AI & Oncology: Managing the Tsunami of Medical Information

University of Pennsylvania
Biomedical Research Building
421 Curie Boulevard
Philadelphia, PA 19104

June 21, 2024

ClinPGx 2024

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President, ACCC 2022-2023

Disclosures

Name	Employment	Funding Sources	Ownership & investments	Leadership
David R. Penberthy, MD, MBA	UVa Health AstraZeneca Startups and Real Estate	None	CHS stock Mutual funds Startup - ROMTech Startup – TensorBlack	ACCC Board of Trustees

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Ryan Langdale

for their assistance with this presentation

Learning objectives

- Statement of the cancer problem
- Current state of multidisciplinary care
- AI and Future directions

ACCC
ASSOCIATION OF CANCER CARE CENTERS™
50 Years STRONG

- Powerful network of >41,000 multidisciplinary practitioners from over 2100 hospitals and practices nationwide in every state
- ~2/3 of the nation's cancer patients are treated by a member of ACCC

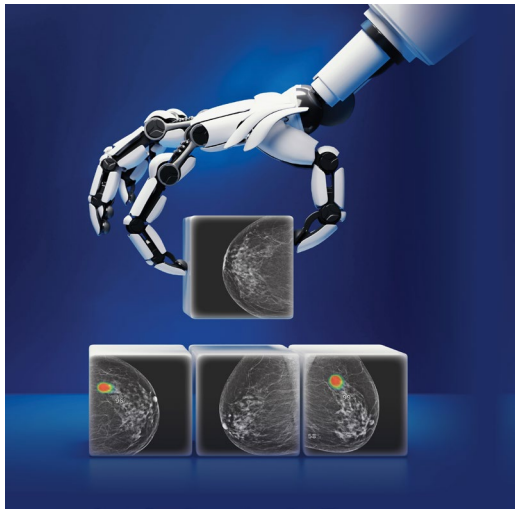
www.accc-cancer.org

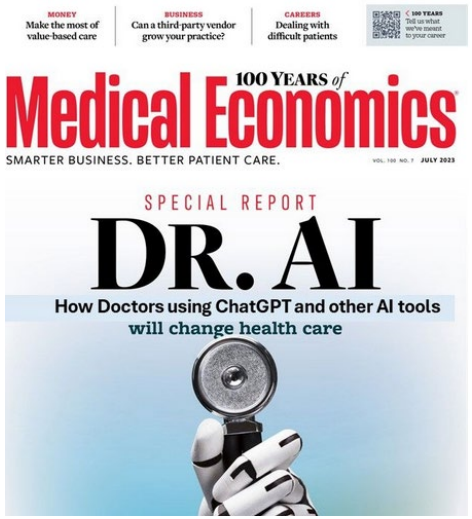

nature medicine
AI-guided cancer radiotherapy


Science Focus
The life and times of
FUNGAL BODY SNATCHERS
The hunt for
TINY KILLER ASTEROIDS
Could the
UK'S TAP WATER RUN OUT?
AI

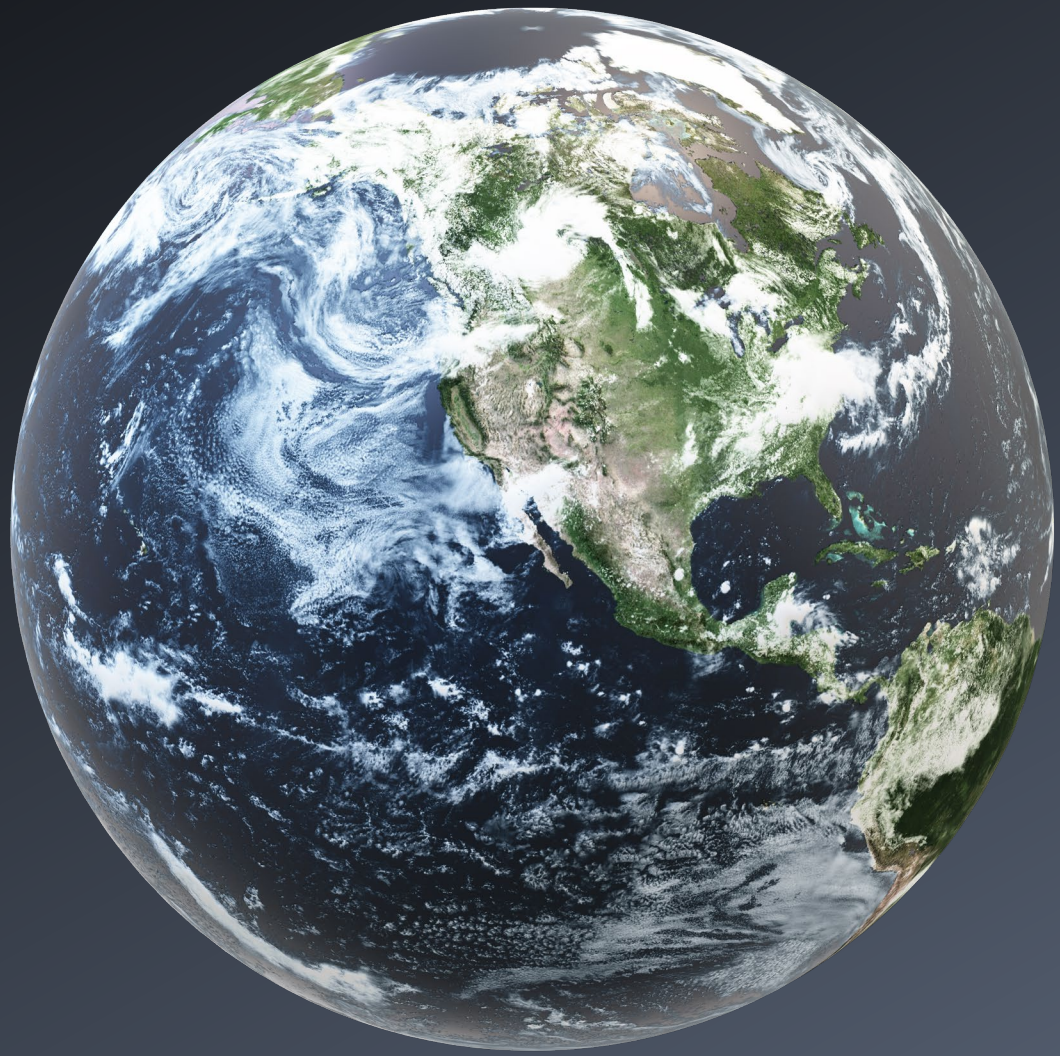

12.01-08.2023
Newsweek
CAN AI BEAT
CANCER?


SPECIAL
TIME
EDITION
THE FUTURE
OF MEDICINE
Amazing
Breakthroughs
How Artificial




MONEY
Make the most of value-based care
BUSINESS
Can a third-party vendor grow your practice?
CAREERS
Dealing with difficult patients
100 YEARS
Tell us what we've meant to your career
100 YEARS of
Medical Economics
SMARTER BUSINESS. BETTER PATIENT CARE.
JULY 2023
SPECIAL REPORT
DR. AI
How Doctors using ChatGPT and other AI tools
will change health care

Magnitude



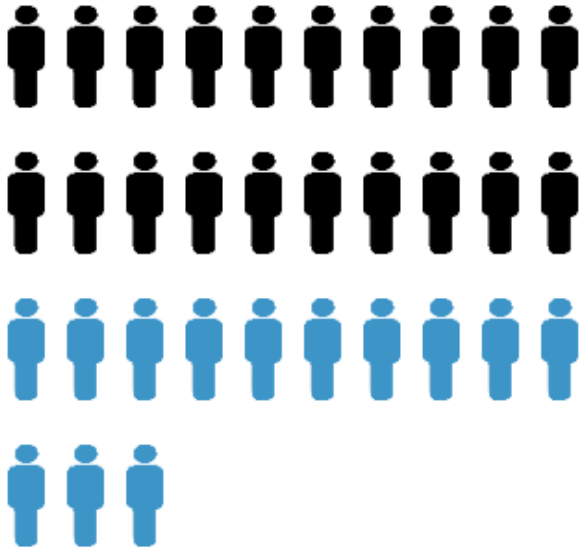
Estimated number of new cases from 2022 to 2045, Both sexes, age [0-85+]
All cancers
World

GLOBAL CANCER OBSERVATORY

2022

20.0M

2045



32.6M

= 1 000 000 Demographic changes

Cancer Tomorrow | **IARC** – https://gco.iarc.who.int
Data version: Globocan 2022 (version 1.1) – 08.02.2024

International Agency for Research on Cancer
World Health Organization

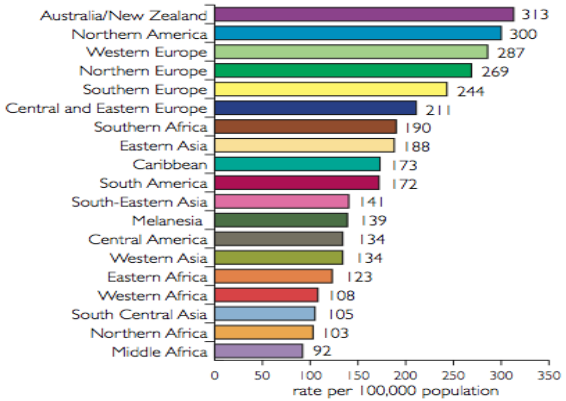
CANCER RESEARCH UK

International Agency for Research on Cancer

World Health Organization

Cancer Incidence Worldwide

Breakdown of the estimated 12.7 million new cases, World-age standardised incidence rates and the most commonly diagnosed cancers by the different regions of the world, 2008.



