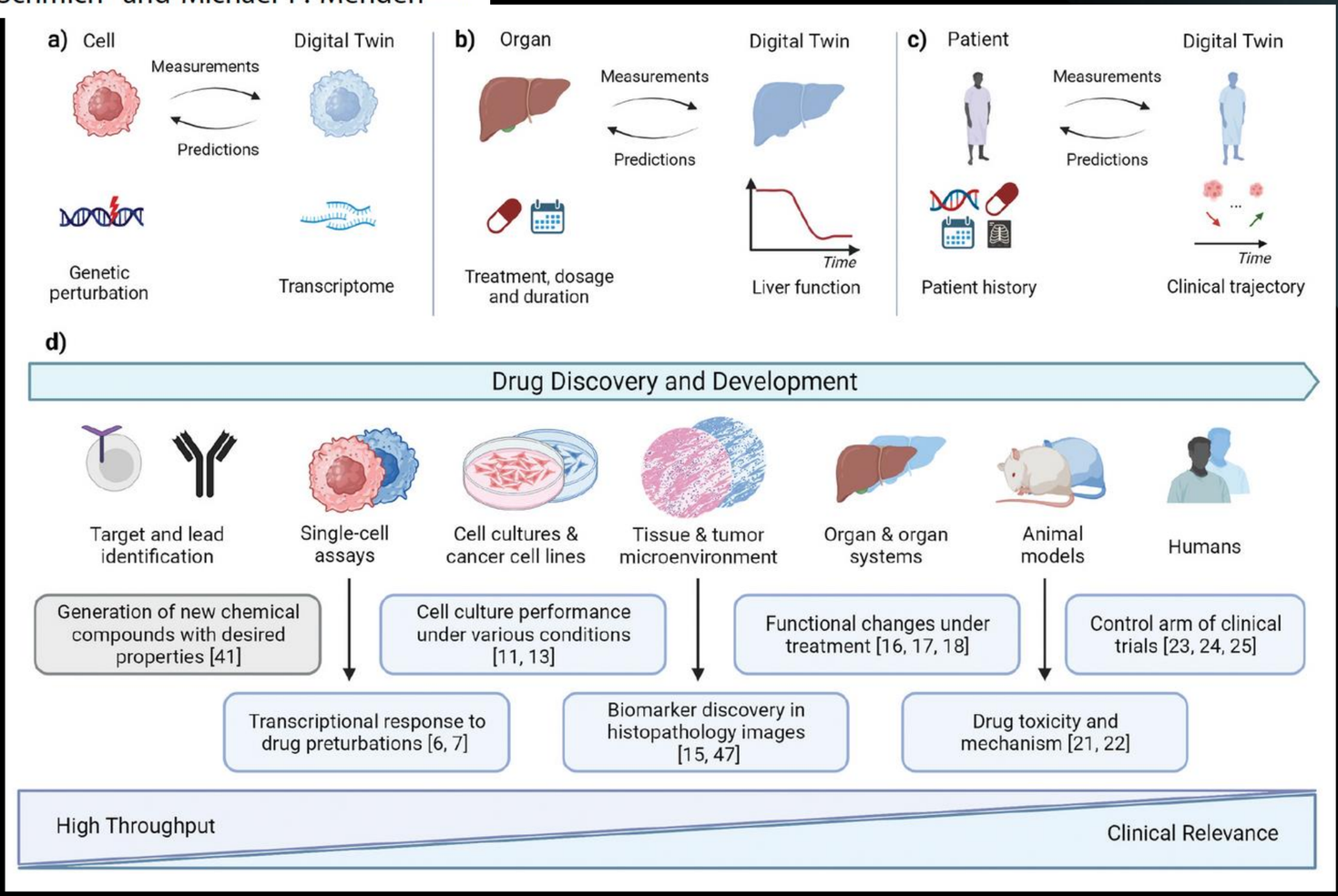
EXPERT OPINION ON DRUG DISCOVERY
2024, VOL. 19, NO. 1, 33–42

Maria Bordukova[a,b,c*], Nikita Makarov[a,b,c*], Raul Rodriguez-Esteban[d], Fabian Schmich[a] and Michael P. Menden[b,c,e,f]

-Around 80% of all clinical trials are delayed due to pt enrollment

-1/10 (10%) of compounds in clinical trials will achieve regulatory approval== $$$ loss

-As of March 2023, at least 14 drugs fully generated by AI have entered clinical trials



“In Silico” Drug Development

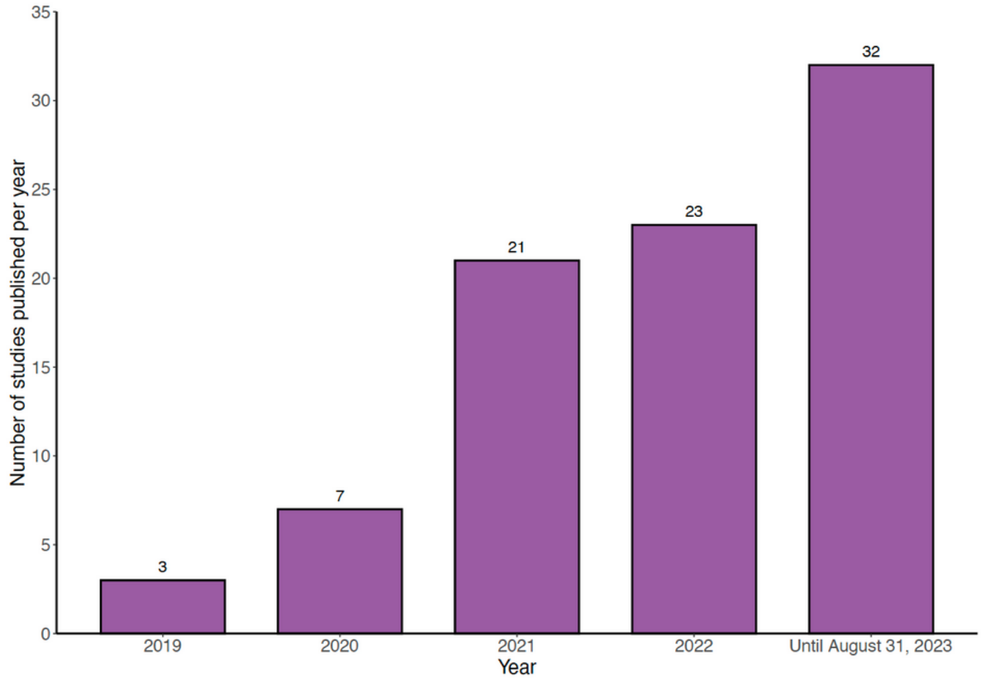
DIGITAL TWINS AND RESEARCH

Definitions and Characteristics of Patient Digital Twins Being Developed for Clinical Use: Scoping Review

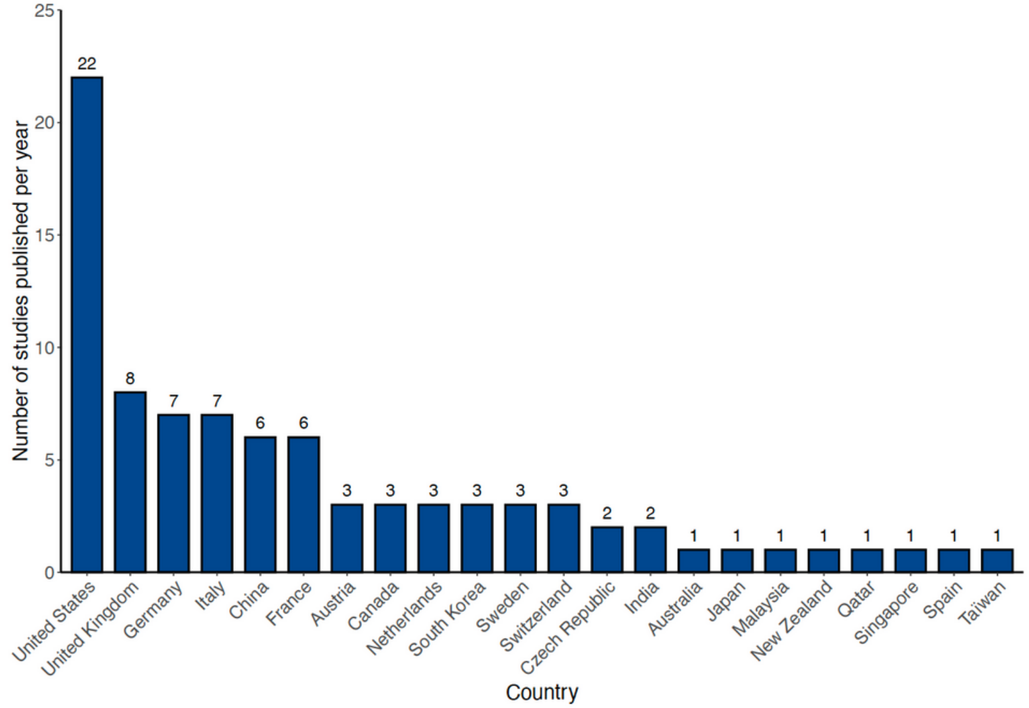
J Med Internet Res 2024 | vol. 26 | e58504 | p. 1

David Drummond[1,2,3,4], MD, PhD; Apolline Gonsard[3], MD

Number of studies claiming to be developing or to have developed/evaluated a patient digital twin published per year.



Geographic distribution of studies claiming to be developing or to have developed/evaluated a patient digital twin.



Digital Twin Investigation Increasing Significantly

PT ENROLLMENT IN CLINICAL TRIALS

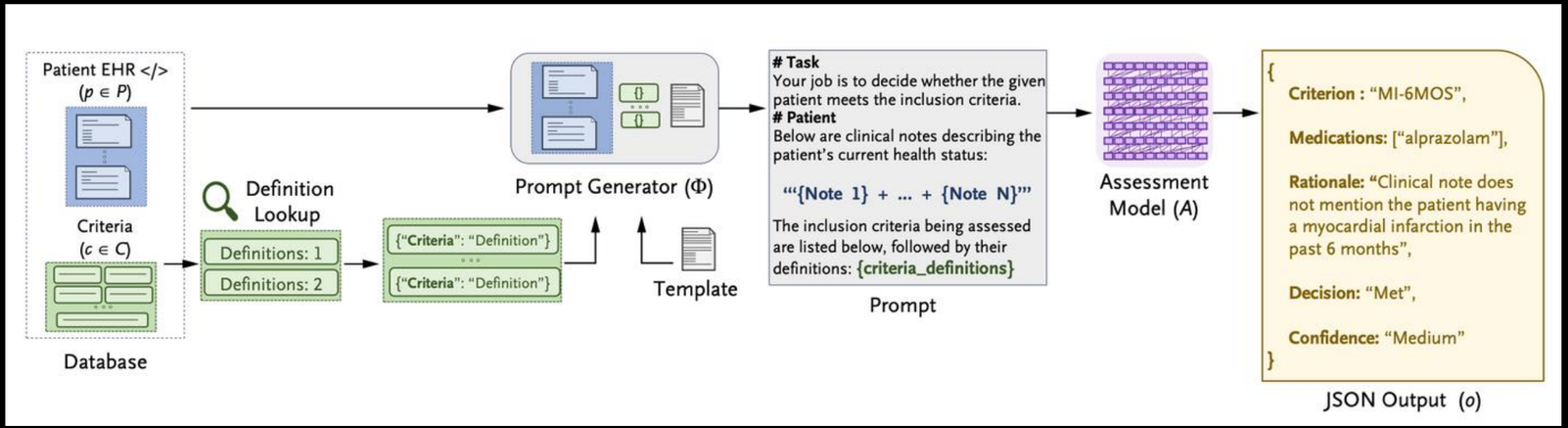
Zero-Shot Clinical Trial Patient Matching with LLMs

Michael Wornow, B.A.,[1] Alejandro Lozano, B.A.,[1] Dev Dash, M.D.,[1] Jenelle Jindal, M.D.,[1] Kenneth W. Mahaffey, M.D.,[1] and Nigam H. Shah, Ph.D.[1]

NEJM AI 2025;2(1)
DOI: 10.1056/AIcs2400360

-Around 80% of all clinical trials are delayed due to pt enrollment

-1 in 3 clinical trials fail due to pt enrollment



-designed a zero-shot large language model (LLM)–based system that evaluates a patient's medical history (as unstructured clinical text) against trial inclusion criteria (also specified as free text)- 97% correct enrollment decision, less time/$

EPIC Annual User Meeting Sept 2024

Highlighted more than 100 applications for AI for their EHR model

1. Evaluate Medical Necessity Criteria Automatically	Epic Gen AI Projects 2024 and Patient Care Improvement
2. CDI Nudges for Physicians	Automating the evaluation of medical necessity can significantly reduce unnecessary procedures, leading to more appropriate care and reducing patient harm.
3. Auto-calculate Wound Measurements from Images	Providing clinical documentation improvement (CDI) nudges can ensure more accurate documentation, leading to better patient care and more precise coding for treatment decisions.
4. Extract Cancer Staging Data from Notes Using Large Language Models	Accurate wound measurements are critical for proper treatment and healing. Automating this process can reduce human error and improve wound care management.
5. Summarize Health and Social Data for Transitional Care Management Handoffs	Accurate staging is vital for determining treatment plans in oncology. Automating this extraction can lead to more timely and accurate treatment decisions.
6. Extract Phenotypes as Human Phenotype Ontology Codes from Notes	Ensuring smooth transitions between care settings is critical for patient safety. Summarizing relevant data can reduce errors during these transitions.
7. Error Log and Documentation Search in Bridges	Accurate phenotype extraction can improve personalized care and reduce the risk of incorrect treatment plans.
8. AI Text Assistant	Identifying and analyzing errors in real-time can significantly improve patient safety by preventing recurring mistakes.

EPIC Annual User Group Meeting

Highlighted at least 100 projects for AI for their EHR model

9. Summarize Recent Events for Call Centers	Assisting healthcare providers with real-time information and documentation can reduce cognitive load, leading to fewer errors.
10. Patient Message Urgency Detection	Keeping call center staff informed of recent events can improve patient communication and prevent misunderstandings.
11. Auto-index Patient Documents	Automatically detecting the urgency of patient messages can ensure that critical issues are addressed promptly, improving patient outcomes.
12. Forage and Summarize Patient Messages	Efficient document indexing can make relevant patient information more accessible, improving decision-making and care coordination.
13. Transplant Episode Summary for Committee Review Meetings	Summarizing patient messages can help healthcare providers prioritize and address concerns more effectively, improving patient satisfaction and safety.
14. Enable Transplant Data Models in Sidekick	Automating transplant summaries can improve decision-making in transplant cases, potentially leading to better patient outcomes.
15. Discharge Insights from Notes	Data models can help predict transplant success and complications, leading to more informed decisions and safer patient care.
16. Draft Denial Appeals and Clinical Summaries	Summarizing discharge insights can help ensure that patients leave the hospital with a clear understanding of their care plan, reducing readmissions and complications.
17. Pre-visit CDI Coding for Risk Adjustment	Automating denial appeals can streamline the process, ensuring patients receive the care they need without delay.
18. Draft Results Comments Using Art	Accurate pre-visit coding can ensure that patients are appropriately triaged and that care plans reflect their true risk profile.
19. Auto-collect Clinical Documentation for Prior Authorization	Automating the drafting of comments on results can improve communication with patients, though its direct impact on safety is less than other projects.

AI in Pediatric Healthcare, Slow But Not Absent

Children's Hospital LOS ANGELES

Within four months, the robots made more than 2,500 deliveries and traveled 132 miles, **saving staff 1,620 hours of time.**

Children's NEBRASKA

12% increase in overall surgical volumes, a 7% increase in primetime utilization of operating rooms.

UPMC | CHILDREN'S HOSPITAL OF PITTSBURGH

diagnose ear infections; now has **93% accuracy, compared to 30% to 84%** (range due to difficulty in diagnosis) accuracy for clinicians.

AI in Children's Hospitals

Error detection and alerting at Boston Children's using an LLM connected via API with Swirl AI tech.

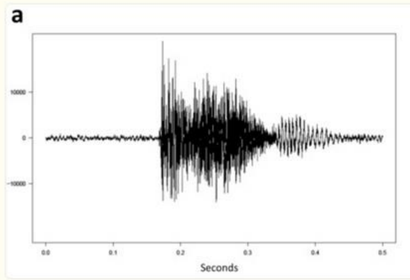
UCSF Benioff Children's Hospitals

mobile app + AI; analyzing coughs and cough patterns--acoustic epidemiology

Making cough count in tuberculosis care ▸ Commun Med (Lond). 2022 Jul 6;2:83.

Alexandra J Zimmer [1,2], César Ugarte-Gil [3,4], Rahul Pathri [5], Puneet Dewan [6], Devan Jaganath [7,8], Adithya Cattamanchi [7,8], Madhukar Pai [1,2], Simon Grandjean Lapierre [2,9,10,✉]

Fig. 1. Digital cough spectrograms for artificial intelligence algorithm analysis.

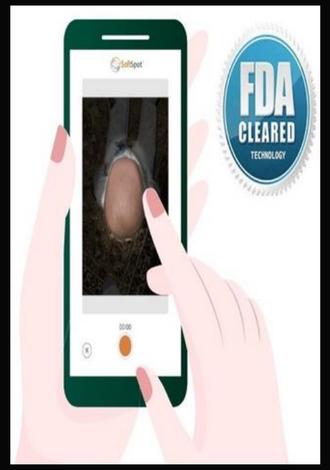


Mobile App + AI; Children's National Hospital assesses a patient's face for specific features associated with genetic disorders.