Northern America
Numbers 1,603,870
Lung 15%
Prostate 13%
Breast 13%
Colorectum 11%

Western Europe
Numbers 1,029,993
Prostate 16%
Breast 14%
Colorectum 13%
Lung 11%

Northern Europe
Numbers 482,080
Breast 15%
Prostate 13%
Colorectum 13%
Lung 12%

Central and Eastern Europe
Numbers 983,408
Lung 14%
Colorectum 13%
Breast 12%
Stomach 7%

Southern Europe
Numbers 713,401
Colorectum 14%
Breast 13%
Lung 12%
Prostate 11%

Eastern Asia
Numbers 3,720,658
Lung 17%
Stomach 16%
Liver 13%
Colorectum 10%

Northern Africa
Numbers 164,350
Breast 17%
Lung 7%
Bladder 7%
Non-Hodgkin lymphoma 7%

Caribbean
Numbers 79,347
Prostate 20%
Breast 11%
Lung 11%
Colorectum 9%

Western Africa
Numbers 184,071
Breast 16%
Cervix uteri 16%
Liver 11%
Prostate 7%

Western Asia
Numbers 223,042
Breast 13%
Lung 12%
Colorectum 8%
Stomach 7%

South-Eastern Asia
Numbers 725,446
Lung 14%
Breast 12%
Liver 10%
Colorectum 9%

Central America
Numbers 176,564
Prostate 12%
Breast 10%
Cervix uteri 9%
Stomach 8%

Middle Africa
Numbers 66,895
Liver 16%
Breast 12%
Cervix uteri 12%
Prostate 6%

South-Central Asia
Numbers 1,423,213
Cervix uteri 12%
Breast 12%
Lung 7%
Lip, oral cavity 7%

Melanesia
Numbers 7,028
Lip, oral cavity 12%
Cervix uteri 10%
Breast 9%
Liver 7%

South America
Numbers 650,097
Breast 14%
Prostate 13%
Lung 8%
Colorectum 7%

Southern Africa
Numbers 79,179
Breast 11%
Prostate 10%
Oesophagus 9%
Cervix uteri 8%

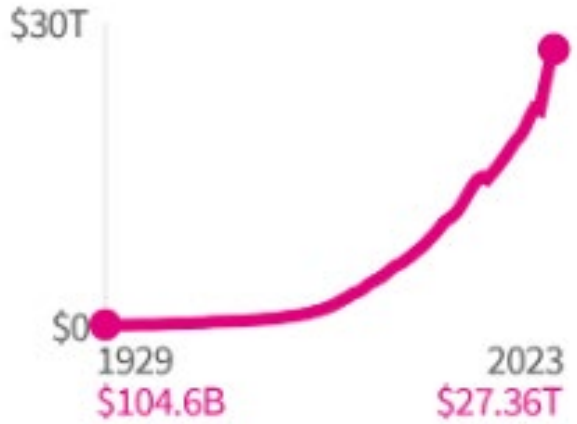
Eastern Africa
Numbers 221,076
Cervix uteri 14%
Kaposi sarcoma 11%
Breast 8%
Oesophagus 7%

Australia/New Zealand
Numbers 127,022
Prostate 17%
Colorectum 14%
Breast 13%
Melanoma of skin 11%

Source: GLOBOCAN 2008, v. 1.2, Cancer Incidence and Mortality Worldwide. IARC, 2010 (http://globocan.iarc.fr)
Map updated February 2011

http://info.cancerresearchuk.org/cancerstats/

GDP issues

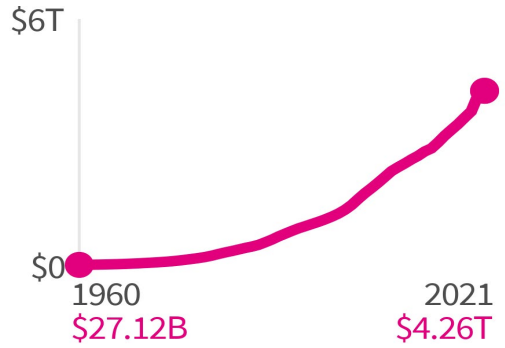


Gross domestic product

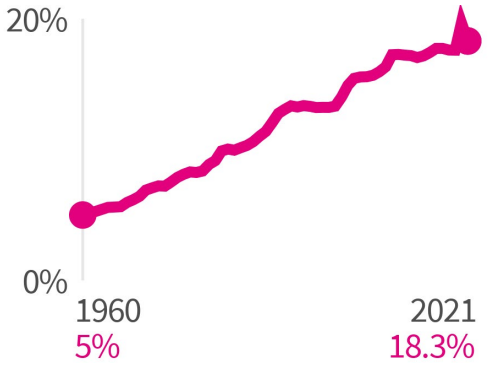
$27.36 trillion

2023

National spending on healthcare goods and services

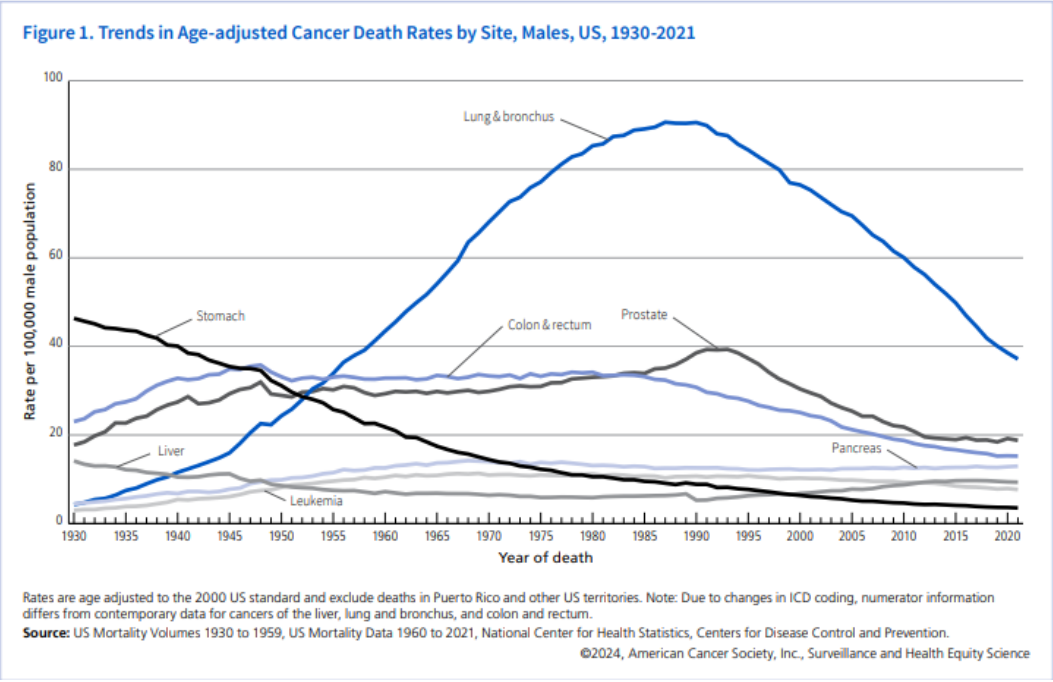


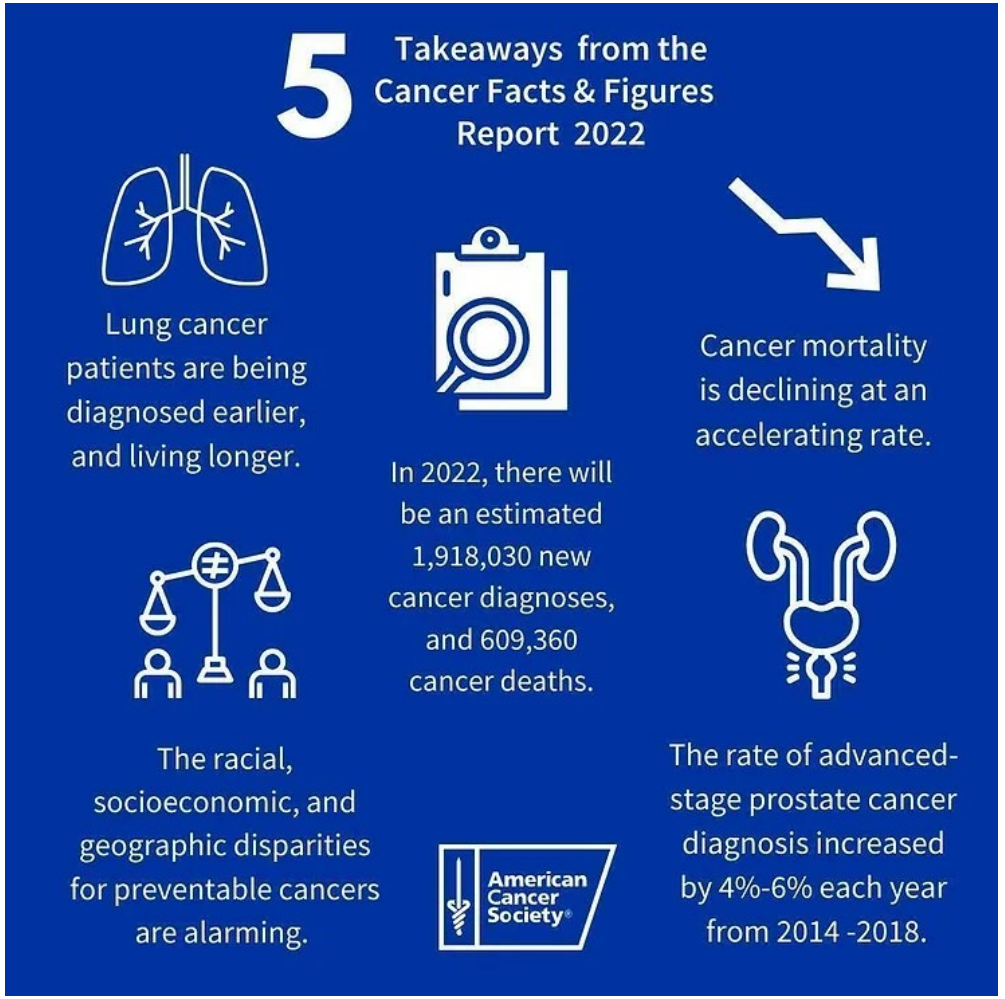
Healthcare expenditures as a percent of GDP

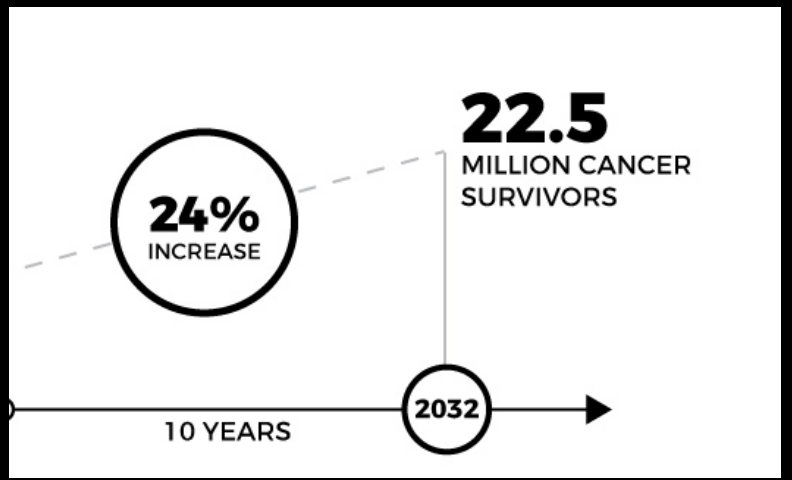


Source: Health – USAFacts accessed 2/1/24

So how are we doing?