AI in Pediatric Healthcare, Slow But Not Absent

Image Analysis

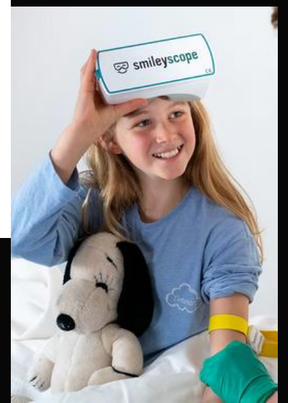
PEDIAMETRIX



SoftSpot™: The first and only mobile app cleared by the FDA for Cranial Measurements

Virtual Reality

smileyscope™
reimagine healthcare



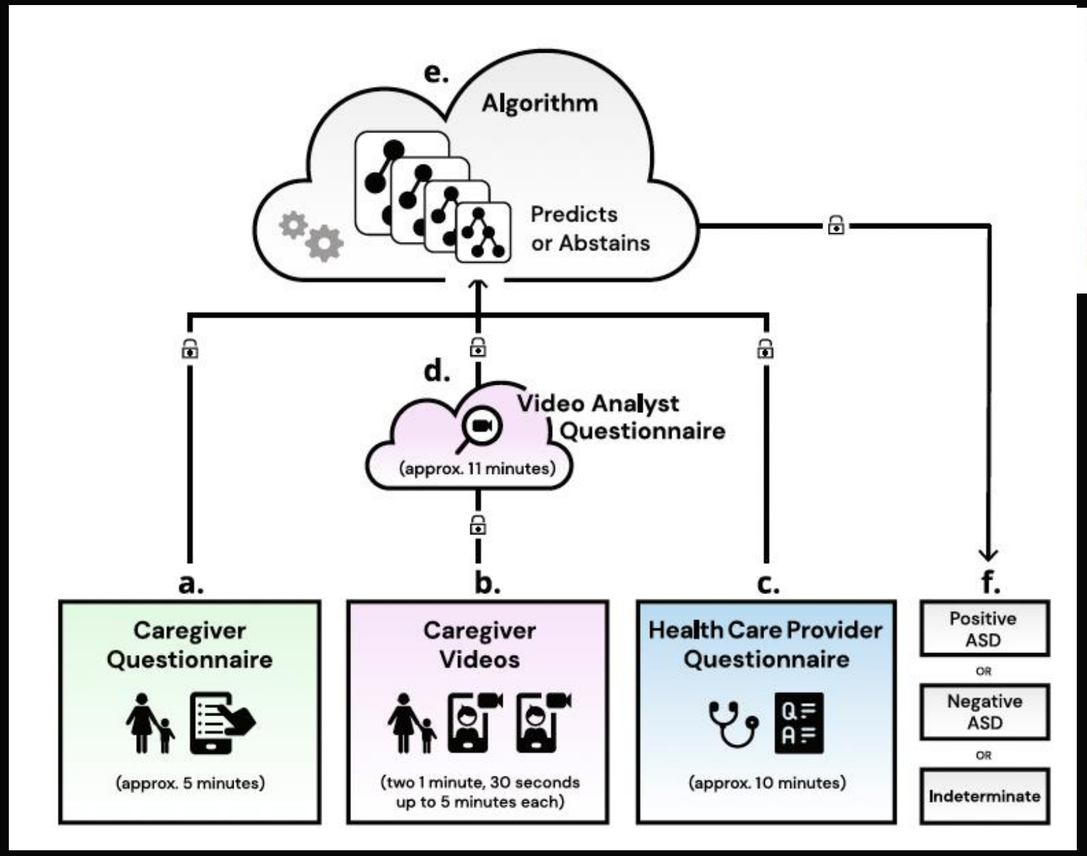
Smileyscope pioneered and patented a powerful new approach to digital therapeutics – virtual reality neuromodulation.

Smileyscope's innovative therapeutic platform underwent rigorous clinical studies, and has changed pediatric needle practice worldwide. International vascular access guidelines now recommend Smileyscope.

Virtual reality neuromodulation is now improving outcomes from burns dressings to medical imaging. Read on to see how we enhance needle experiences.

Pediatric Neurodevelopment

Autism Spectrum Disorder Detection



Evaluation of an artificial intelligence-based medical device for diagnosis of autism spectrum disorder

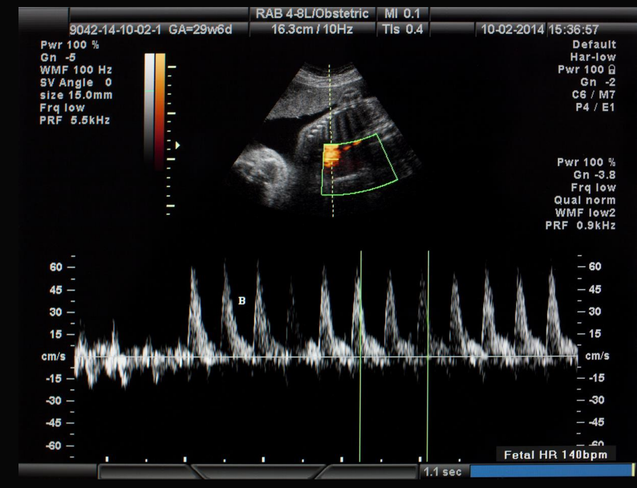
Jonathan T. Megerian[1,2], Sangeeta Dey[3,4], Raun D. Melmed[5], Daniel L. Coury[6,7], Marc Lerner[1,2], Christopher J. Nicholls[8,9], Kristin Sohl[10], Rambod Rouhbakhsh[11,12], Anandhi Narasimhan[13], Jonathan Romain[1,2], Sailaja Golla[14], Safiullah Shareef[15], Andrey Ostrovsky[16,17], Jennifer Shannon[18], Colleen Kraft[18], Stuart Liu-Mayo[18], Halim Abbas[18], Diana E. Gal-Szabo[18], Dennis P. Wall[18,19] and Sharief Taraman[1,2,18,20]✉

npj Digital Medicine (2022)5:57 ; https://doi.org/10.1038/

FDA APPROVED

PPV-81%
NPV-98%

Perinatal Care



Prospective Applications of Artificial Intelligence In Fetal Medicine: A Scoping Review of Recent Updates

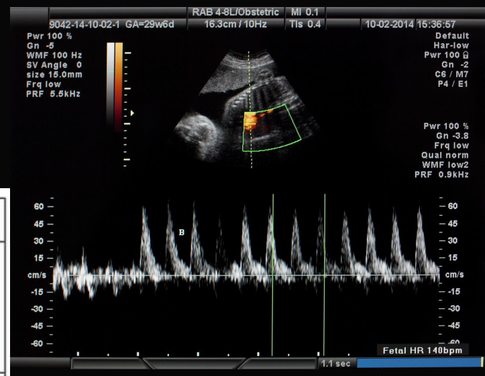
Elhadi Miskeen[1], Jaber Alfaifi[2], Dalal Mohammed Alhuian[3], Mushabab Alghamdi[4],

International Journal of General Medicine 2025:18 237–245

-AI has shown success in detecting congenital heart defects (CHDs) and neural tube defects (NTDs) with greater accuracy than traditional methods.

-Machine learning algorithms can combine maternal history, genetic information, and ultrasound features to forecast pregnancy risks with high accuracy.

Perinatal Care



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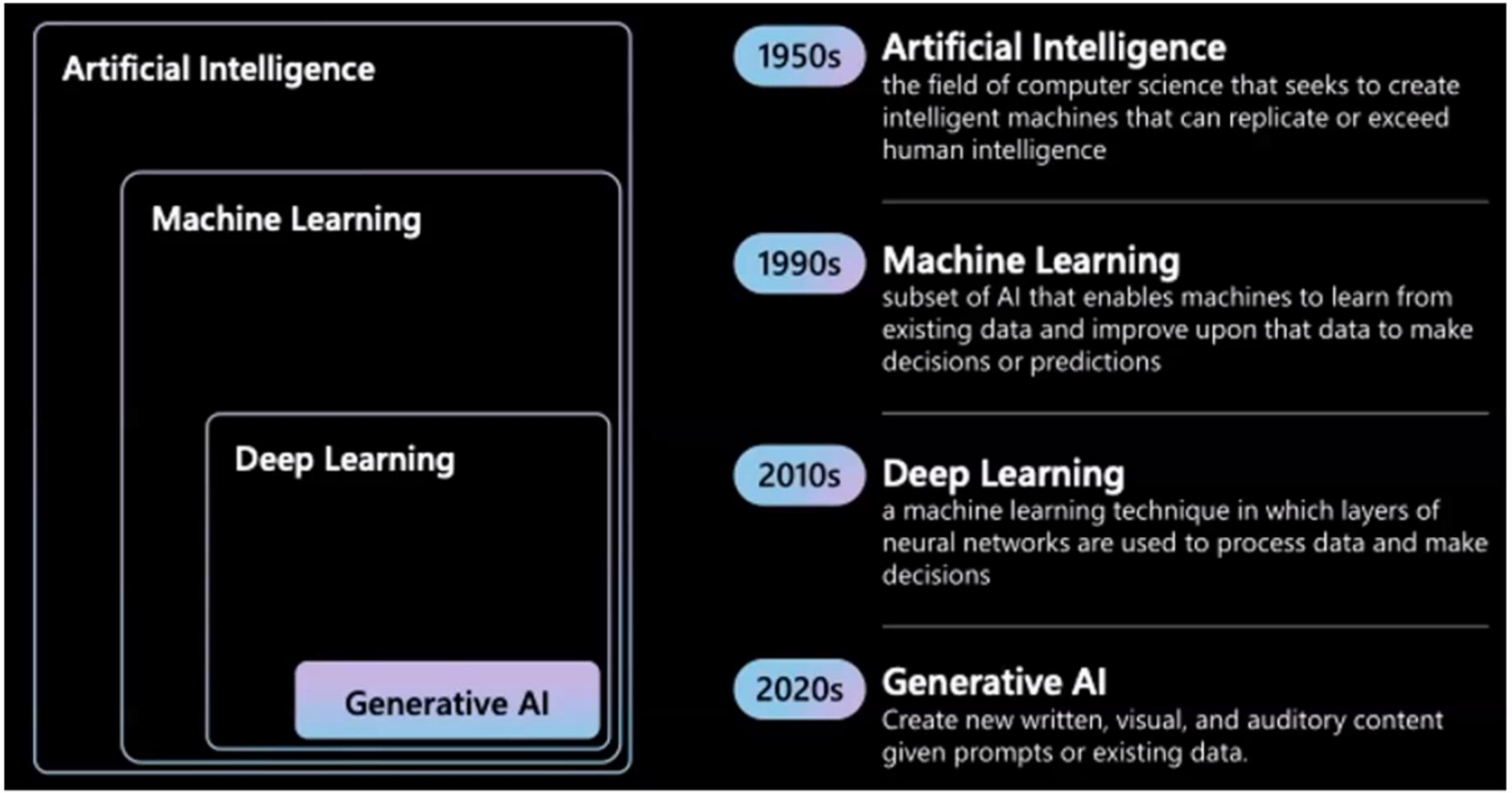
International Journal of General Medicine 2025:18 237–245

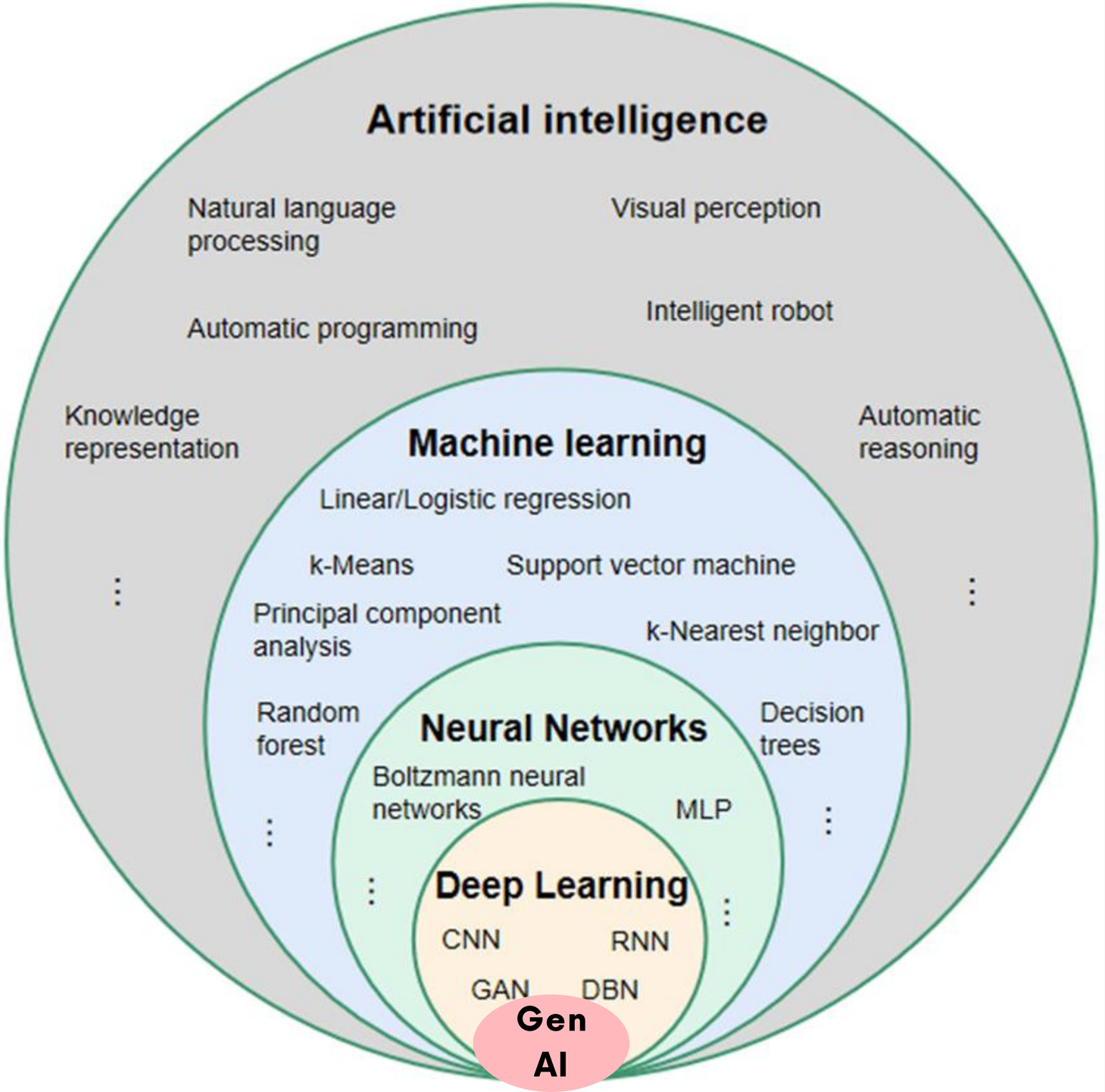
-My Take--- Still not ready for prime time, need RCT and continued evaluation for bias and model drift and generalization

Author/ Year	Design	Country	Highlight	AI Application
Zhang et al (2024).[24]	Systematic review	China	AI technology can significantly enhance the efficiency and accuracy of sonographers. Successful applications of AI in fetal echocardiography, spanning image processing, biometrics, and disease diagnosis.	Prenatal Screening and Diagnosis
Delgado-Gonzalo et al (2024).[25]	Retrospective study	Switzerland	Emphasizing the significance of interdisciplinary collaborations for the future of medical practice. Unique value and potential for advancing AI interpretation in healthcare.	Prenatal Screening and Diagnosis
Frisch EH, (2024).[16]	Analysis	America	The newly developed AI model demonstrated a notable capability in accurately determining fetal sex, presenting potential value particularly in regions with limited access to ultrasound expertise. Its high rate of fetal sex capture suggests practical applicability in settings where traditional ultrasound services may be scarce or unavailable, offering a promising solution to address diagnostic challenges in such areas.	Determine fetal sex
Moutaib M et al, (2024).[26]	Random forest-based approach	Morocco	Fetal ECG prediction, with the increasing integration of artificial intelligence technologies	Fetal Monitoring
Dubey G et al, (2024).[27]		India	This study introduces a novel method for fetal ultrasound segmentation and measurements by combining appearance and shape prior-based density regression with deep convolutional neural networks.	Fetal Monitoring Fetal ultrasound
Nieminen, (2024).[28]	Systematic reviews	Finland	Caution against unsustainable promises and unmet expectations with machine learning and predictive algorithms Integrating outcomes with simpler classical approaches can offer compelling and adequate solutions to key inquiries, Potentially persuading clinicians of the validity and utility of the results.	Predictive Modeling
Shreeve et al (2024).[29]	Retrospective study	UK	Whole-genome sequencing (WGS) shows promise in cases of congenital anomaly, but its additional value compared to exome sequencing (ES) is still uncertain.	Genetics and Genomics
Calhoun et al (2024).[30]	Retrospective study		The study establishes a reliable framework for AI-based classification of ultrasound images This framework offers a reproducible method for developing AI-assisted ultrasound classifications	Automated Image Analysis

AI is not new, but Generative AI is



Intelligence-Based Medicine, Anthony Chang, Elsevier 2020



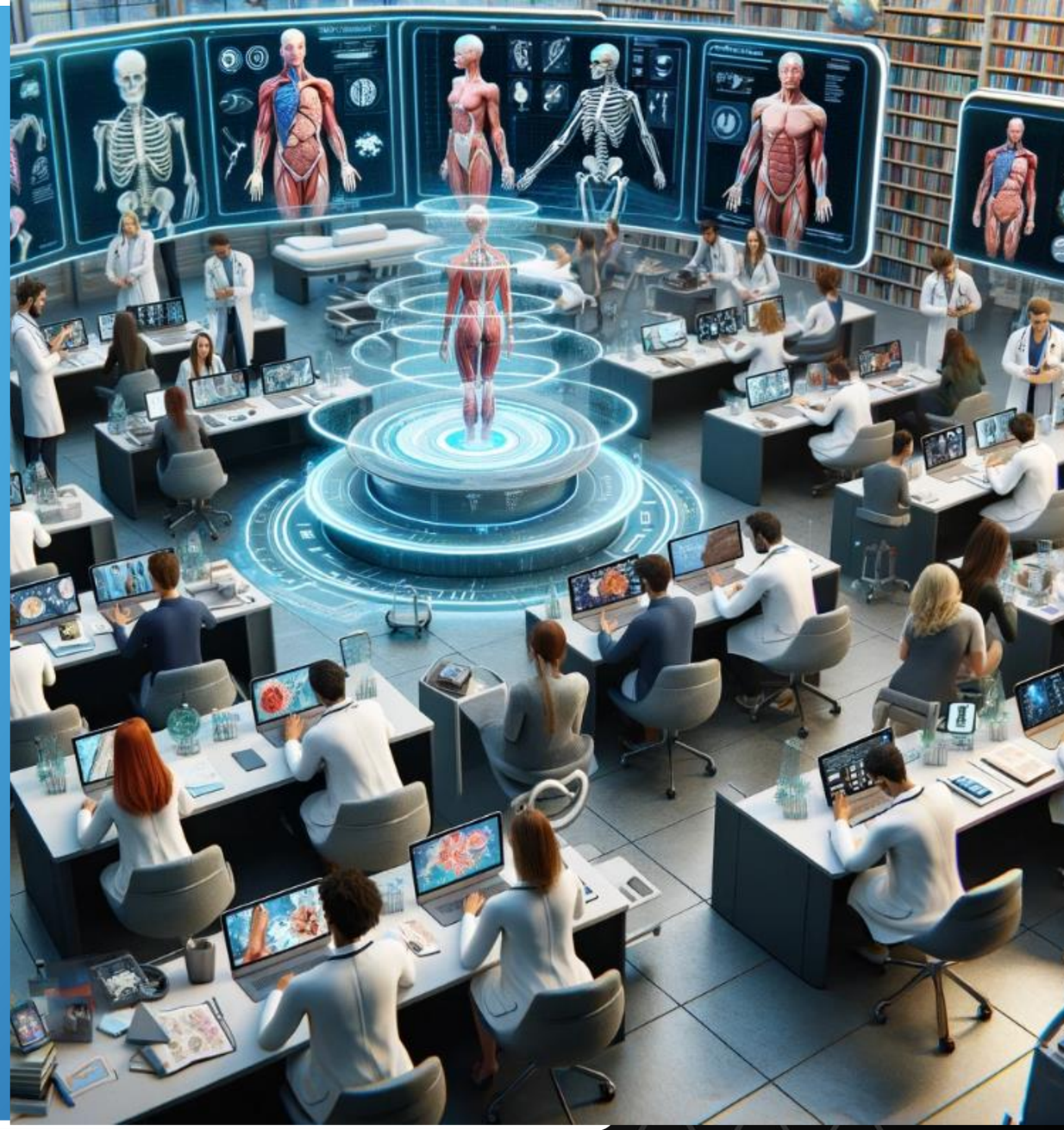
A Comprehensive Review on Radiomics and Deep Learning for Nasopharyngeal Carcinoma Imaging

August 2021 · Diagnostics 11(9):1523

AI Artificial Intelligence

Definition- Artificial Intelligence (AI) is a branch of computer science that focuses on creating systems (algorithms and software) capable of performing tasks that typically require human intelligence:

-learning
-problem-solving
-perception
-language understanding
-decision making



FIRST TO HAVE WIDESPREAD USE

Large Language Models; ChatGPT, Gemini, Claude...

-Designed to understand and generate human-like text (and now images/videos..)

-Models are trained on vast amounts of data (up to a specific date)---they are PREDICTION MACHINES

-Built on “transformer” architecture; allows the model to pay attention to different parts of text as it reads, helping it to understand context and generate coherent responses.

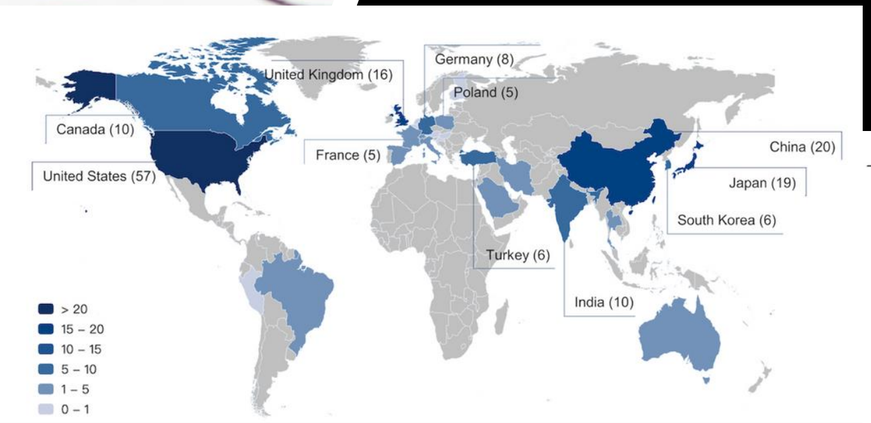
LLMs and Medical Board Exams

Large Language Models in Worldwide Medical Exams: Platform Development and Comprehensive Analysis

J Med Internet Res 2024 | vol. 26 | e66114 | p. 1

Hui Zong[1*], PhD; Rongrong Wu[1*], PhD; Jiaxue Cha[2], PhD; Jiao Wang[1], PhD; Erman Wu[1,3], PhD; Jiakun Li[1,4], MD, PhD; Yi Zhou[1], PhD; Chi Zhang[1], MD, PhD; Weizhe Feng[1], MS; Bairong Shen[1,5], PhD

-Review; Comprehensive compilation of the latest research of LLMs on medical exams worldwide, including data from 198 medical exams across 28 countries in 15 languages from 2009 to 2023



LLM	Frequency of use, n
GPT[a]-3.5	273
GPT-4	262
ChatGPT	64
Bard	44
Bing	24
InstructGPT	8
GPT-3	7
GPT-4V	7
Perplexity	6

Language		
English	64	127
Chinese	10%	20
Japanese	10%	19
German		5
Korean		5
Polish		5

LLMs Can PASS Medical Board Exams

Large Language Models in Worldwide Medical Exams: Platform Development and Comprehensive Analysis

J Med Internet Res 2024 | vol. 26 | e66114 | p. 1

Hui Zong[1*], PhD; Rongrong Wu[1*], PhD; Jiaxue Cha[2], PhD; Jiao Wang[1], PhD; Erman Wu[1,3], PhD; Jiakun Li[1,4], MD, PhD; Yi Zhou[1], PhD; Chi Zhang[1], MD, PhD; Weizhe Feng[1], MS; Bairong Shen[1,5], PhD

-LLMs can pass Medical Board Exams

-Newer versions of LLMs have better performance on standardized tests

-Significant variability in the capabilities of LLMs across different geographic regions and languages

LLM	Passed, n (%)	Failed, n (%)	Not reported, n (%)
GPT[a]-3.5 (n=273)	55 (20.2)	127 (46.5)	91 (33.3)
GPT-4 (n=262)	131 (50)	23 (8.8)	108 (41.2)
ChatGPT (n=64)	4 (6)	14 (22)	46 (72)
Bard (n=44)	4 (9)	23 (52)	17 (39)
Bing (n=24)	3 (12)	6 (25)	15 (63)

LLMs Can PASS Medical Board Exams

So What

Being a clinician is much more than ability able to pass a multiple choice exam

Large Language Model Influence on Diagnostic Reasoning
A Randomized Clinical Trial

Ethan Goh, MBBS, MS; Robert Gallo, MD; Jason Hom, MD; Eric Strong, MD; Yingjie Weng, MHS; Hannah Kerman, MD; Joséphine A. Cool, MD;

JAMA Network Open. 2024;7(10):e2440969. doi:10.1001/jamanetworkopen.2024.40969 October 28, 2024

Group	Median (IQR), %			
	Physicians plus LLM			
All participants	76 (66 to [illegible])			
Level of training				
Attending				.92
Resident			11)	.50
LLM				
			−0.5 (−8 to 7)	.90
		to 84)	5 (−7 to 16)	.40
LLM				
Les		42)	572 (474 to 778)	−46 (−219 to 127)	.59
More		(305 to 627)	556 (427 to 810)	−140 (−294 to 13)	.07

The New York Times
https://www.nytimes.com › chatgpt-ai-doctors-diagnosis

A.I. Chatbots Defeated Doctors at Diagnosing Illness

Nov 17, 2024 — A small study found ChatGPT outdid human **physicians** when assessing medical case histories, even when those **doctors** were using a chatbot.

Large Language Model Influence on Diagnostic Reasoning
A Randomized Clinical Trial

Ethan Goh, MBBS, MS; Robert Gallo, MD; Jason Hom, MD; Eric Strong, MD; Yingjie Weng, MHS; Hannah Kerman, MD; Joséphine A. Cool, MD;

JAMA Network Open. 2024;7(10):e2440969. doi:10.1001/jamanetworkopen.2024.40969 October 28, 2024

-50 physicians (26 attendings, 24 residents; median years in practice, 3 [IQR, 2-8]) from Stanford, Beth Israel Deaconess Medical Center, and University of Virginia in internal medicine, family medicine, or emergency medicine.

-Randomized to either access the LLM (ChatGPT4) in addition to conventional diagnostic resources or conventional resources only, stratified by career stage. Participants were allocated 60 minutes to review up to 6 clinical vignettes

-Both groups were instructed to access any conventional resources they normally use for clinical care, but the control group was explicitly instructed not to use LLMs.

-Evaluate diagnostic reasoning on clinically challenging cases

Large Language Model Influence on Diagnostic Reasoning
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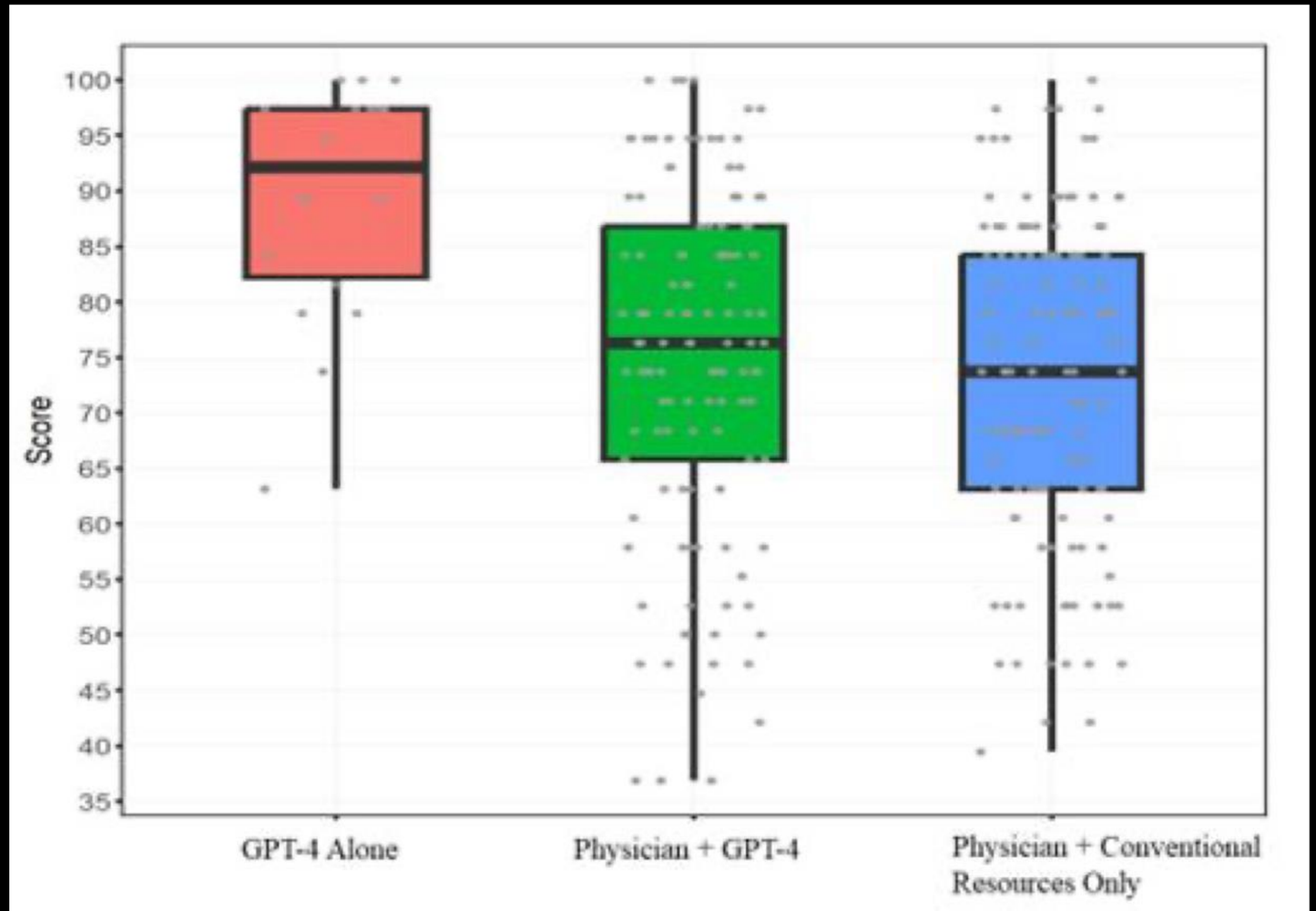
Ethan Goh, MBBS, MS; Robert Gallo, MD; Jason Hom, MD; Eric Strong, MD; Yingjie Weng, MHS; Hannah Kerman, MD; Joséphine A. Cool, MD;

JAMA Network Open. 2024;7(10):e2440969. doi:10.1001/jamanetworkopen.2024.40969 October 28, 2024

CHATGPT 4 by itself performed better than any combo of MDs in diagnosing



Large Language Model Influence on Diagnostic Reasoning
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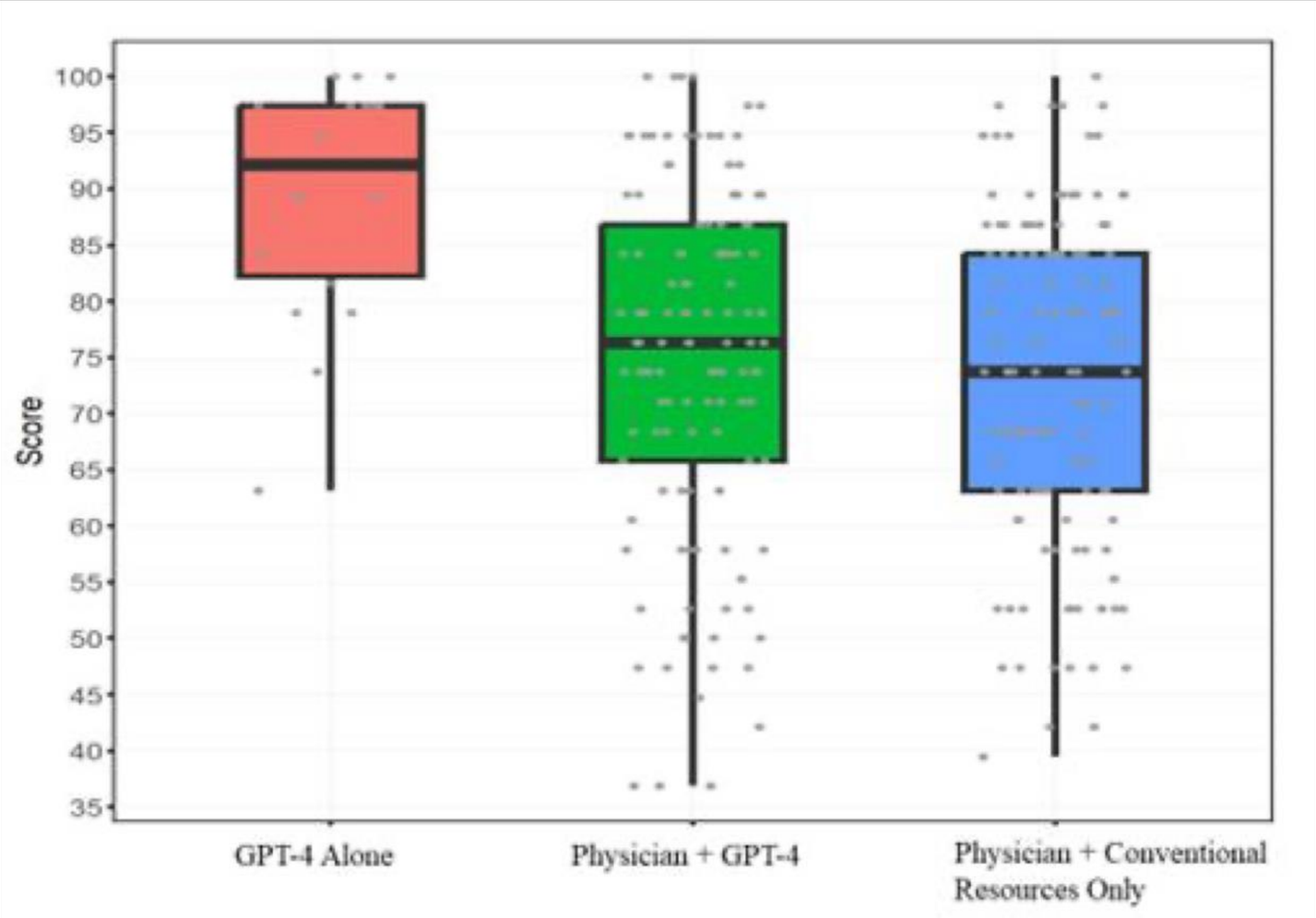