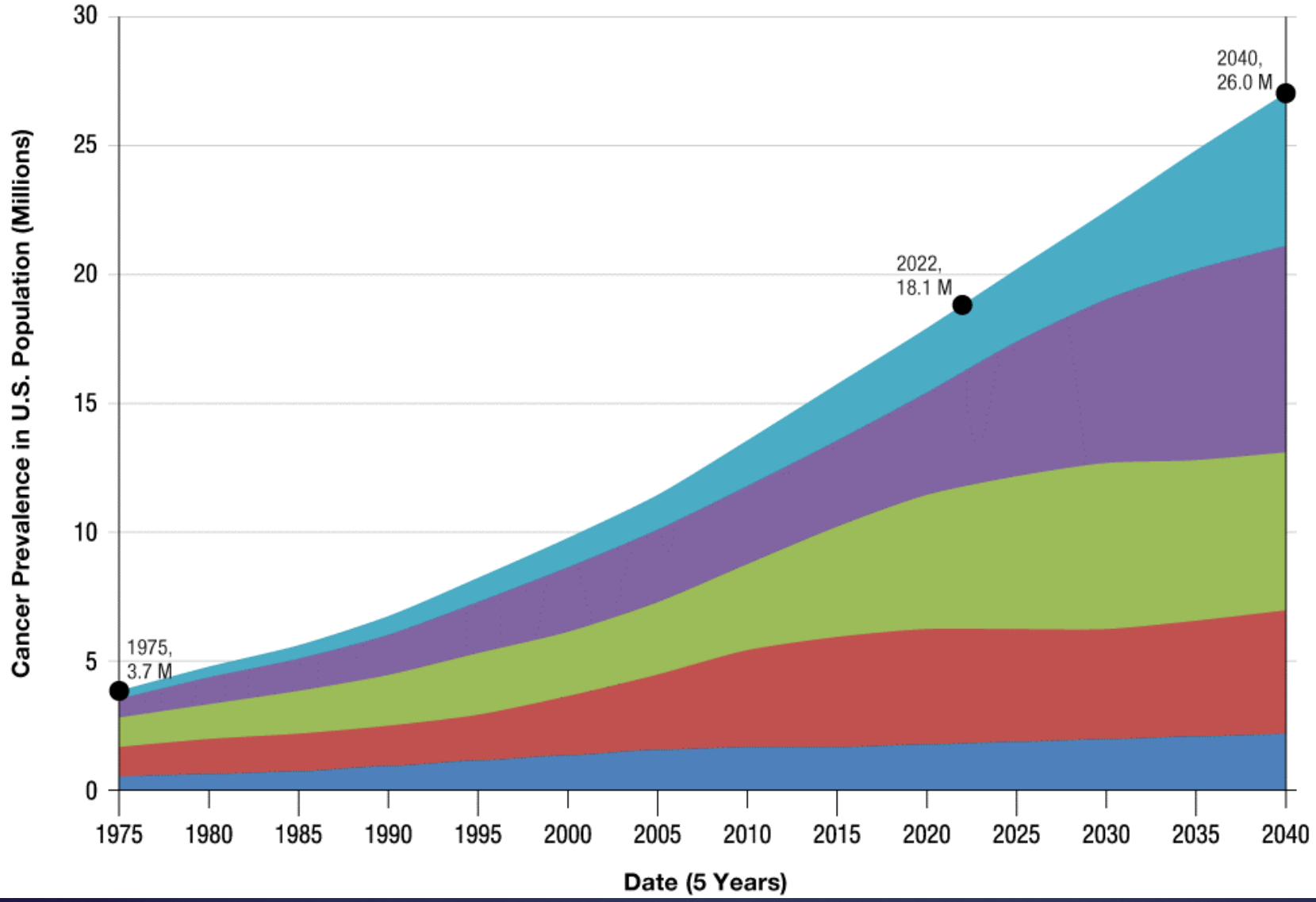


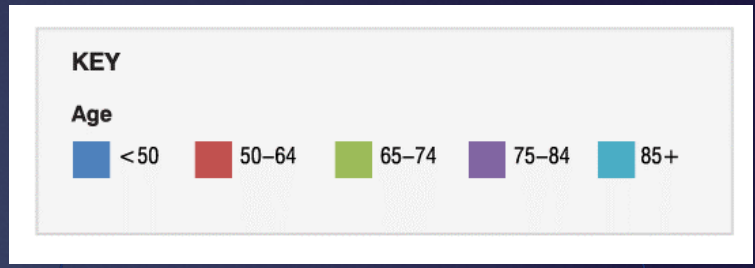




Source: Statistics and Graphs | Division of Cancer Control and Population Sciences (DCCPS) accessed 2/1/24

Cancer Prevalance and Projections in U.S. Population from 1975–2040



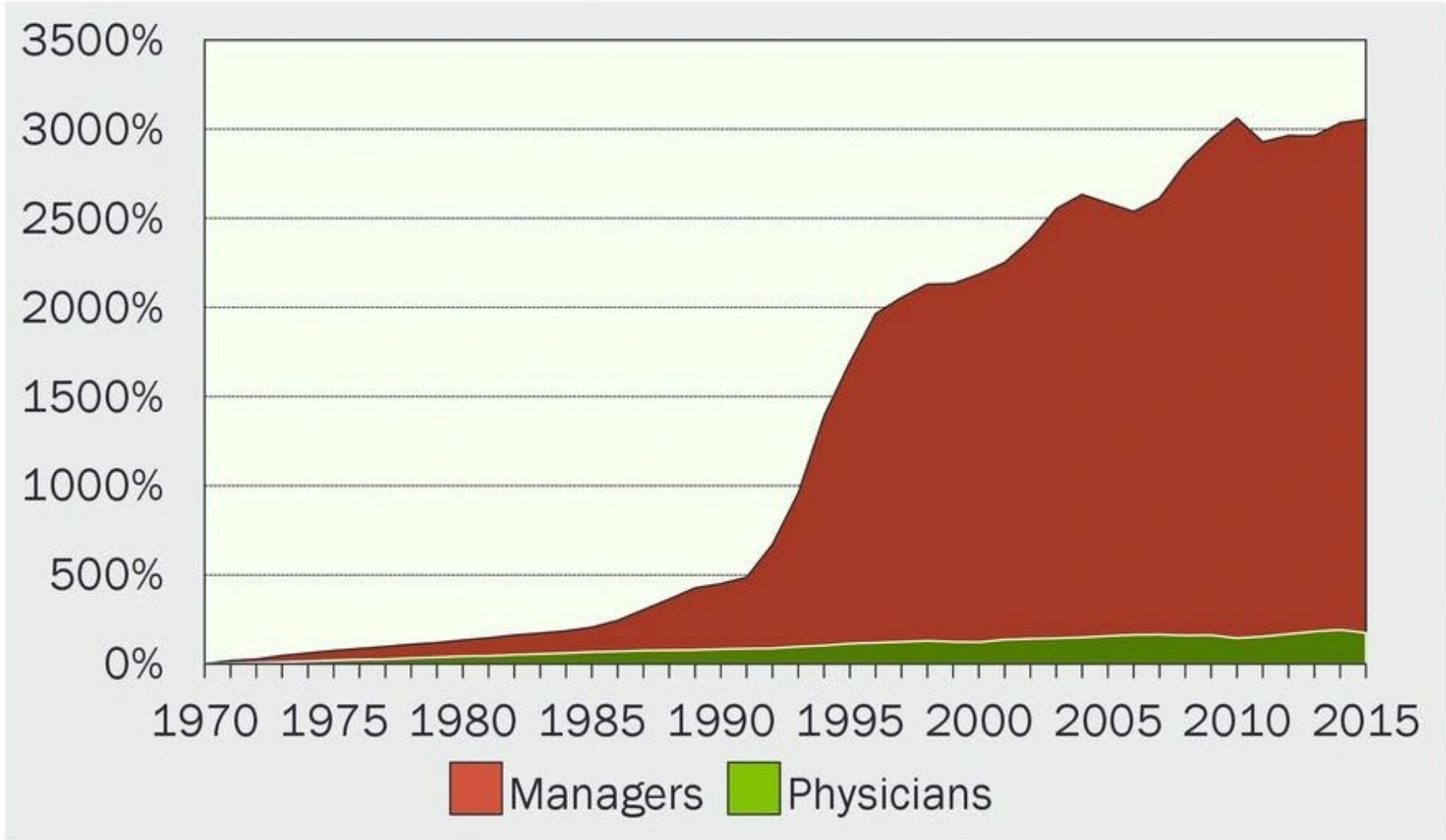


REFERENCES:

Adapted from Bluethmann SM, Mariotto AB, Rowland JH. Anticipating the "Silver Tsunami": Prevalence Trajectories and Comorbidity Burden among Older Cancer Survivors in the United States. Cancer Epidemiol Biomarkers Prev. 2016 Jul;25(7):1029-36.

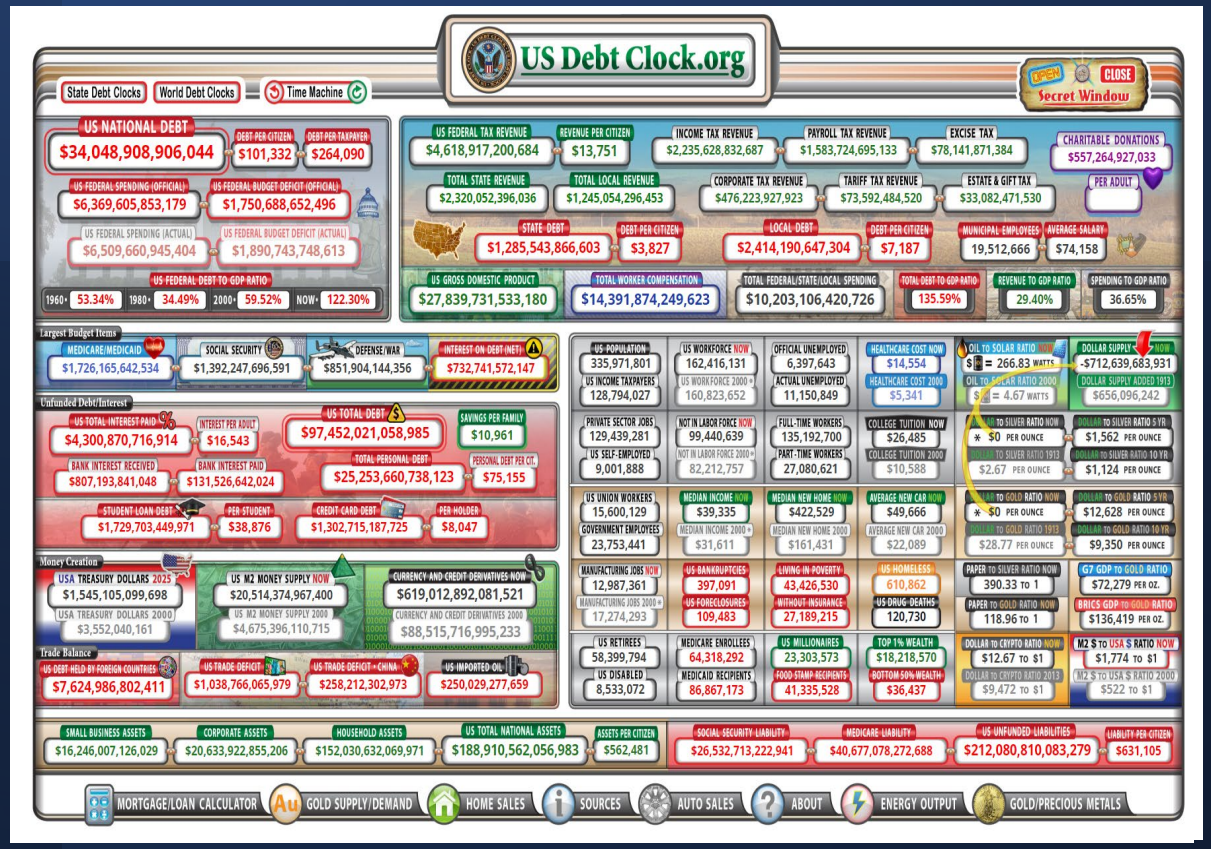
Miller KD, Nogueira L, Devasia T, Mariotto AB, Yabroff KR, Jemal A, Kramer J and Siegel RL. Cancer Treatment and Survivorship Statistics. CA A Cancer J Clin. 2022.

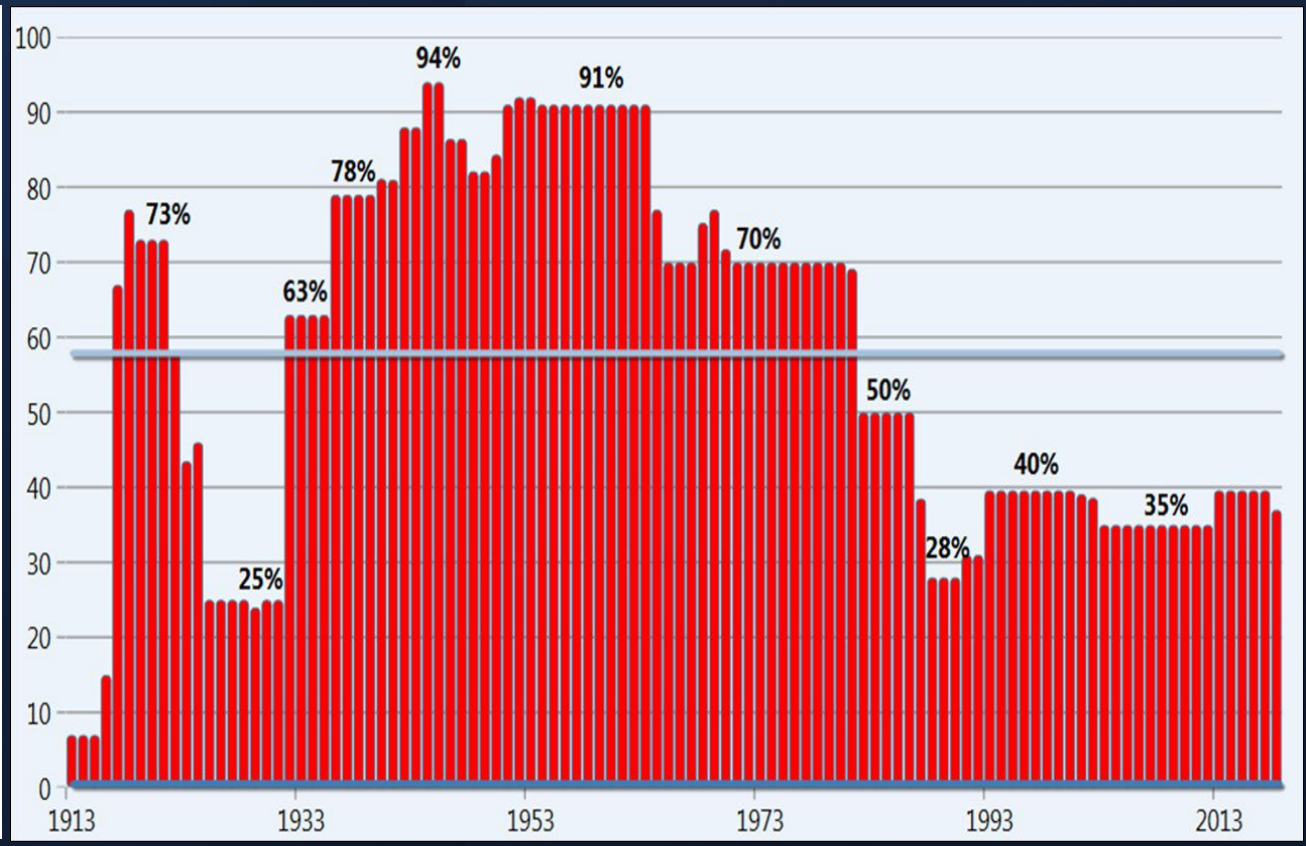
Growth of Physicians and Administrators in U.S.



Bureau of Labor Statistics; NCHS; Himmelstein/Woolhandler analysis of CPS
Managers shown as moving average of current year and two previous years