Epistemic Uncertainty

Is AI/Human Interaction Complementary?

nature human behaviour

Article

https://doi.org/10.1038/s41562-024-02024-1

When combinations of humans and AI are useful: A systematic review and meta-analysis

Received: 6 April 2023

Michelle Vaccaro[1,2], Abdullah Almaatouq[1] & Thomas Malone[1]

Sept 2024

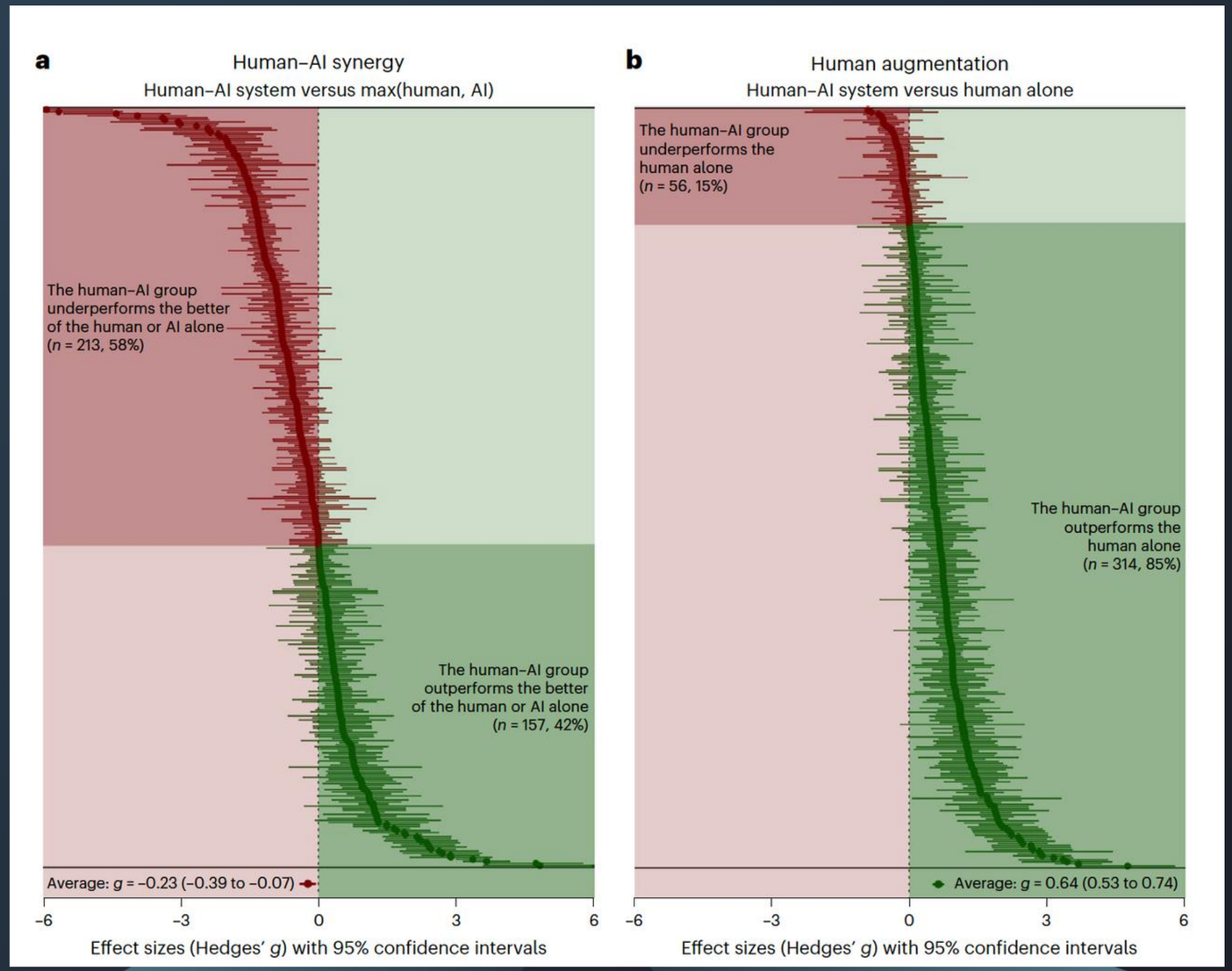
Meta-analysis of 106 studies evaluating performance of Human-AI Systems (AI, Human, AI+Human).

Augmentation >> Synergy

Task Matters in human-AI systems:

-Decision tasks; performance losses

-Creation tasks; performance gains



Meta-Analysis of AI + Human

nature human behaviour

Article

https://doi.org/10.1038/s41562-024-02024-1

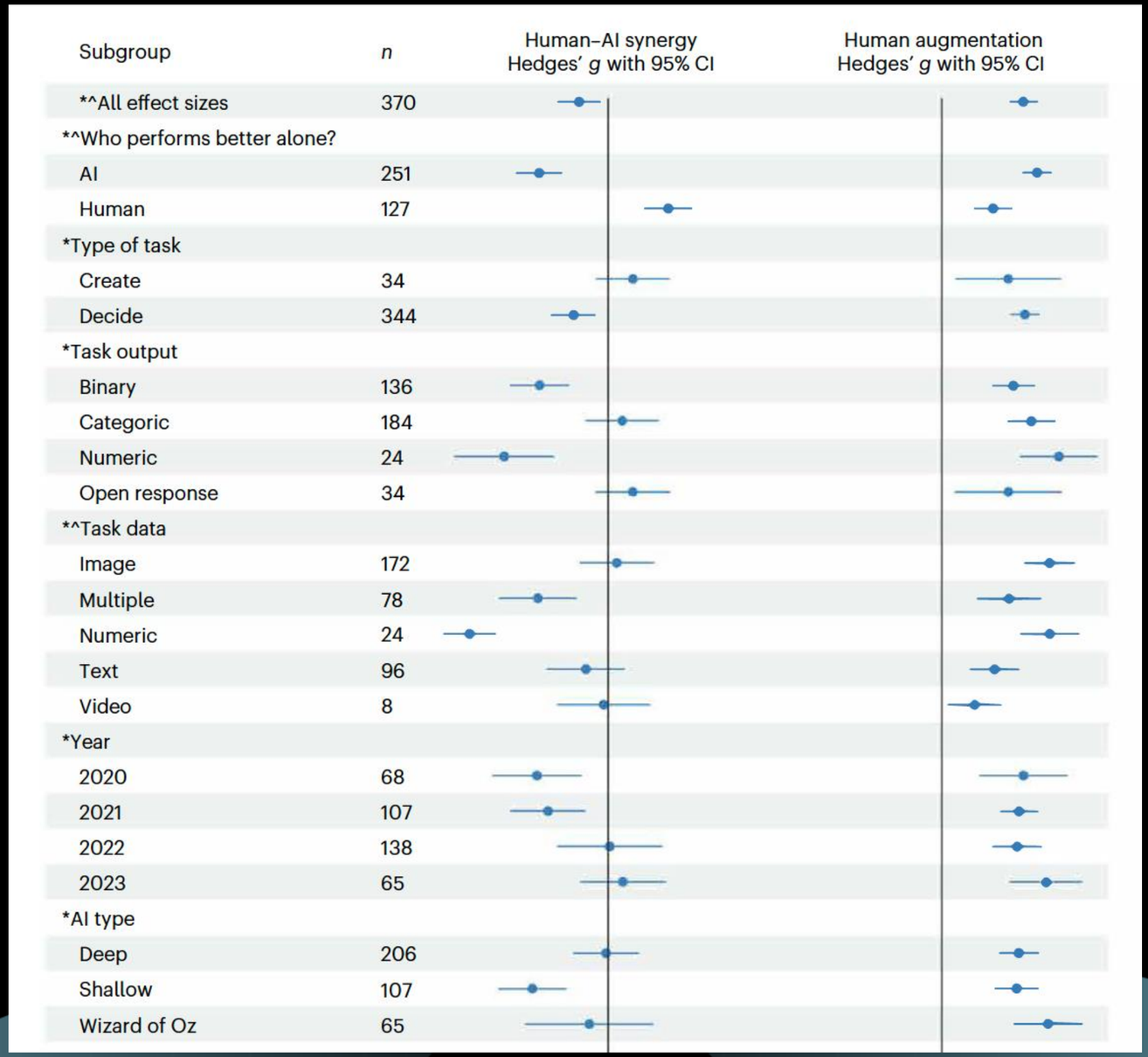
When combinations of humans and AI are useful: A systematic review and meta-analysis

Received: 6 April 2023

Michelle Vaccaro[1,2], Abdullah Almaatouq[1] & Thomas Malone[1]

The Human–AI groups performed worse than either the human alone or the AI alone.

The AI system did on average help humans perform better.



What Do We Know From RCTs Evaluating AI in Medicine?

Lancet Digit Health. 2024 May ; 6(5): e367–e373. doi:10.1016/S2589-7500(24)00047-5.

Randomised controlled trials evaluating artificial intelligence in clinical practice: a scoping review

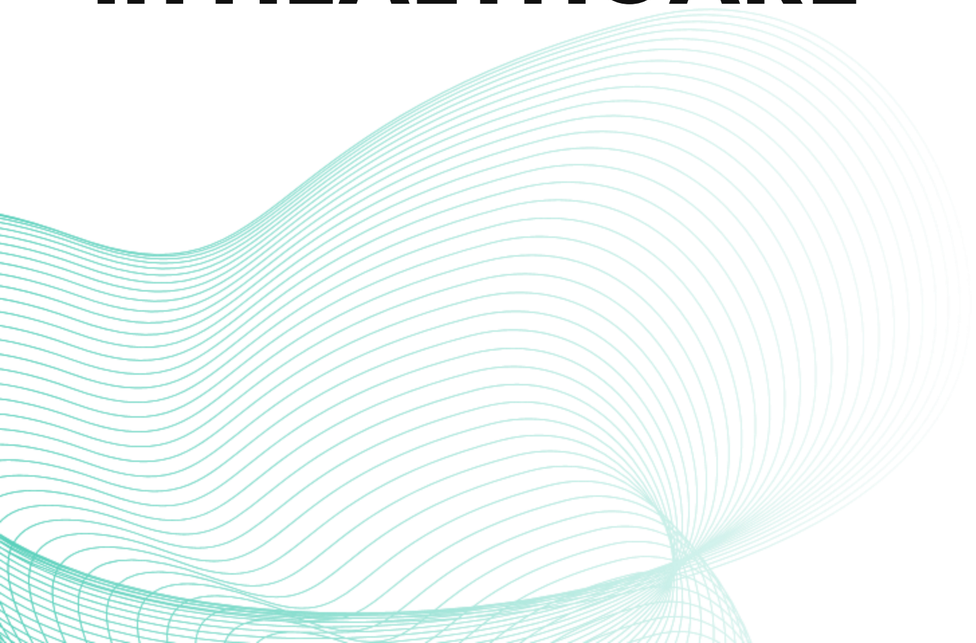
Ryan Han,
Julián N Acosta,
Zahra Shakeri,
John P A Ioannidis,
Eric J Topol*,
Pranav Rajpurkar*

-Only 19% of trials used CONSORT-AI guidelines, signaling a need for better reporting standards in AI-focused clinical trials.

-Bias of these models needs further study; only 22 of 86 trials (25%) reported race or ethnicity.

We Need More Evaluation That Is Standardized, Focused on Effectiveness and Efficiency, Diverse in Patient Population, and More Diverse in Specialty and Application