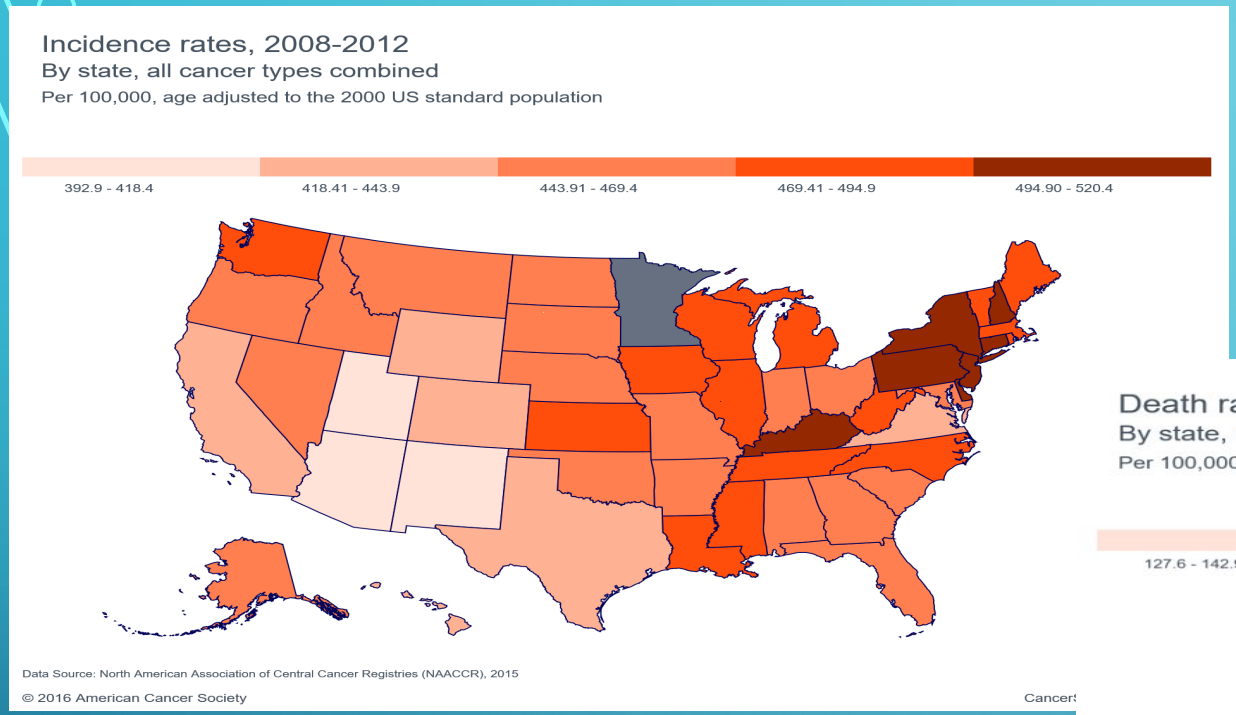
US Debt and Taxes

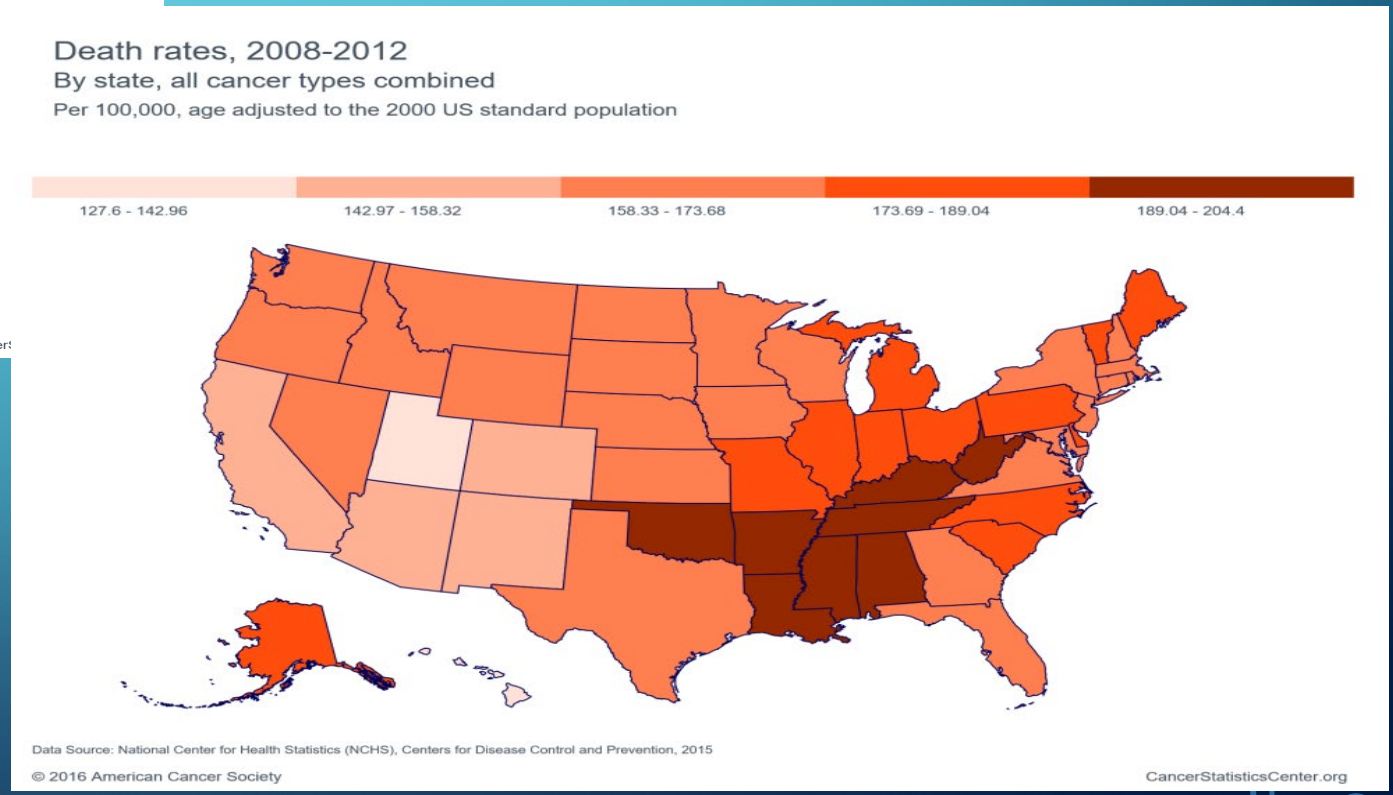




National debt $34T and counting
www.usdebtclock.org

US CANCER INCIDENCE AND MORTALITY





THE MEDICAL LITERATURE TSUNAMI

Pubmed

Daily: ~4,000 Weekly: ~28,000 Monthly: ~120,000

Annually: ~1.44 million articles

10% oncology related

Daily - ~400 Weekly - ~2800 Monthly – ~12,000

Annually- ~144,000

These figures only represent a fraction of the medical information being generated, as they do not account for other sources like clinical trials, patents, guidelines, conference proceedings, and more. Additionally, the growth of data in fields like genomics and digital health is further accelerating the expansion of medical information.

Growth of Guidelines

"Further approaches, including guideline stratification by evidence level and the use of artificial intelligence for decision support, should be investigated as ways to synthesize data and improve cancer decision-making."

JAMA Network | Open

Research Letter | Oncology

Changes in Length and Complexity of Clinical Practice Guidelines in Oncology, 1996-2019

Benjamin H. Kann, MD; Skyler B. Johnson, MD; Hugo J. W. L. Aerts, PhD; Raymond H. Mak, MD; Paul L. Nguyen, MD

Figure 1. Page Volume of National Comprehensive Cancer Network Clinical Practice Guidelines by Disease Site, 1996-2019

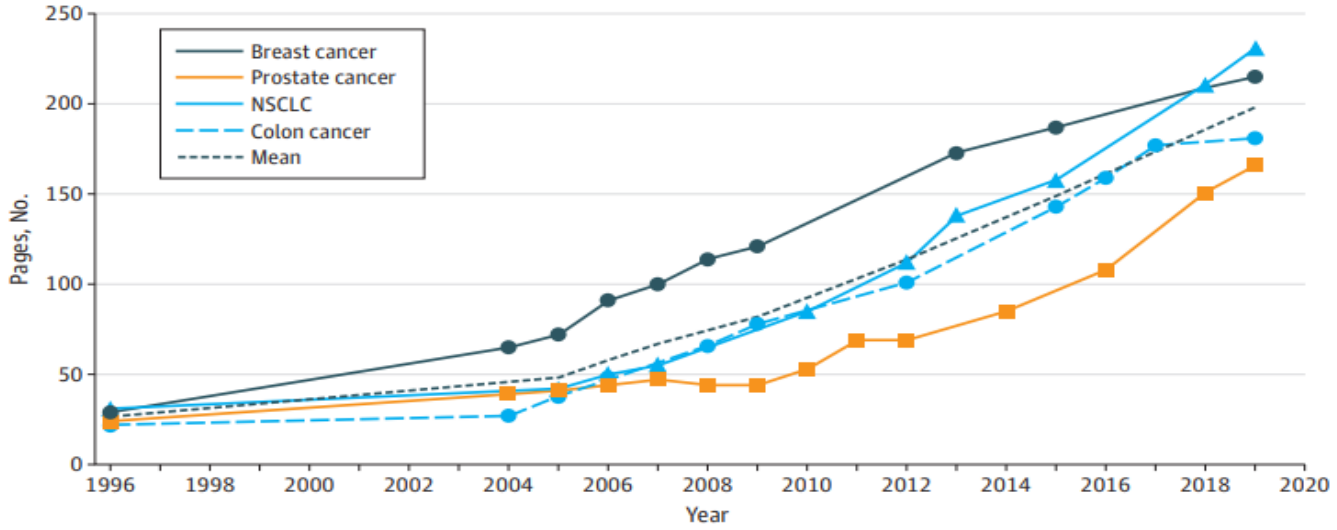
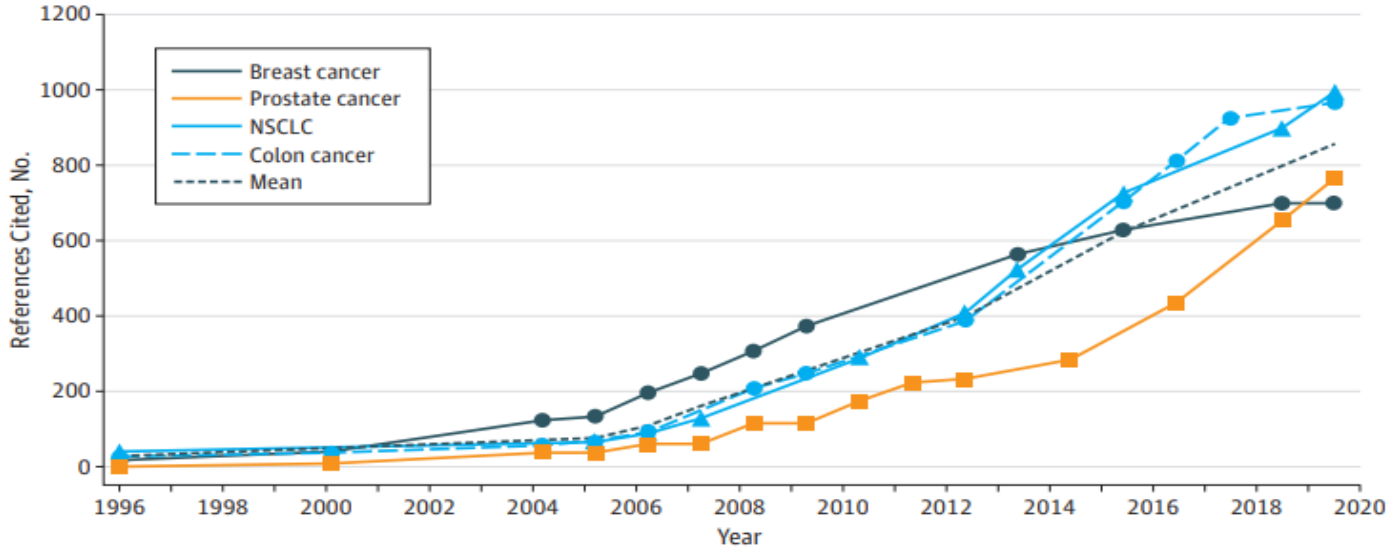
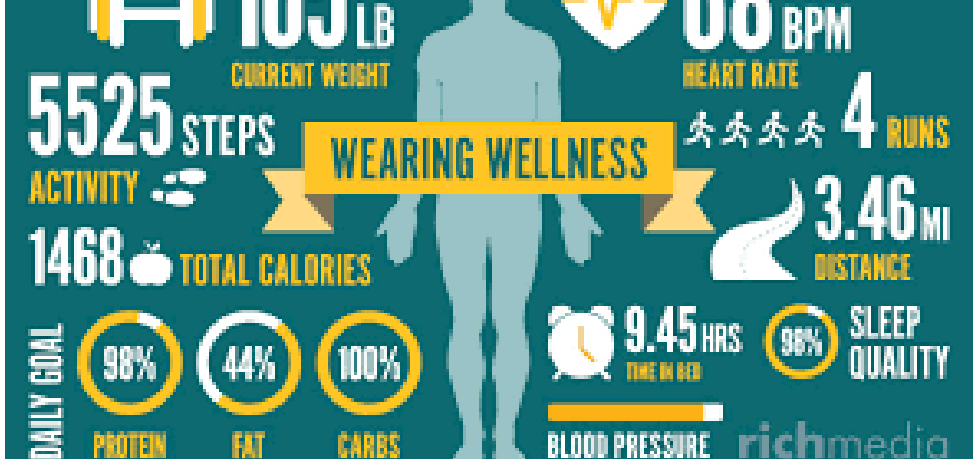


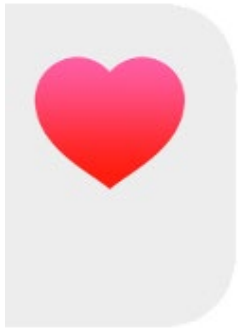
Figure 2. References Cited in National Comprehensive Cancer Network Clinical Practice Guidelines by Disease Site, 1996-2019



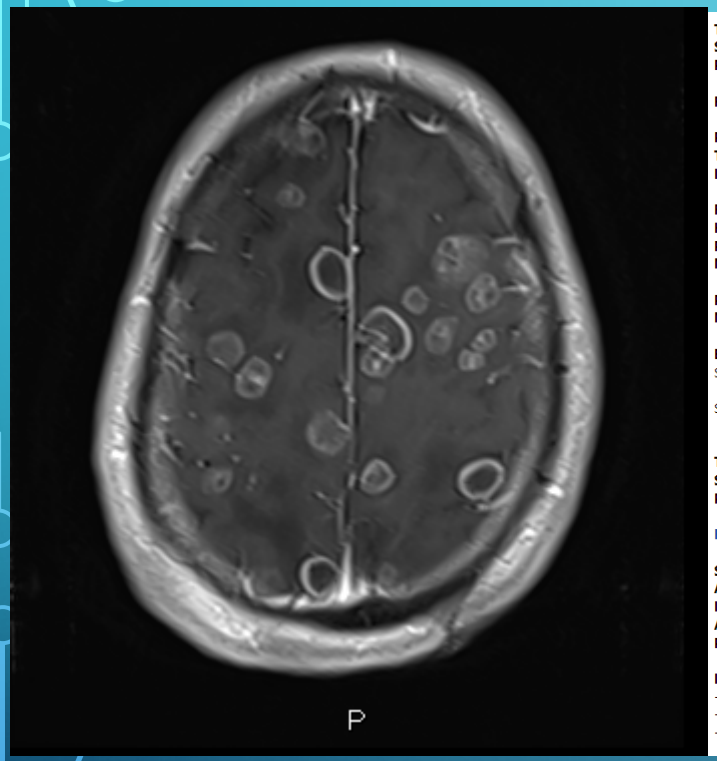


Google

HEALTH



FEEL GOOD CASE



Test Name: Histology Analysis Multiple Marker Panel
Specimen type: Lymph Node, Station 4R
Performed at : NeoGenomics Laboratories

Results

PD-L1 22C3 FDA for NSCLC: HIGH PD-L1 EXPRESSION
Tumor Proportion Score: 100%
Intensity: 3+

Reference Ranges

High PD-L1 Expression	**TPS >/=50%**
PD-L1 Expression	**TPS 1-49%**
No PD-L1 Expression	**TPS <1%**

Pan-TRK
Not Expressed

Electronic Signature
Scott Bourne, M.D.,Pathologist

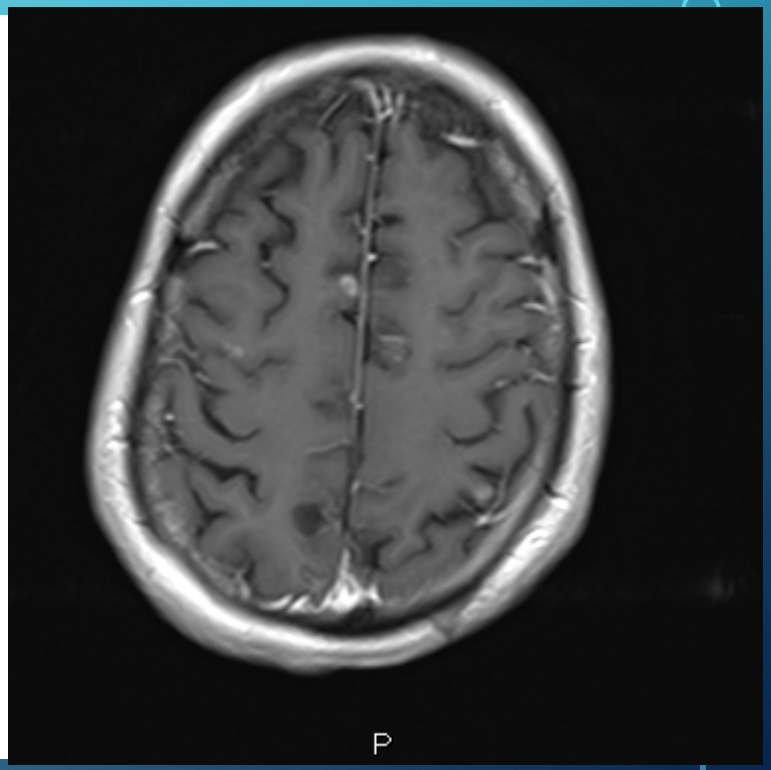
See attached report for further details.

Test Name: NeoTYPE Analysis Lung Tumor Profile
Specimen type: Lymph Node, Station 4R
Performed at : NeoGenomics Laboratories

Results Summary

SNVs/Indels: **ERBB2** Y772_A775dup; **TERT** promoter c.-124C>T
Alterations Detected By FISH: FISH report is not yet completed, see subsequent report
Immuno-Oncology Biomarkers: **Microsatellite Instability:** MSI - Stable (MSS); **PD-L1 22C3:** HIGH PD-L1 EXPRESSION; **Tumor Mutation Burden:** Intermediate
Additional Studies: **MET Exon 14 Deletion Analysis:** Not Detected; **Pan-TRK:** Not Expressed
Pertinent Negatives: NO alterations detected in the following genes: BRAF, EGFR, KRAS

Interpretation
- FLUORESCENCE IN SITU HYBRIDIZATION (FISH): Please refer to separate report for FISH details once results are available.
- The expression of PD-L1 suggests response to immunotherapy with anti-PD-1 or anti-PD-L1, which are FDA-approved for diverse solid tumor types.
- The VAF of the ERBB2 variant suggests ERBB2 (HER2) amplification. Clinical correlation with immunohistochemistry and/or FISH is recommended.



Her2 Exon 20 insertion mutation for which there is an FDA approved indication - Enhertu® (Traztuzumab deruxtecan)
*also did HER2 IHC and FISH testing, IHC reported 2+ equivocal, a distractor for someone who also treats breast cancer

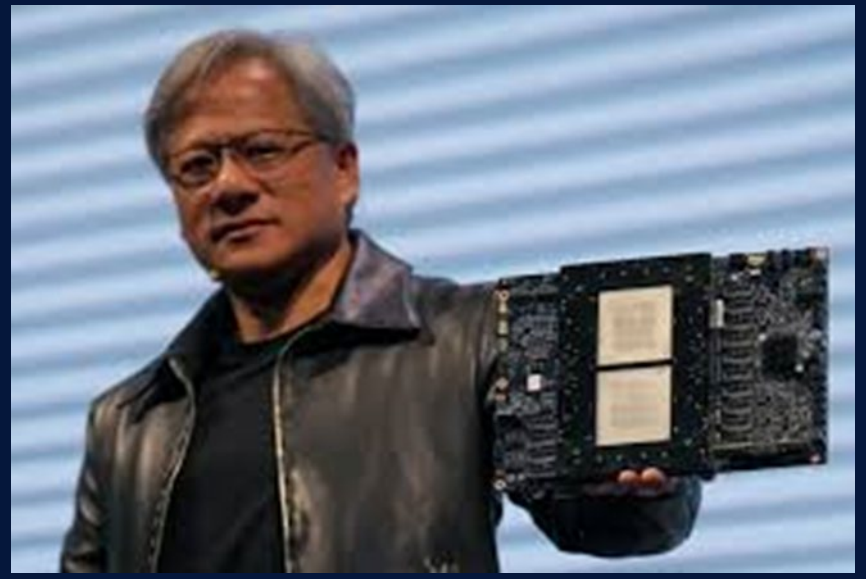
“It is often easier **(and faster)** to make something 10x better than it would be to make it 10% better.”