ISSUES WITH AI in HEALTHCARE



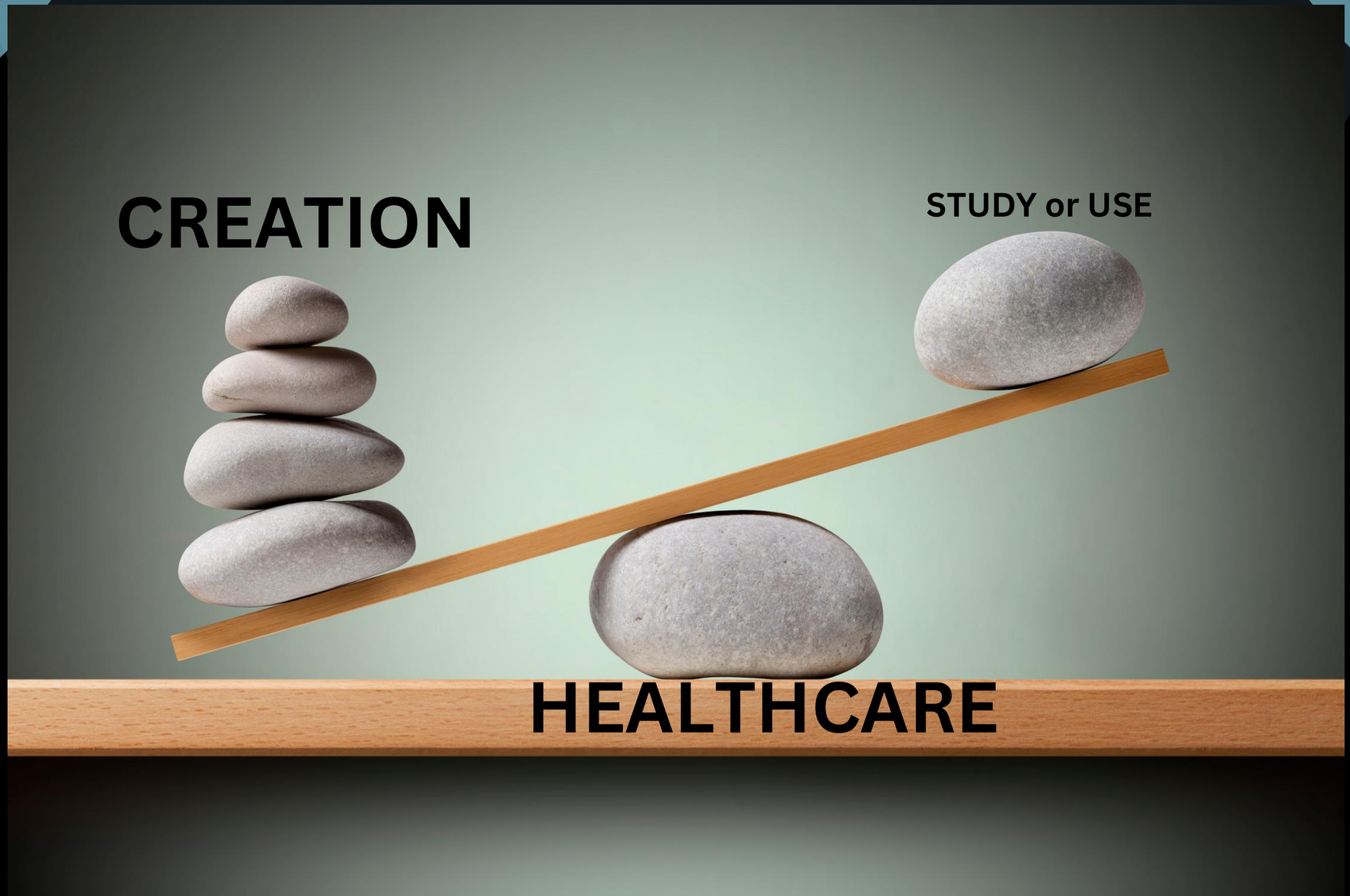
Garbage In, Garbage Out

Accountability

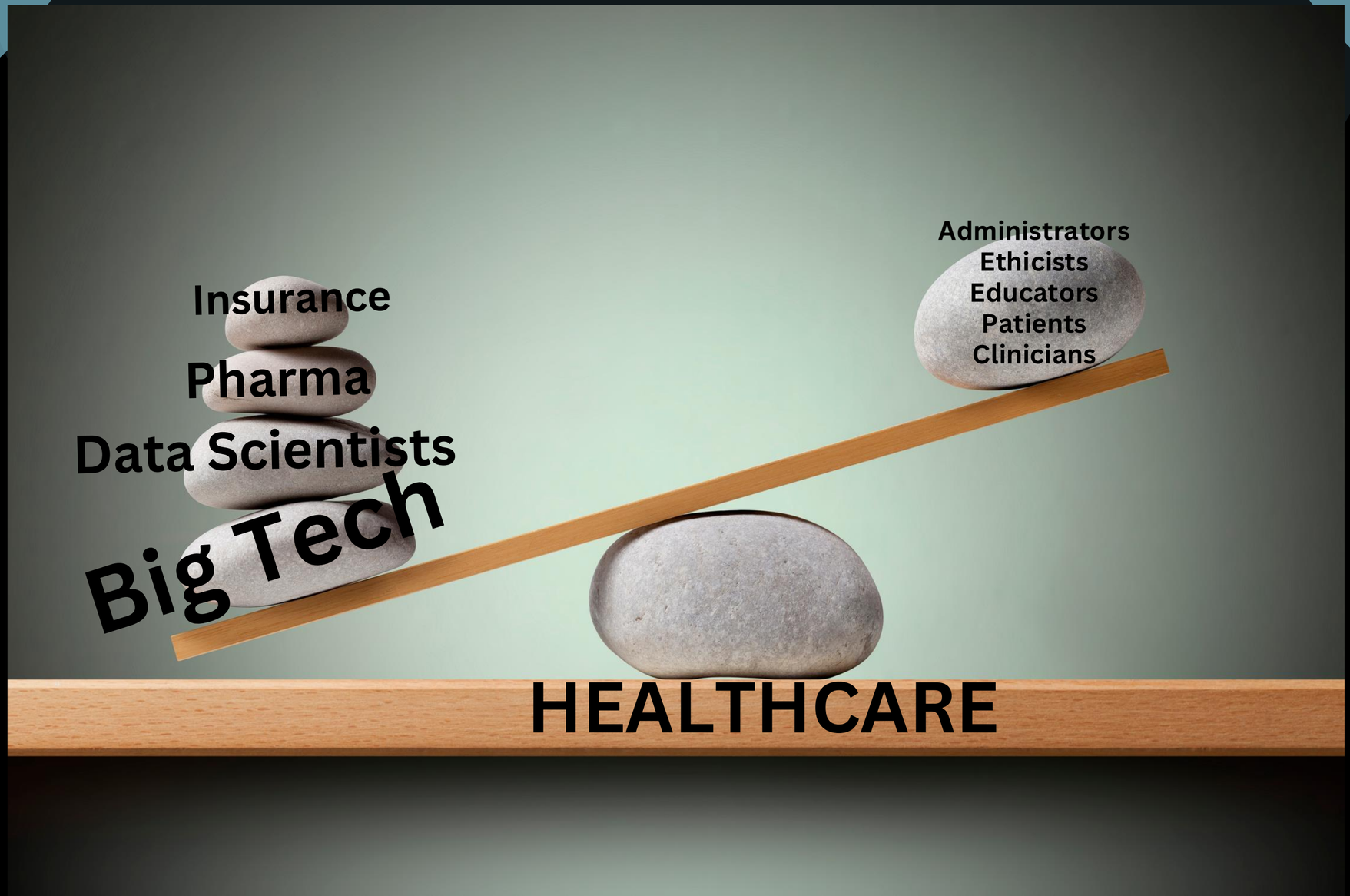
Explainability

Trustworthiness

AI Imbalance



AI Imbalance



Where Are We?

NEJM AI

NEJM AI 2024; 1 (3)
DOI: 10.1056/Aioa2300138

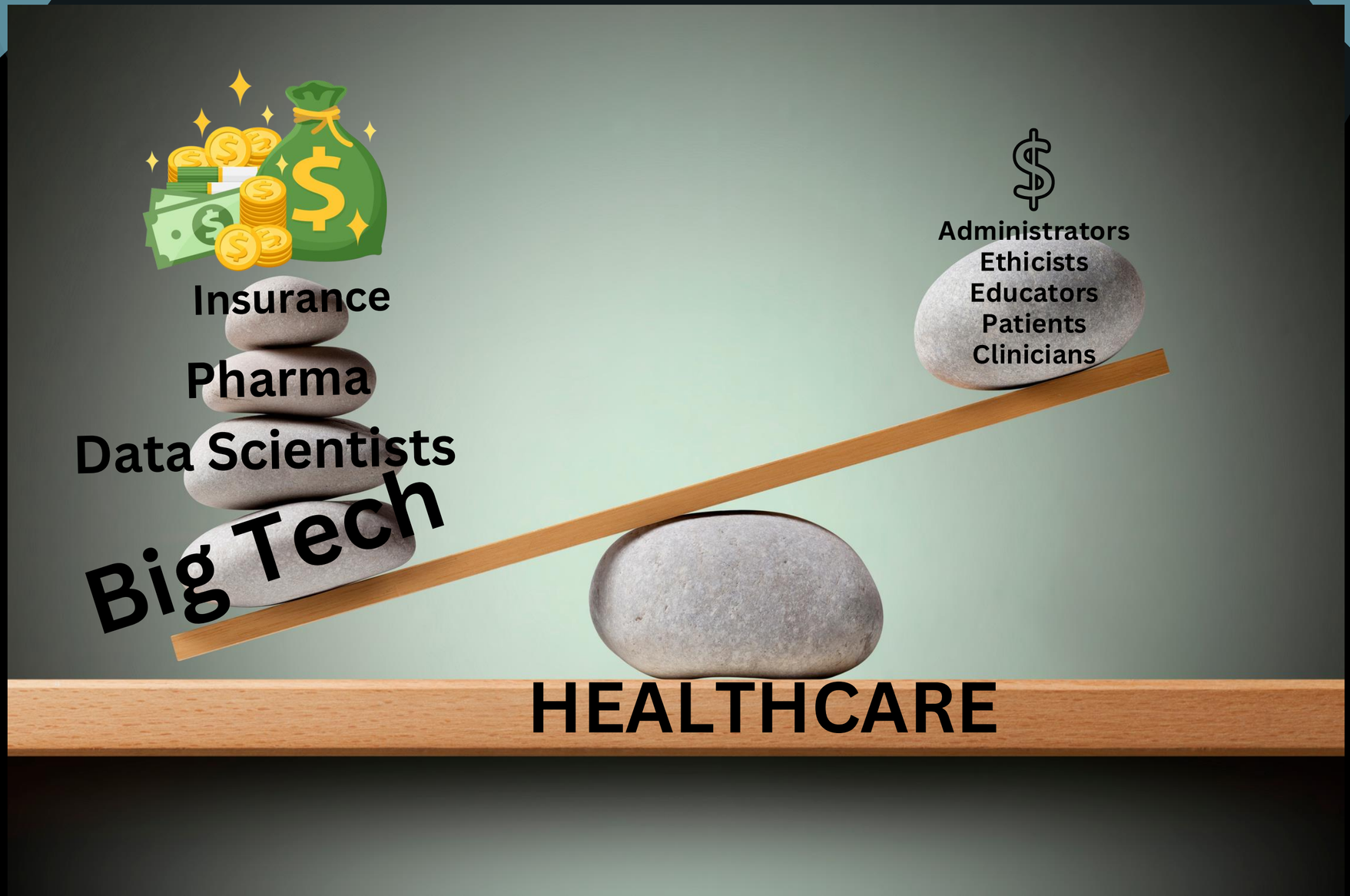
ORIGINAL ARTICLE

Towards Generalist Biomedical AI

Tao Tu, Ph.D.,[1] Shekoofeh Azizi, Ph.D.,[2] Danny Driess, M.S.,[2] Mike Schaekermann, Ph.D.,[1] Mohamed Amin, B.S.,[1] Pi-Chuan Chang, Ph.D.,[1] Andrew Carroll, Ph.D.,[1] Charles Lau, M.B.A.,[1] Ryutaro Tanno, Ph.D.,[2] Ira Ktena, Ph.D.,[2] Anil Palepu, M.S.,[1] Basil Mustafa, M.S.,[2] Aakanksha Chowdhery, Ph.D.,[2] Yun Liu, Ph.D.,[1] Simon Kornblith, Ph.D.,[2] David Fleet, Ph.D.,[2] Philip Mansfield, Ph.D.,[1] Sushant Prakash, M.S.,[1] Renee Wong, B.Sc.,[1] Sunny Virmani, M.S.,[1] Christopher Semturs, M.S.,[1] S. Sara Mahdavi, Ph.D.,[2] Bradley Green, Ph.D.,[1] Ewa Dominowska, M.S.,[1] Blaise Aguera y Arcas, M.S.,[1] Joelle Barral, Ph.D.,[2] Dale Webster, Ph.D.,[1] Greg S. Corrado, Ph.D.,[1] Yossi Matias, Ph.D.,[1] Karan Singhal, M.S.,[1] Pete Florence, Ph.D.,[2] Alan Karthikesalingam, M.D., Ph.D.,[1] and Vivek Natarajan, M.S.[1]

https://orcid.org

AI Imbalance



AI Study in the NICU and PICU

From bytes to bedside: a systematic review on the use and readiness of artificial intelligence in the neonatal and pediatric intensive care unit

Janno S. Schouten[1,2], Melissa A. C. M. Kalden[1,2,3], Eris van Twist[4], Irwin K. M. Reiss[1], Diederik A. M. P. J. Gommers[2,5], Michel E. van Genderen[2,5] and H. Rob Taal[1,2*]

Intensive Care Med (2024) 50:1767–1777
https://doi.org/10.1007/s00134-024-07629-8

- 87% of evaluations and application of AI, reached a level ⩽ 4 on the 'level of readiness' scale

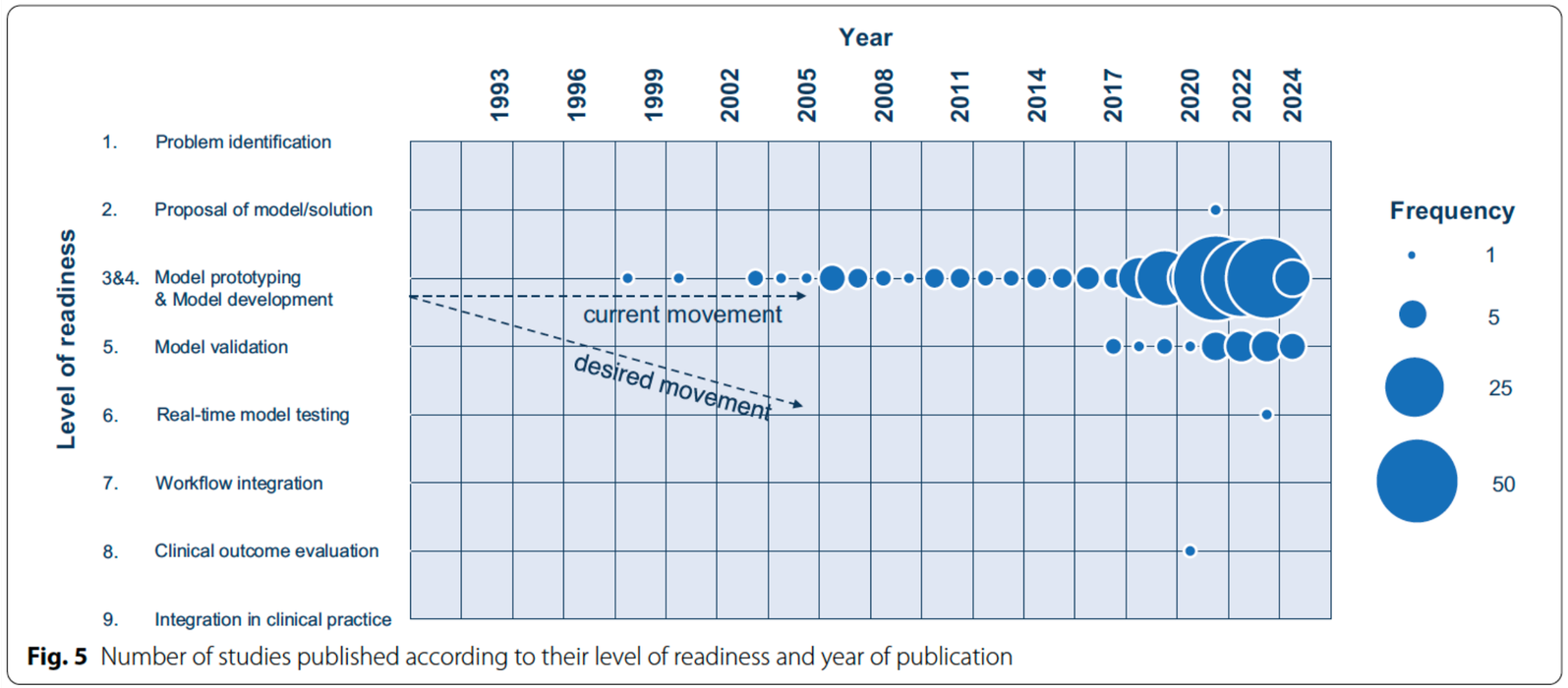


Fig. 5 Number of studies published according to their level of readiness and year of publication

As AI is Applied In Pediatric Medicine, We Need More Information, Especially to Understand Bias

⚠️ WARNING: HEALTH LLMS ARE UNREGULATED — NONE ARE REGISTERED WITH THE FDA!

AI Based On Capabilities

AI Realized today → **Theoretical AI**

1-Narrow

-Only type that exists today

-Has a **defined task**

-Needs a **human to train it**

-Siri, self driving cars

2-Artificial General Intelligence

-Uses previously learned skills and learnings to **accomplish a new task without the need of human training--TRANSFER LEARNING**

-can do **anything that a human could do**.

-can do any **cognitive task.**

-Self driving car that drives around a protest

3-Super AI

-would **think, reason, learn, make judgements**, and possess **cognitive abilities that exceed humans**.

-would have **own emotions, beliefs, and needs**

BASIC TYPES OF AI

Machine Learning (ML)

-Enables computers to learn from and make decisions based on data.

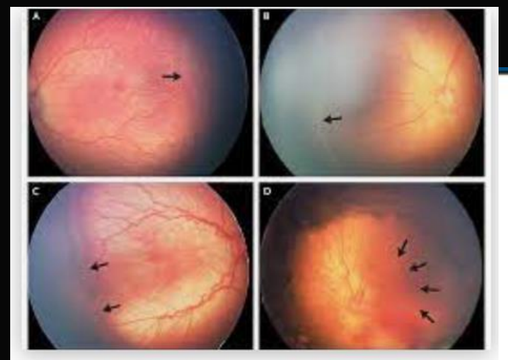
-In traditional computing, rules are explicitly programmed and used

-ML allows a system to learn those rules by analyzing data and identifying patterns

-Improves over time as it gets more data

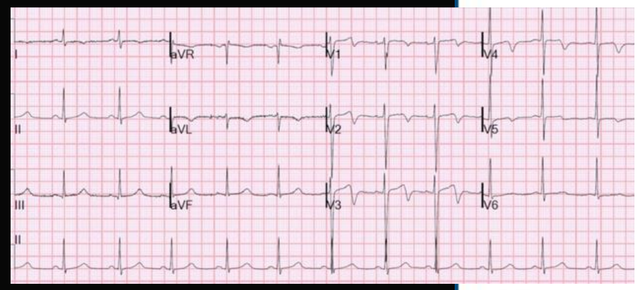
Predictive Analytics

which patient with pulmonary hypoplasia is at highest risk for mortality?



Retinopathy of Prematurity | NEJM

nejm.org



MACHINE LEARNING

LABELED DATA

UNLABELED DATA

SUPERVISED LEARNING

UNSUPERVISED LEARNING

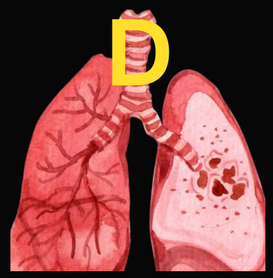
CLASSIFICATION

REGRESSION

CLUSTERING

BP

D



NEC

Chang AC. *Intelligence-Based Medicine: Principles and Applications of Artificial Intelligence and Human Cognition in Clinical Medicine and Healthcare* (published by Elsevier 2020)

AI IS GREAT FOR:

PATTERN RECOGNITION

IN LARGE DATA SETS

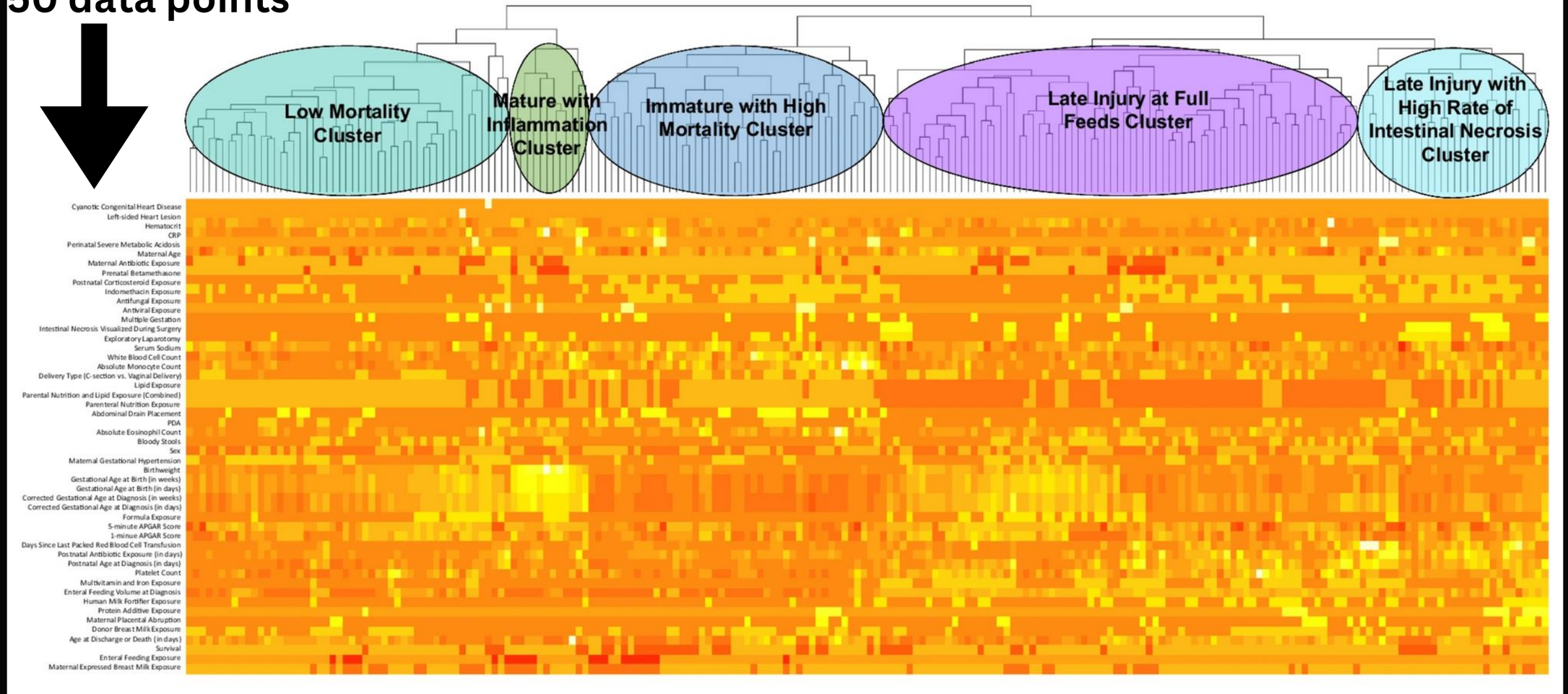
Reassessing acquired neonatal intestinal diseases using unsupervised machine learning

Daniel R. Gipson ✉, Alan L. Chang, Allison C. Lure, Sonia A. Mehta, Taylor Gowen, Erin Shumans, David Stevenson, Diomel de la Cruz, Nima Aghaeepour & Josef Neu

Pediatric Research **96**, 165–171 (2024) | Cite this article

183 babies with intestinal injury at U Fl from 2013-2019

50 data points



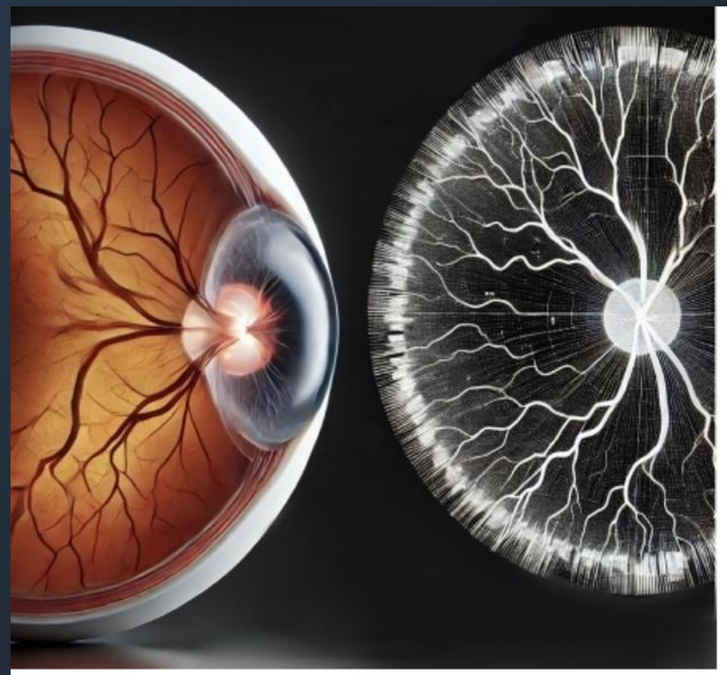
AUGMENTING ROP SCREENING

JAMA Ophthalmology | Original Investigation

Multinational External Validation of Autonomous Retinopathy of Prematurity Screening

Aaron S. Coyner, PhD; Tom Murickan, MD; Minn A. Oh, PhD; Benjamin K. Young, MD; Susan R. Ostmo, MS; Praveer Singh, PhD; R. V. Paul Chan, MD, MSc; Darius M. Moshfeghi, MD; Parag K. Shah, MD; Narendran Venkatapathy, MD; Michael F. Chiang, MD, MA; Jayashree Kalpathy-Cramer, PhD; J. Peter Campbell, MD, MPH

JAMA Ophthalmol. 2024;142(4):327-335. doi:10.1001/jamaophthalmol.2024.0045
Published online March 7, 2024.



Segmentation of Retinal Fundus Images: Converted retinal blood vessel images into black-and-white maps to isolate vessels for analysis.

The **AI model performed as well as humans**, particularly in terms of detecting severe cases; **type 1 ROP** (100% sensitivity), with potential to dramatically reduce the manual workload of clinicians.

USING VIDEO + AI FOR PREDICTION

Detection of neurologic changes in critically ill infants using deep learning on video data: a retrospective single center cohort study

Alec Gleason,[a] Florian Richter,[b] Nathalia Beller,[c] Naveen Arivazhagan,[d,e] Rui Feng,[f] Emma Holmes,[e,g] Benjamin S. Glicksberg,[c] Sarah U. Morton,[h,i] Maite La Vega-Talbott,[j,k] Madeline Fields,[j] Katherine Guttmann,[g,l] Girish N. Nadkarni,[d,e] and Felix Richter[k,l,]*

Key Findings

- **Movement patterns showed age-related increases** in infants, which correlated with neurological maturity.

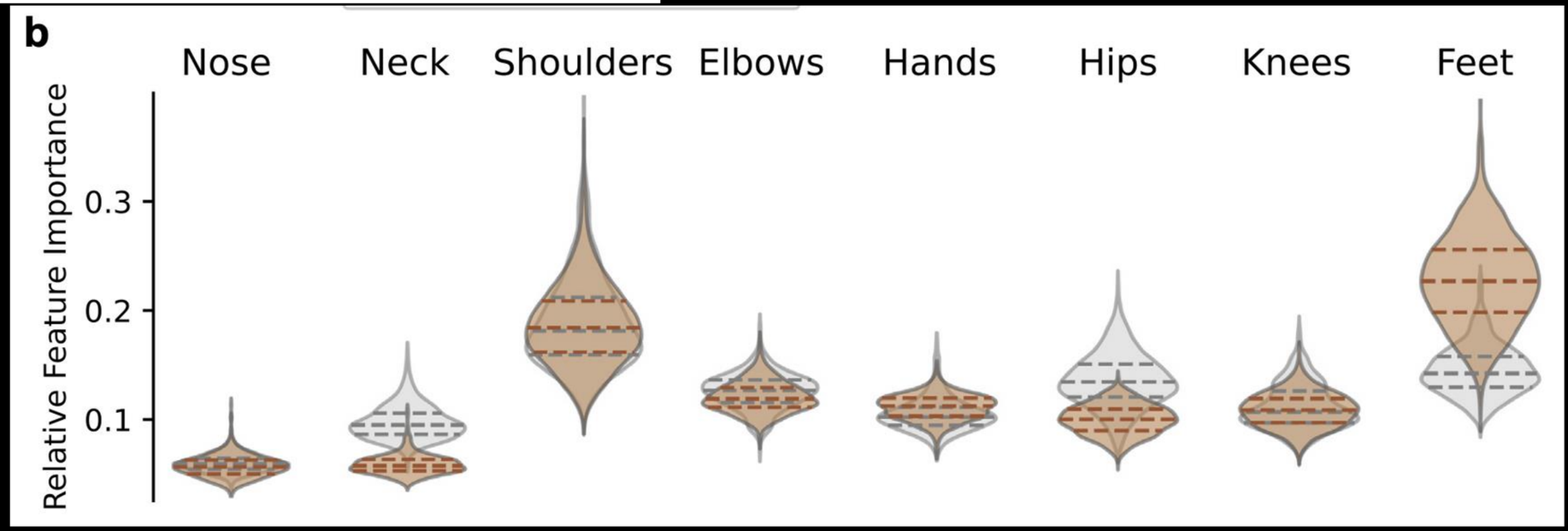
- Sedation and cerebral dysfunction were detectable by analyzing shifts in movement patterns. For instance, **reduced movements were observed with sedative medication administration or in cases with cerebral dysfunction**, indicating these states affect normal movement.

USING VIDEO + AI FOR PREDICTION

Detection of neurologic changes in critically ill infants using deep learning on video data: a retrospective single center cohort study

Alec Gleason,[a] Florian Richter,[b] Nathalia Beller,[c] Naveen Arivazhagan,[d,e] Rui Feng,[f] Emma Holmes,[e,g] Benjamin S. Glicksberg,[c] Sarah U. Morton,[h,i] Maite La Vega-Talbott,[j,k] Madeline Fields,[j] Katherine Guttmann,[g,l] Girish N. Nadkarni,[d,e] and Felix Richter[k,l,*]

Key Findings



Feet and shoulders were more influential than other regions like the nose or neck, potentially because the limb and shoulder movements are more impacted by sedation or cerebral dysfunction.

NICU PHYSIOLOGICAL DATA

Reduction in Mortality by 20% with Neonatal Heart Rate Variability Changes Due to Sepsis--- HeRO Monitoring

HeRO ES

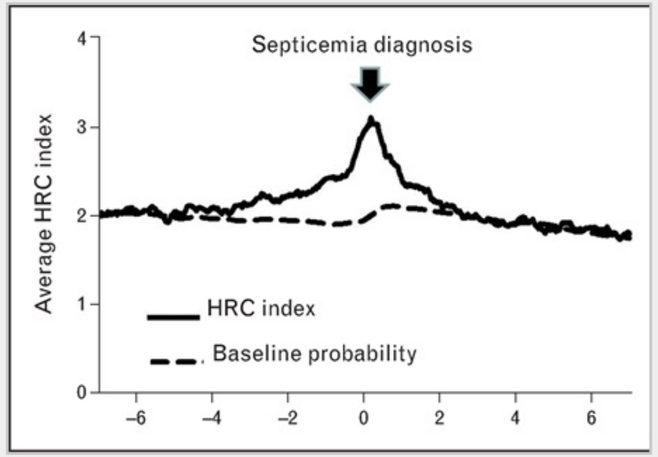
HeRO ES is an embedded HeRO System that can run **within** specific Philips Intellivue MX monitors!

Predictive monitoring for early detection of sepsis in neonatal ICU patients

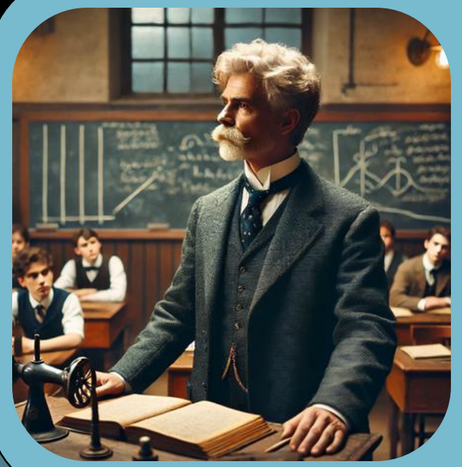
Fairchild, Karen D.

Author Information

Current Opinion in Pediatrics 25(2):p 172-179, April 2013. | ***DOI:*** 10.1097/MOP.0b013e32835e8fe6



AI-Augmented Intelligence



AI is not a replacement for human expertise in medical training but may augment trainee learning and clinical skills

Medical Education

AUGMENTING EDUCATION

Precision Medical Education; at NYU Grossman School of Medicine:

-AI tailors curriculum and study aids to each student's learning style and goals.

-Not a "one size-fits-all" it integrates longitudinal data and analytics to drive precise educational interventions that address each individual learner's needs and goals in a continuous, timely, and cyclical fashion, ultimately improving meaningful educational, clinical, or system outcomes.

Triloa MM. Academic Medicine 98(7):p 775-781, July 2023

AUGMENTING MEDICAL EDUCATION

-Stanford University's AI-Med program is integrating AI across its medical curriculum, focusing on both the use of AI tools in clinical practice and the ethical implications of AI in healthcare.

-Stanford University School of Medicine has introduced a "Medical AI and Computer Vision" track within its MD program, allowing students to develop expertise in AI applications alongside traditional medical training.

-Mayo Clinic's Medical School has introduced a "Human Skills in the Age of AI" curriculum, which focuses on developing empathy, communication, and ethical decision-making skills alongside AI literacy.

AI FOR MEDICAL EDUCATORS

-Using AI for Resident Selection Process

Recruitment; Gen AI creating website and social media engagement

Application Review; ML and NLP to identify values in narrative components, to find “diamonds in the rough”

Interviews; Gen AI to create customized interview invites, analyze interview audio for communication skills

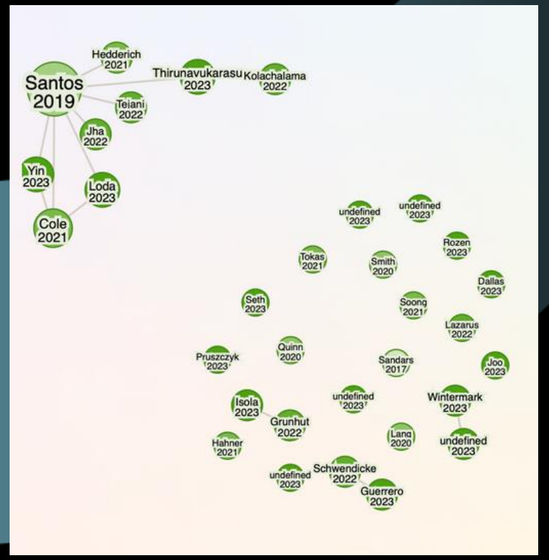
Bias Detection; MI and NLP to screen for bias

AI For Any Clinician Literature Review

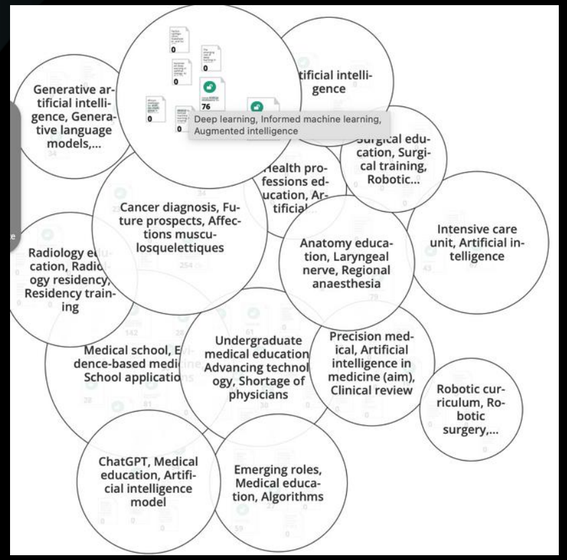
You Should Already Be Using These

AUGMENT MEDICAL LIT. REVIEWS

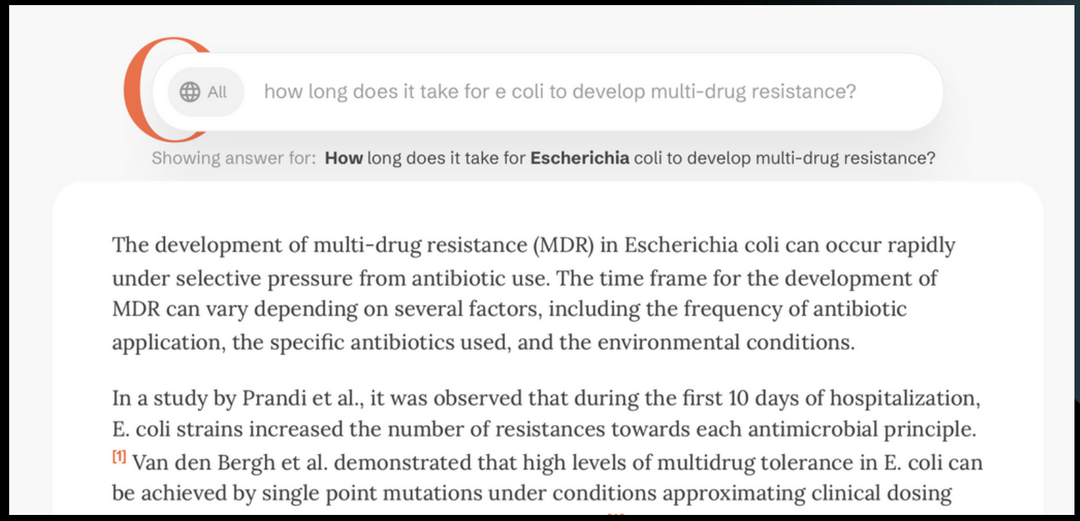
research rabbit



open knowledge maps



open evidence



Notebook LM

Google NotebookLM
https://notebooklm.google.com

Google NotebookLM

Consensus

Consensus
https://consensus.app

Consensus: AI-powered Academic Search Engine

GLASS HEALTH

AI-Powered Clinical Decision Support

We empower clinicians with our AI platform for developing differential diagnoses and drafting clinical plans.

perplexity

Not Just PUBMED or UPTODATE

NEW TYPES OF AI

Multi-Modal Models

integrate multiple types of data to improve the accuracy and effectiveness of AI systems.