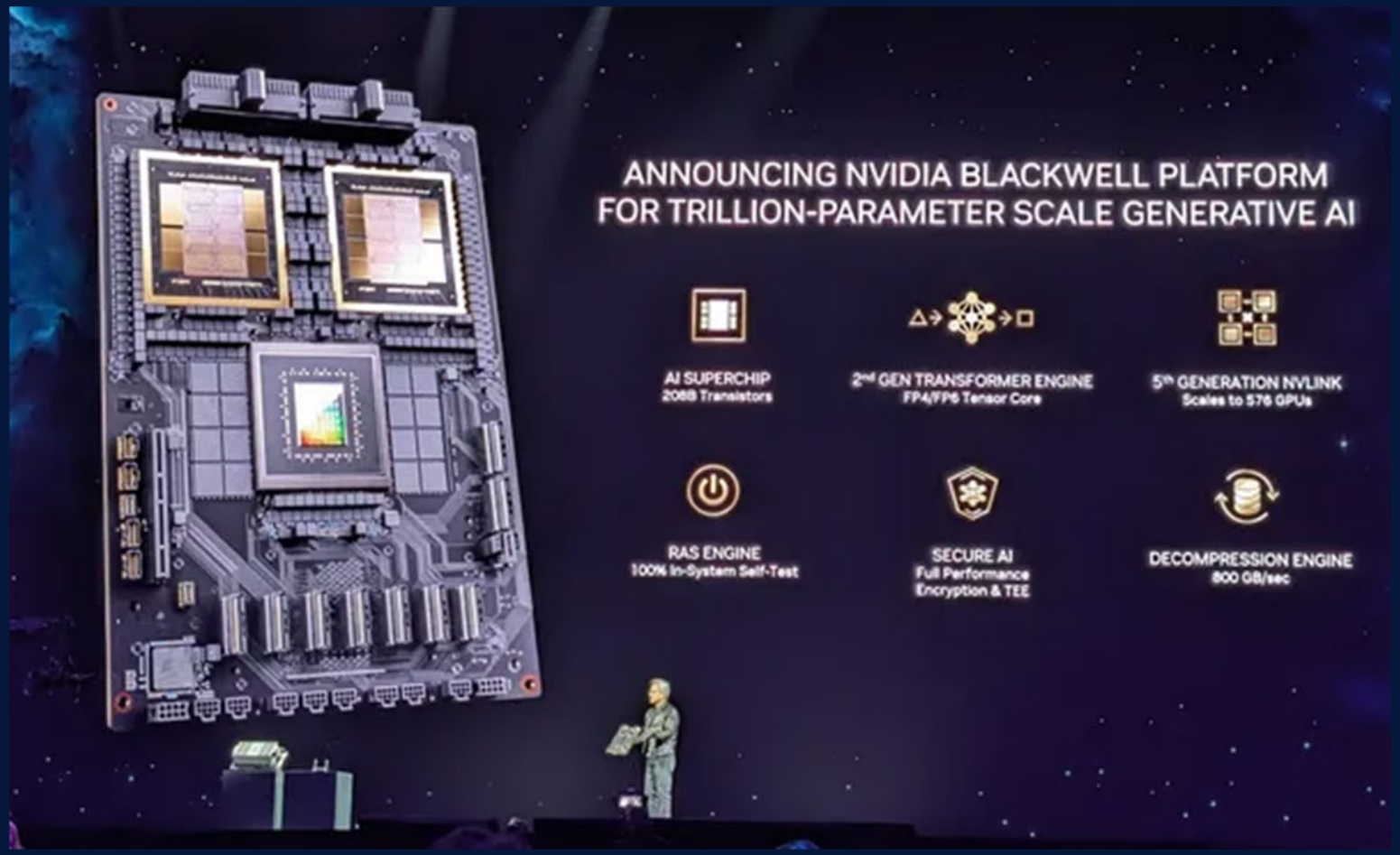
— Astro Teller

WHAT IS THIS?

- Bell Labs scientists invented the transistor in 1947, and won the 1956 Nobel Prize in Physics
  - John Bardeen
  - Walter Brattain
  - William Shockley
- John McCarthy coined the term “artificial intelligence” in 1956

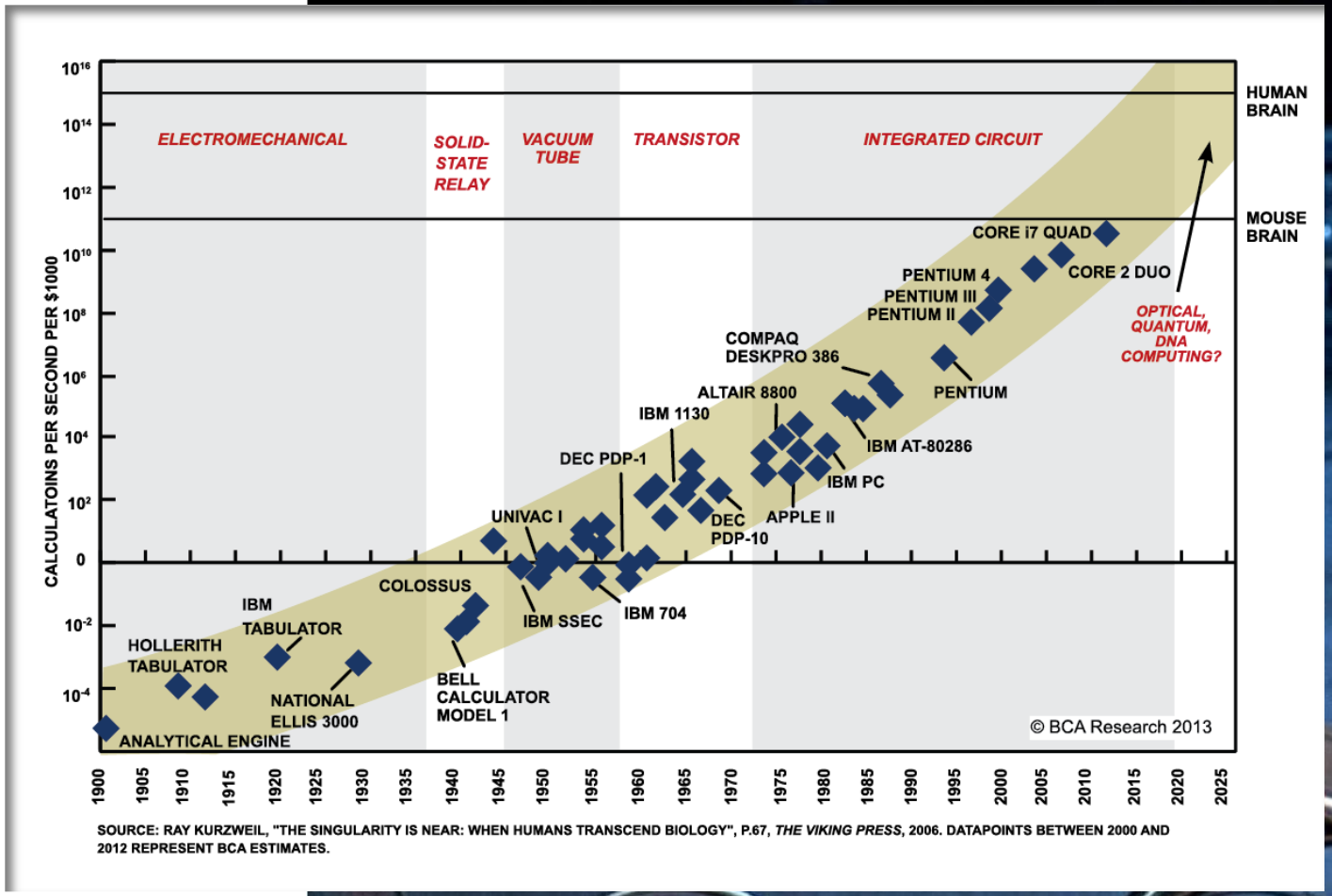
…AND NOW

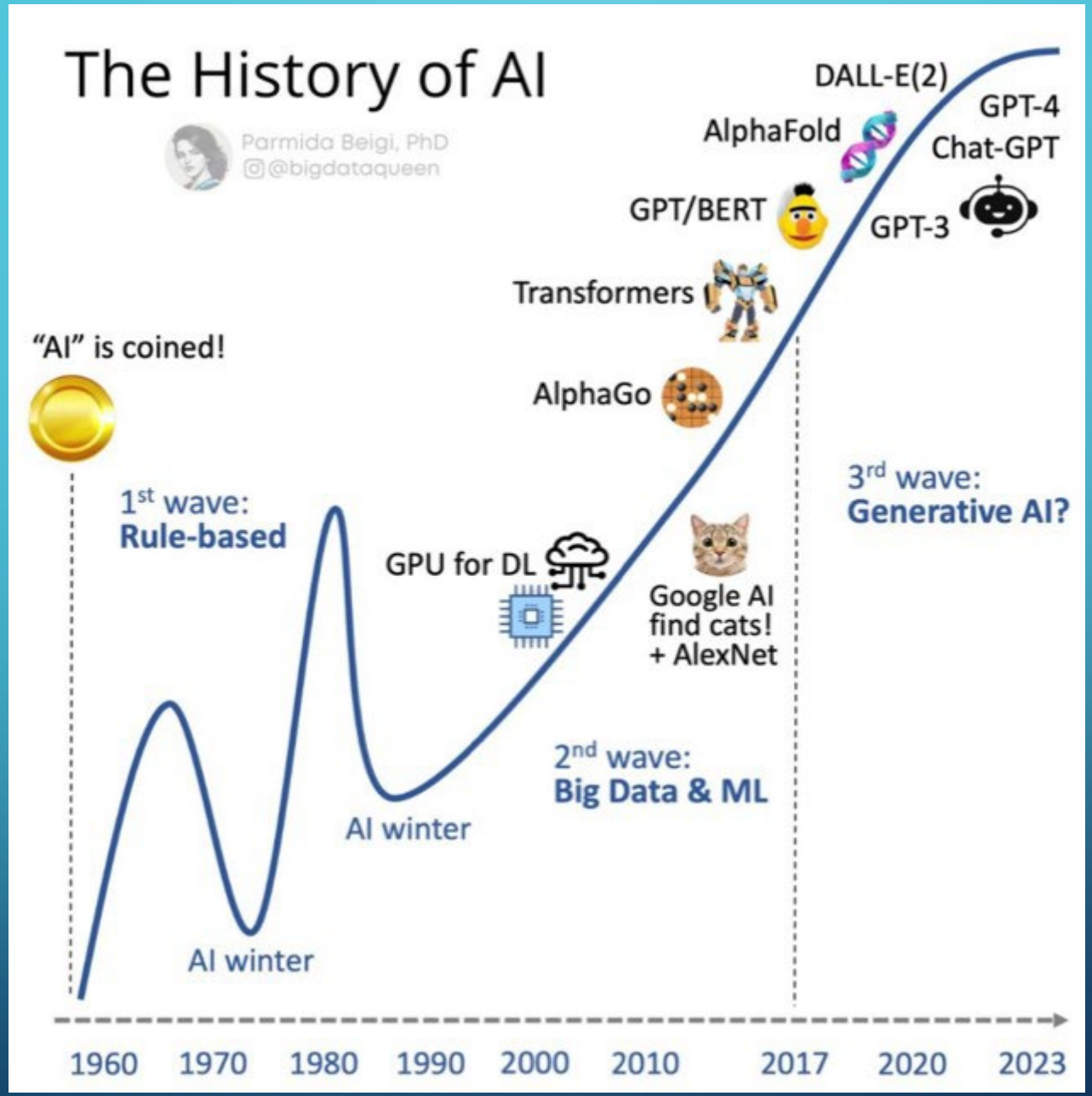



ANNOUNCING NVIDIA BLACKWELL PLATFORM
FOR TRILLION-PARAMETER SCALE GENERATIVE AI
AI SUPERCHIP
208B Transistors
2nd GEN TRANSFORMER ENGINE
FP4/FP6 Tensor Core
5th GENERATION NVLINK
Scales to 576 GPUs
RAS ENGINE
100% In-System Self-Test
SECURE AI
Full Performance
Encryption & TEE
DECOMPRESSION ENGINE
800 GB/sec

The robots are coming.