Images + Text + Audio + Video

SUMMARY
(Knowledge)

Agentic AI- What and Why

Feature	LLM (e.g., ChatGPT-4)	Agentic AI
Interactivity	Responds passively to queries.	Acts autonomously based on provided goals.
Action	Cannot take actions or execute workflows.	Executes tasks (e.g., ordering labs, scheduling).
Context	Limited retention; session-based memory.	Persistent memory for contextual decisions.
Adaptability	Sticks to instructions provided in prompts.	Learns and adapts strategies for better outcomes.
Use Cases	Generating text, answering questions, summarizing data.	Automating clinical workflows, care coordination.

Use Case Example:

An agentic model is tasked with improving clinic flow.

It could:

- **Track patient arrivals and inform clinicians of delays.**
- **Automatically update schedules based on patient acuity.**
- **Recommend actions (e.g., prioritizing urgent cases).**

Why Agentic AI for Healthcare Systems?

- **Scalability: Agentic AI can manage large, repetitive tasks across entire systems (e.g., optimizing operating room schedules, triaging incoming ED patients).**
- **Improved Outcomes: By handling routine but time-consuming workflows, it frees up clinicians to focus on complex, high-impact care.**
- **Data-Driven Decisions: Integrates real-time data for personalized recommendations, reducing errors and delays.**

It Starts With an AI Strategy

And Requires A Culture of Readiness

AUGMENTING SYSTEM INTELLIGENCE

Health system-wide access to generative artificial intelligence: the New York University Langone Health experience

Journal of the American Medical Informatics Association, 2024, 1–7
https://doi.org/10.1093/jamia/ocae285

Kiran Malhotra, MD[1,2,3,*], Batia Wiesenfeld[4], Vincent J. Major, PhD[1,2,5], Himanshu Grover, PhD[1,2], Yindalon Aphinyanaphongs, MD, PhD[1,2,6], Paul Testa, MD[1,2,7], Jonathan S. Austrian, MD[1,2,6]

New York University Langone Health (NYULH) established a secure, private, and managed Azure OpenAI service (GenAI Studio) in the spring of 2023.

-granted widespread access to its employees to experiment and complete projects using GenAI.

-approach was launched with oversight and collaboration from a committee of clinical, informatics, regulatory, and ethical advisors.

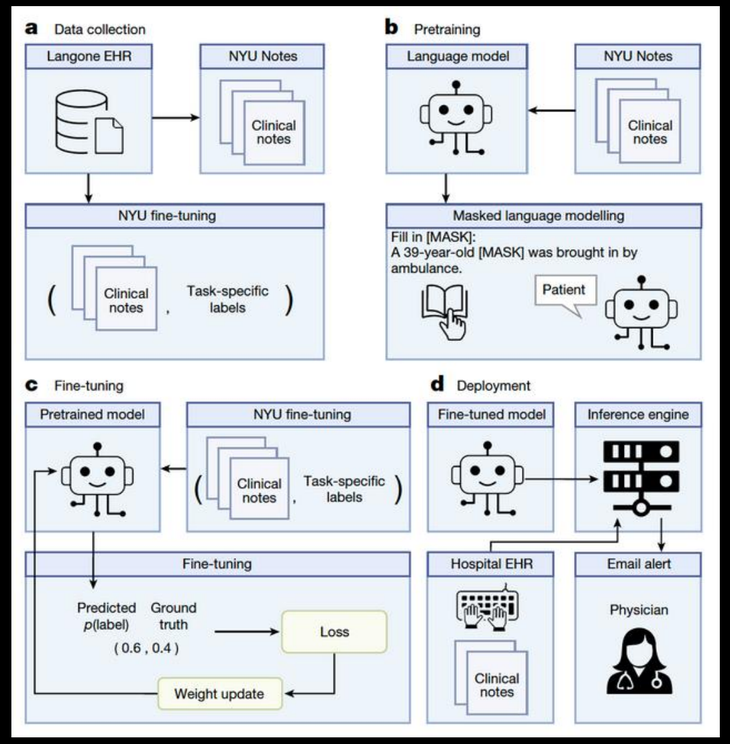
NYU LANGONE; SYSTEM INTELLIGENCE

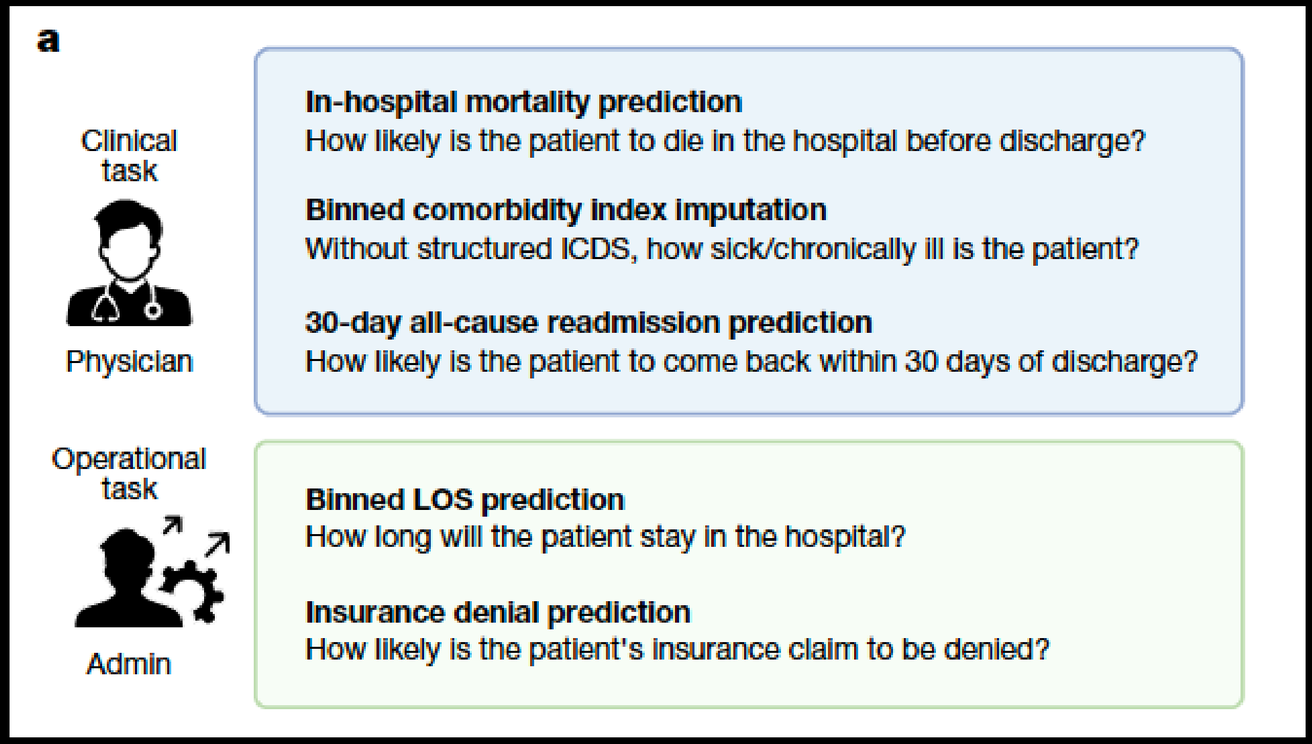
Health system-scale language models are all-purpose prediction engines

Lavender Yao Jiang[1,2], Xujin Chris Liu[1,3], Nima Pour Nejatian[4], Mustafa Nasir-Moin[1], Duo Wang[5], Anas Abidin[4], Kevin Eaton[6], Howard Antony Riina[1], Ilya Laufer[1], Paawan Punjabi[6], Madeline Miceli[6], Nora C. Kim[1], Cordelia Orillac[1], Zane Schnurman[1], Christopher Livia[1], Hannah Weiss[1], David Kurland[1], Sean Neifert[1], Yosef Dastagirzada[1], Douglas Kondziolka[1], Alexander T. M. Cheung[1], Grace Yang[1,2], Ming Cao[1,2], Mona Flores[4], Anthony B. Costa[4], Yindalon Aphinyanaphongs[5,7], Kyunghyun Cho[2,8,9,10] & Eric Karl Oermann[1,2,11]✉

Nature | Vol 619 | 13 July 2023 | 357

-unstructured clinical notes + clinical large language models= all-purpose clinical predictive engines





Artificial Intellegence

Is Something We No Longer Talk About

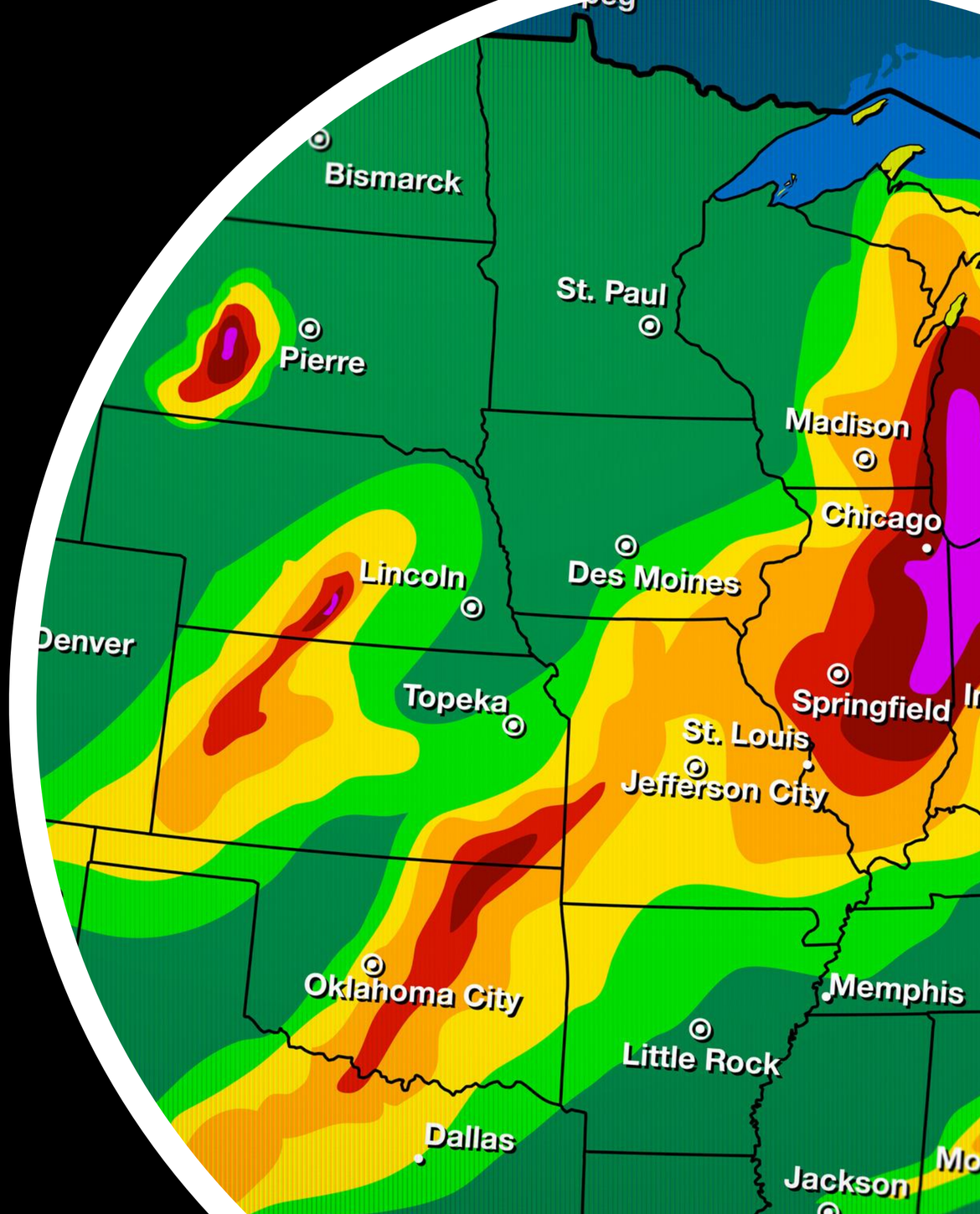
AS A NEW SHINEY BRIGHT OBJECT

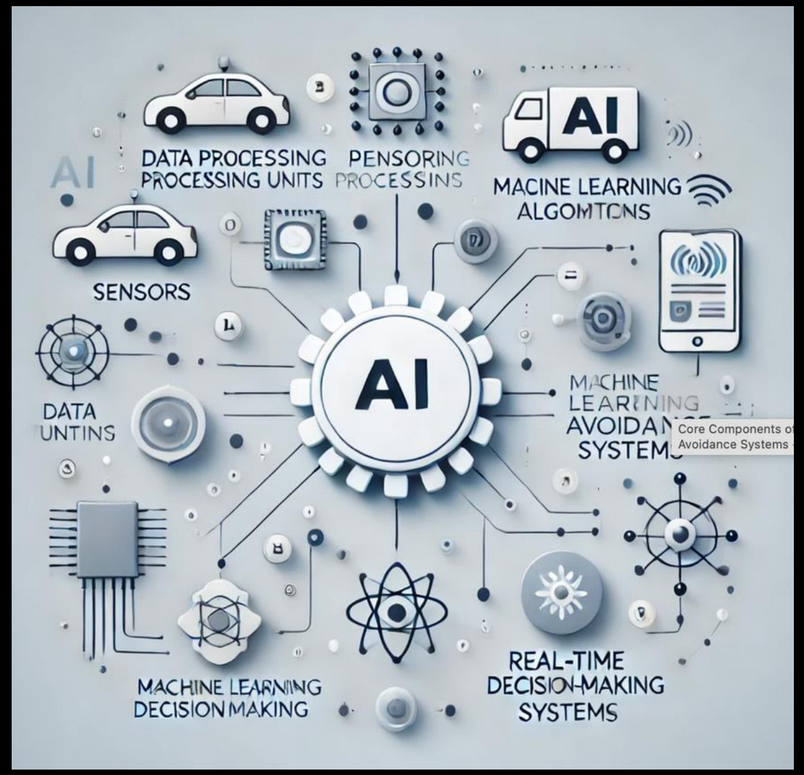
Artificial Intellegence

But Instead, Leverage to Augment Our Care

Weather Forecast Modeing

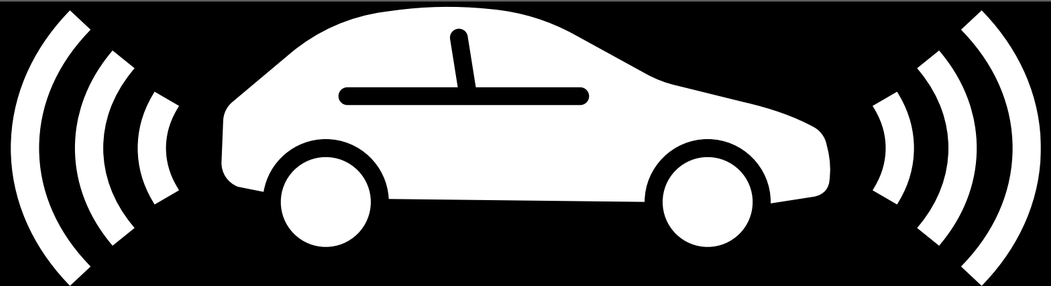
GRAPHCAST- Google DeepMind





Automobile warning systems

Computer Vision

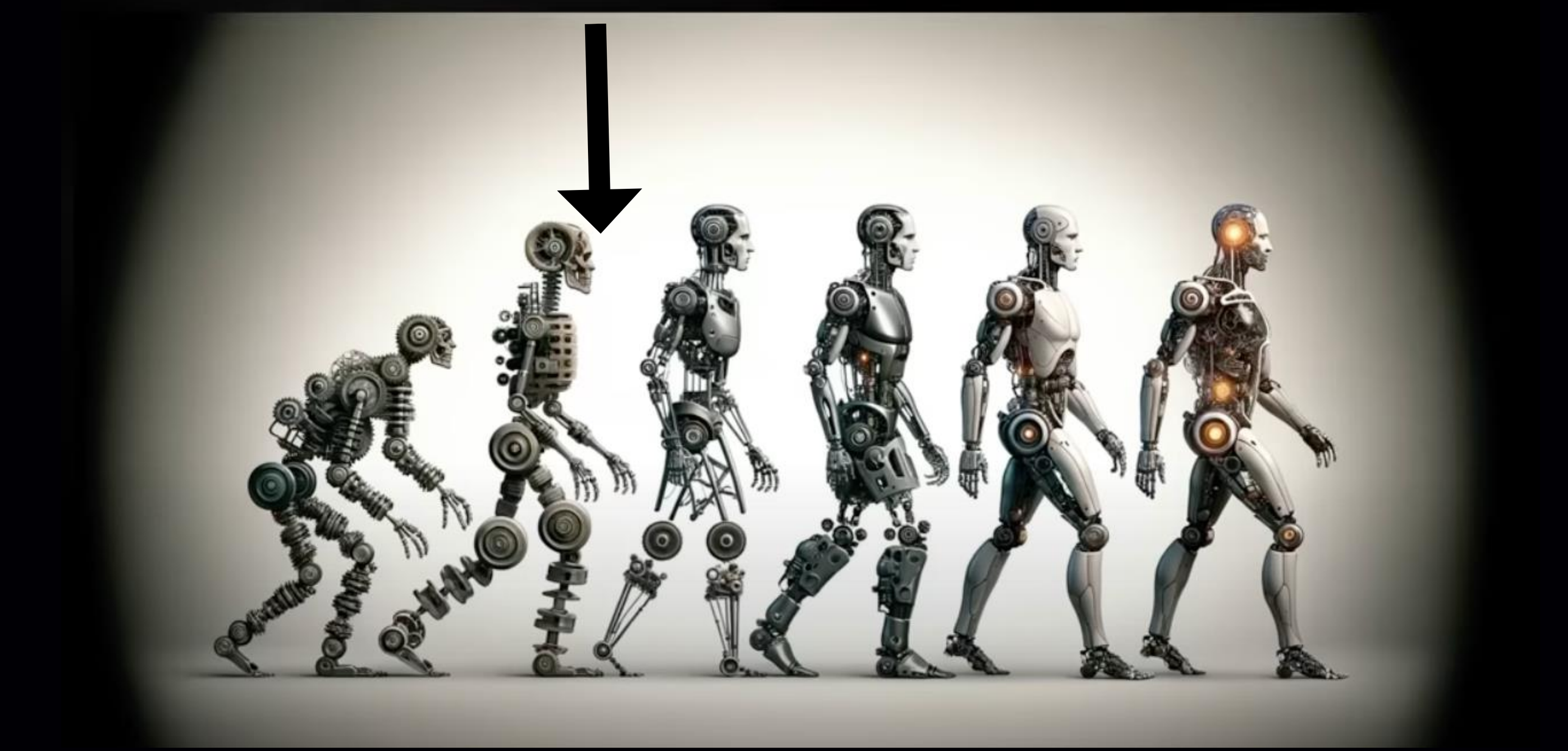


Facial Recognition Systems

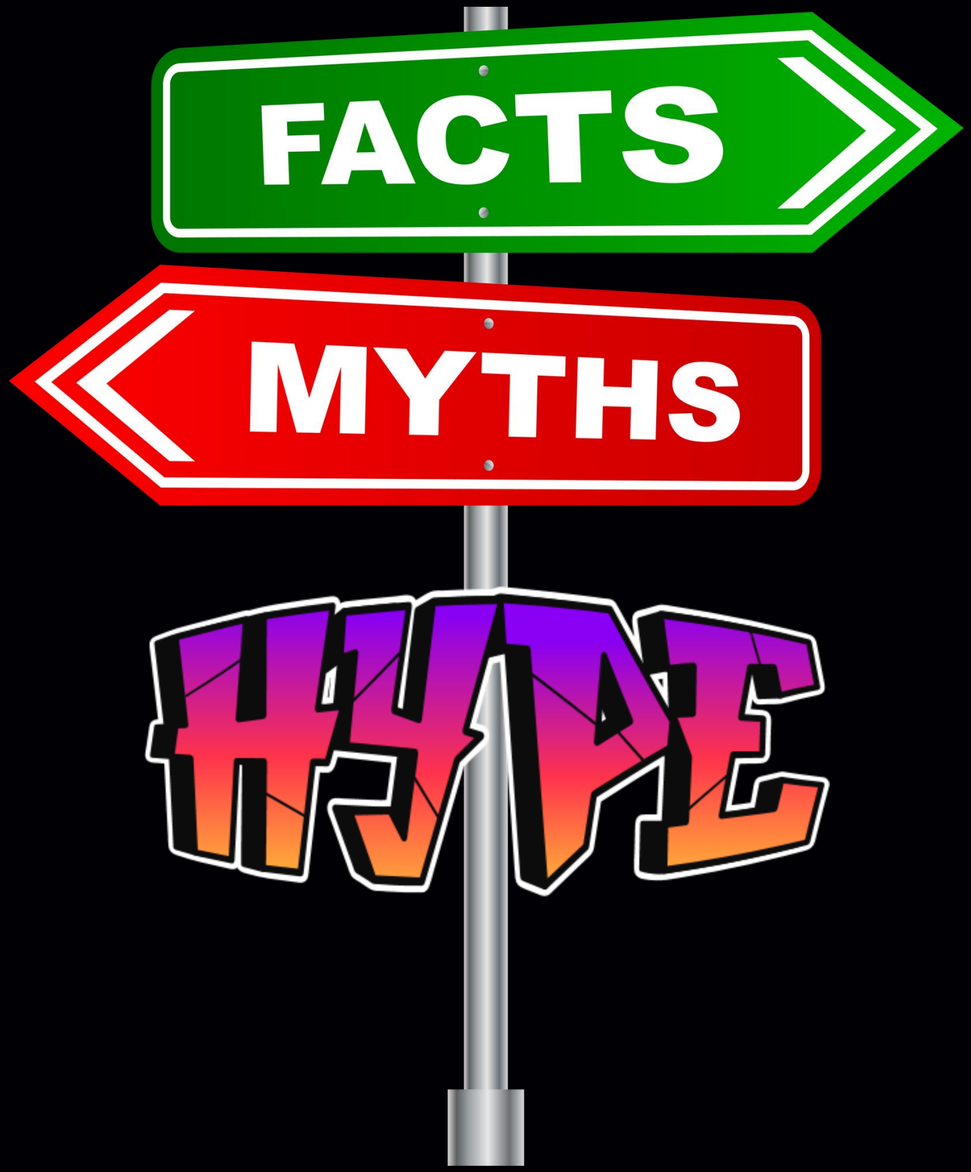
Computer Vision

Content recommendations

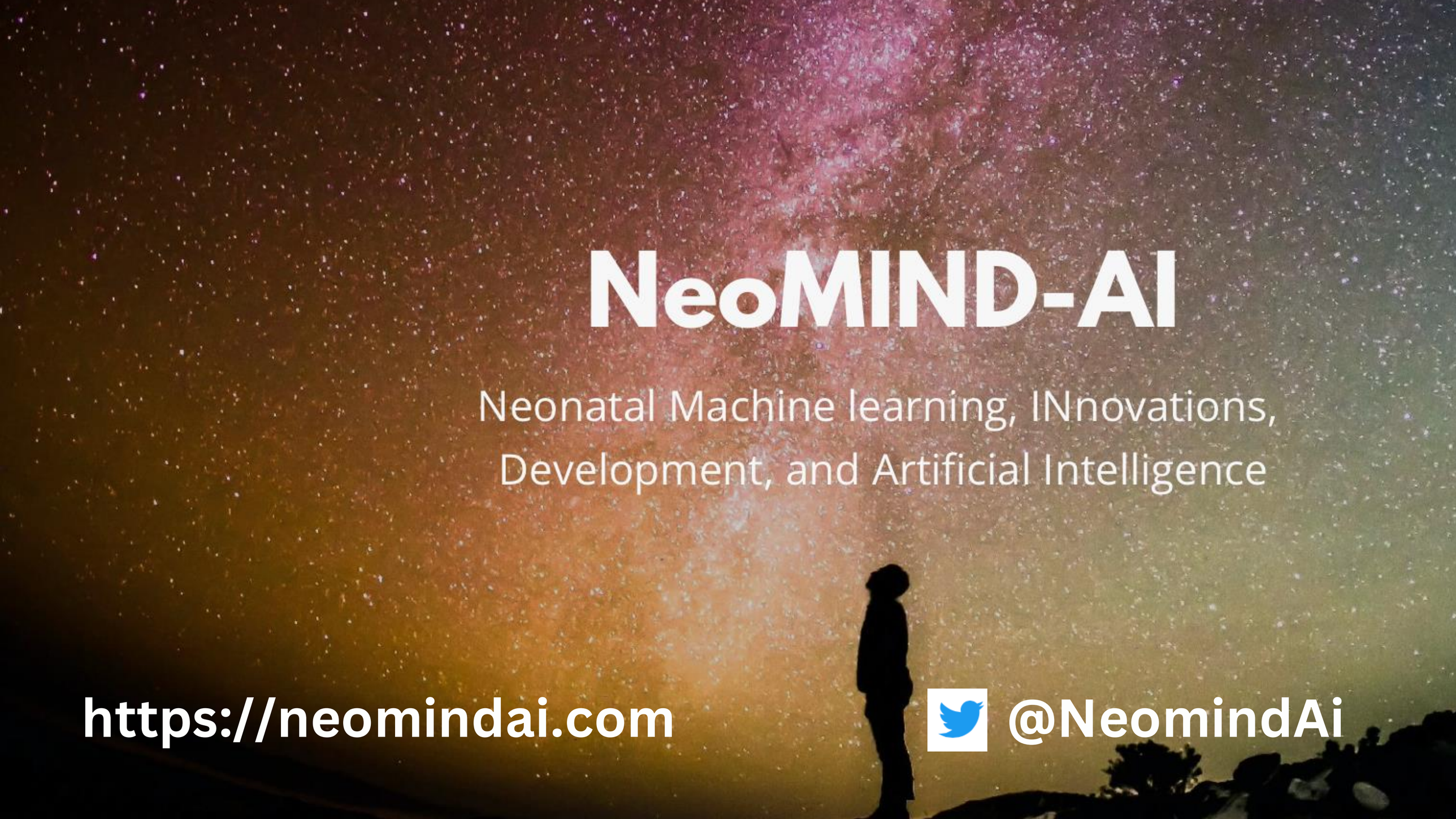
AI and Data Science



Exponential



Critical Optimist


NeoMIND-AI
Neonatal Machine learning, INnovations,
Development, and Artificial Intelligence
https://neomindai.com
@NeomindAi

Sci Rep. 2021 Mar 31;11(1):7308. doi: 10.1038/s41598-021-86748-4.

Predicting mortality risk for preterm infants using random forest

Journal of Perinatology www.nature.com/jp

REVIEW ARTICLE

Predicting clinical outcomes using artificial intelligence and machine learning in neonatal intensive care units: a systematic review

Ryan M. McAdams[1,5], Ravneet Kaur[2,5], Yao Sun[3], Harlieen Bindra[2], Su Jin Cho[4] and Harpreet Singh[2]✉

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Research Letter

July 17, 2023

Performance of a Large Language Model on Practice Questions for the Neonatal Board Examination

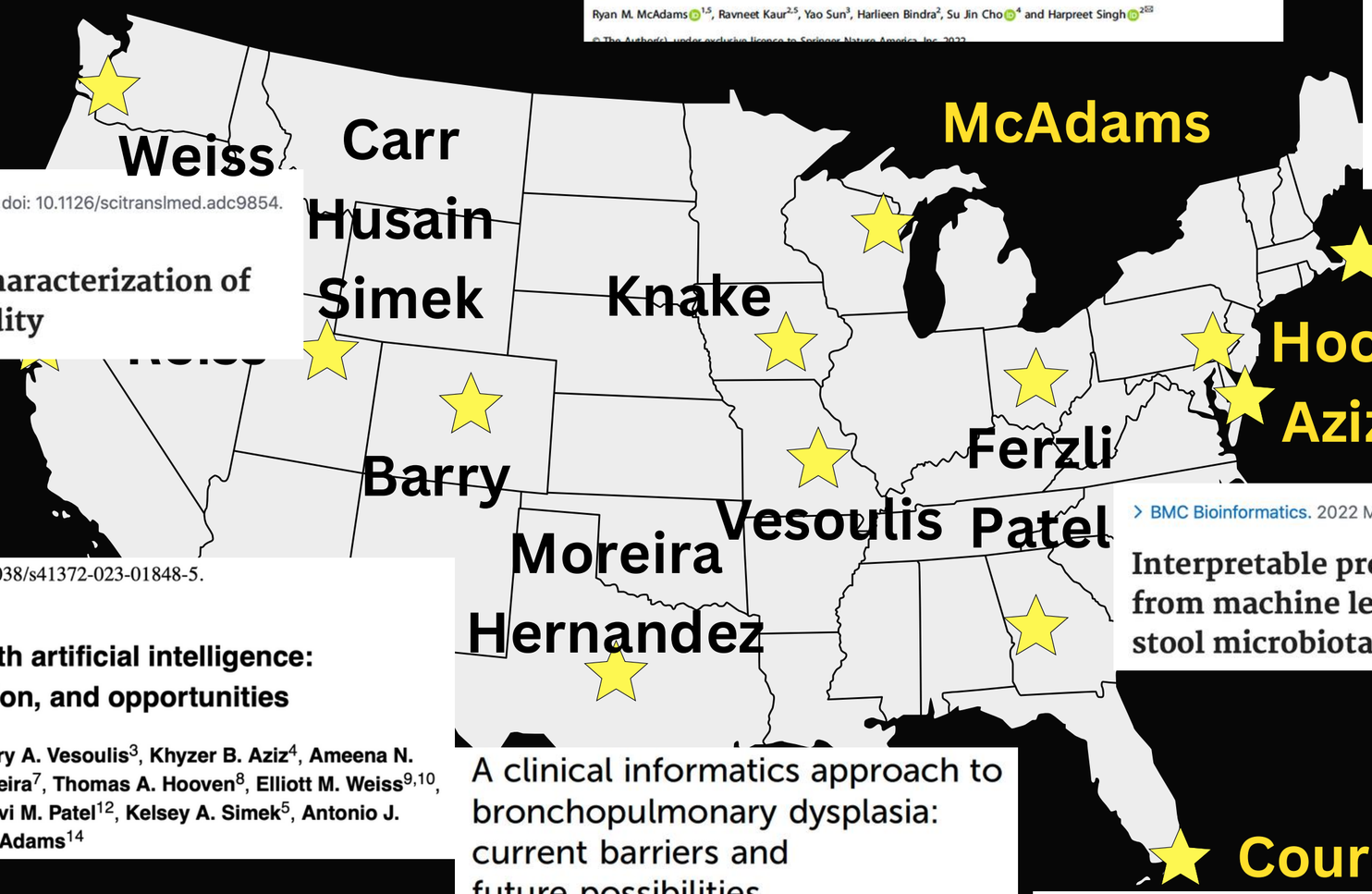
Kristyn Beam, MD, MPH[1]; Puneet Sharma, MD[2]; Bhawesh Kumar, BS[3]; et al

Author Affiliations | Article Information

JAMA Pediatr. 2023;177(9):977-979. doi:10.1001/jamapediatrics.2023.2373

Sci Transl Med. 2023 Feb 15;15(683):eadc9854. doi: 10.1126/scitranslmed.adc9854. Epub 2023 Feb 15.

Data-driven longitudinal characterization of neonatal health and morbidity



J Perinatol. 2024 January ; 44(1): 1–11. doi:10.1038/s41372-023-01848-5.

Transforming neonatal care with artificial intelligence: challenges, ethical consideration, and opportunities

Brynne A. Sullivan[1], Kristyn Beam[2], Zachary A. Vesoulis[3], Khyzer B. Aziz[4], Ameena N. Husain[5], Lindsey A. Knake[6], Alvaro G. Moreira[7], Thomas A. Hooven[8], Elliott M. Weiss[9,10], Nicholas R. Carr[5], George T. El-Ferzli[11], Ravi M. Patel[12], Kelsey A. Simek[5], Antonio J. Hernandez[7], James S. Barry[13], Ryan M. McAdams[14]

BMC Bioinformatics. 2022 Mar 25;23(1):104. doi: 10.1186/s12859-022-04618-w.

Interpretable prediction of necrotizing enterocolitis from machine learning analysis of premature infant stool microbiota

A clinical informatics approach to bronchopulmonary dysplasia: current barriers and future possibilities

Alvaro G. Moreira[1*], Ameena Husain[2†], Lindsey A. Knake[3†], Khyzer Aziz[4†], Kelsey Simek[2†], Charles T. Valadie[1], Nisha Reddy Pandillapalli[1], Vanessa Trivino[1] and James S Barry[5] for Neonatal Machine learning INnovations Development Intelligence (NeoMIND-AI)

Randomized Controlled Trial

Am J Physiol Lung Cell Mol Physiol. 2023 Jan 1;324(1):L76-L87. doi: 10.1152/ajplung.00250.2022. Epub 2022 Dec 6.

Development of a peripheral blood transcriptomic gene signature to predict bronchopulmonary dysplasia

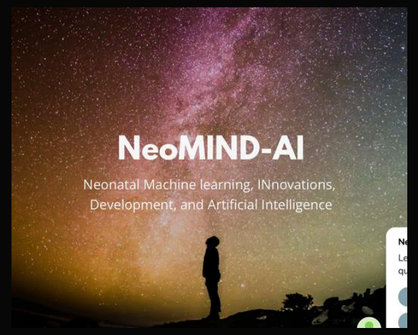
AI = Augmented Intelligence

It is not a panacea and it will not replace you

THANKS FOR LETTING ME SHARE TODAY! ALWAYS HAPPY TO CHAT

email- james.barry@cuanschutz.edu

Linked in- -
www.linkedin.com/in/jamesbarry3636



https://neomindai.com/committee