Ray Kurzweil c. 2006




The History of AI
Parmida Beigi, PhD
@bigdataqueen
DALL-E(2)
GPT-4
AlphaFold
Chat-GPT
GPT/BERT
GPT-3
Transformers
"AI" is coined!
AlphaGo
1st wave:
Rule-based
3rd wave:
Generative AI?
GPU for DL
Google AI
find cats!
+ AlexNet
2nd wave:
Big Data & ML
AI winter
AI winter
1960
1970
1980
1990
2000
2010
2017
2020
2023

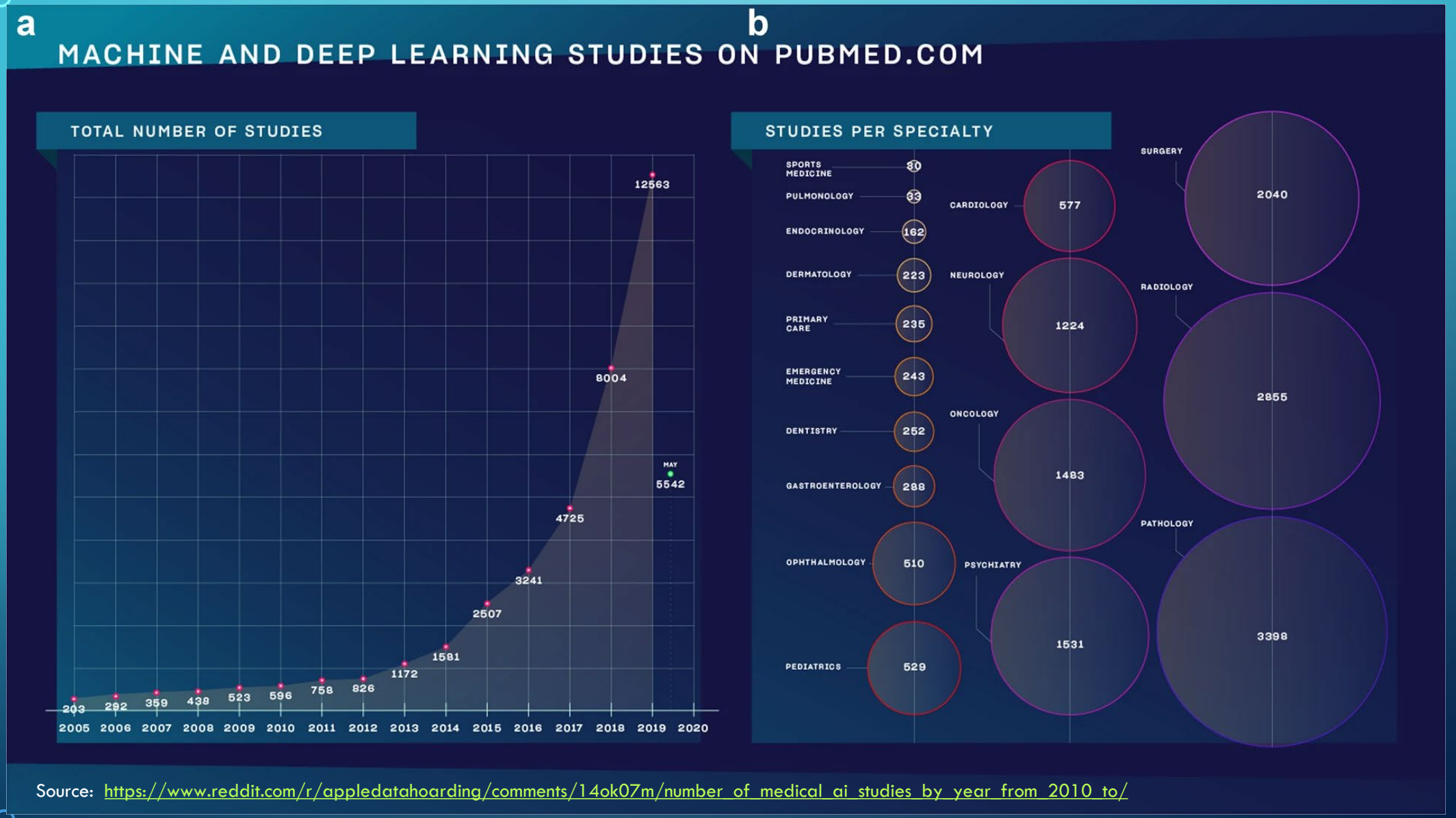
arXiv

https://arxiv.org Cornell University

Free distribution service and open access for **>2.3M** articles in physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science, and economics

~1200 daily submissions

a place of connection, linking together people and ideas, and connecting them with the world of open science



Source: https://www.reddit.com/r/appledatahoarding/comments/14ok07m/number_of_medical_ai_studies_by_year_from_2010_to/

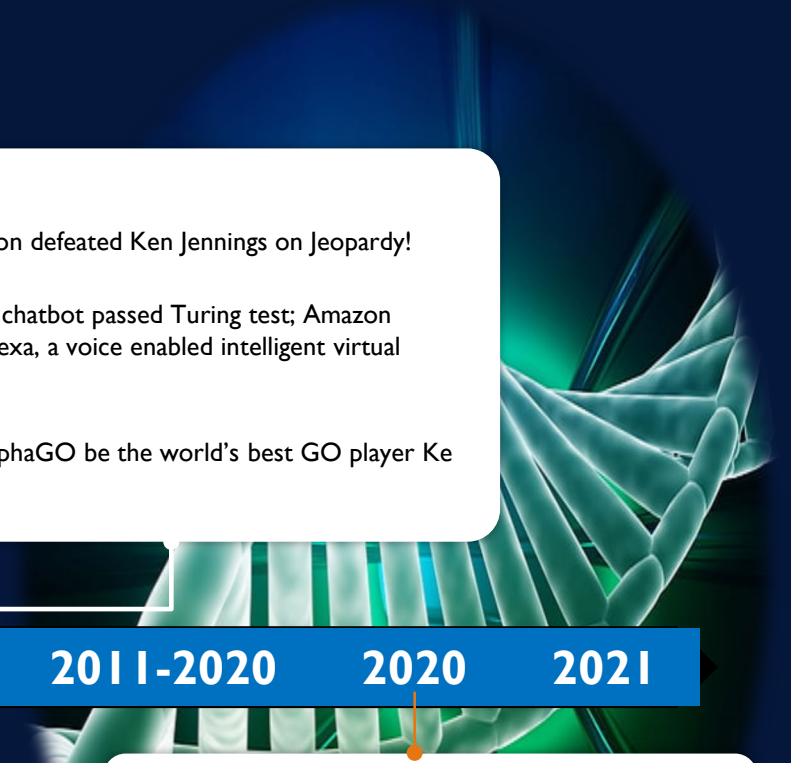
Accessed 2/1/24

DEEP BLUE – HOW AI BEAT THE WORLD CHAMPION

HOW AI "WATSON" BEAT TWO CHAMPIONS

ALPHAGO BEAT LEE SEDOL

AI THEN AND NOW



1961
First industrial robot replaced humans at assembly line

1964
Pioneering chat, but named ELIZA was developed at MIT

1966
General purpose, mobile robot developed at Stanford

1997
IBM's Deep Blue defeated Garry Kasparov in chess competition

1998
An emotionally intelligent robot KISMAT was developed

1999
Sony launched pet robot dog named AIBO

2011
IBM's Watson defeated Ken Jennings on Jeopardy!

2014
EUGENE, a chatbot passed Turing test; Amazon launched Alexa, a voice enabled intelligent virtual assistant

2017
Google's AlphaGO be the world's best GO player Ke Jie

1950-1960 | **1961-1970** | **1971-1990** | **1991-2000** | **2001-2010** | **2011-2020** | **2020** | **2021**

1950
Turing test by Alan Turing

1956
term of AI was coined

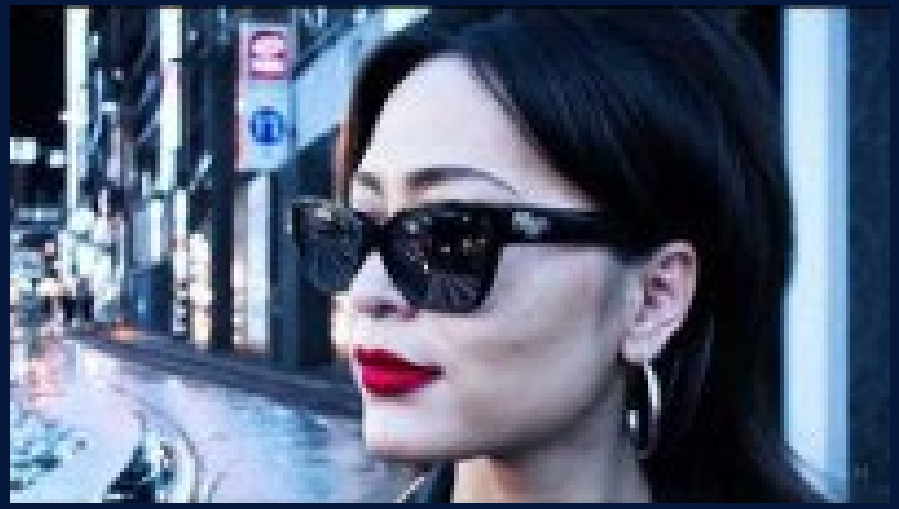
AI WINTER

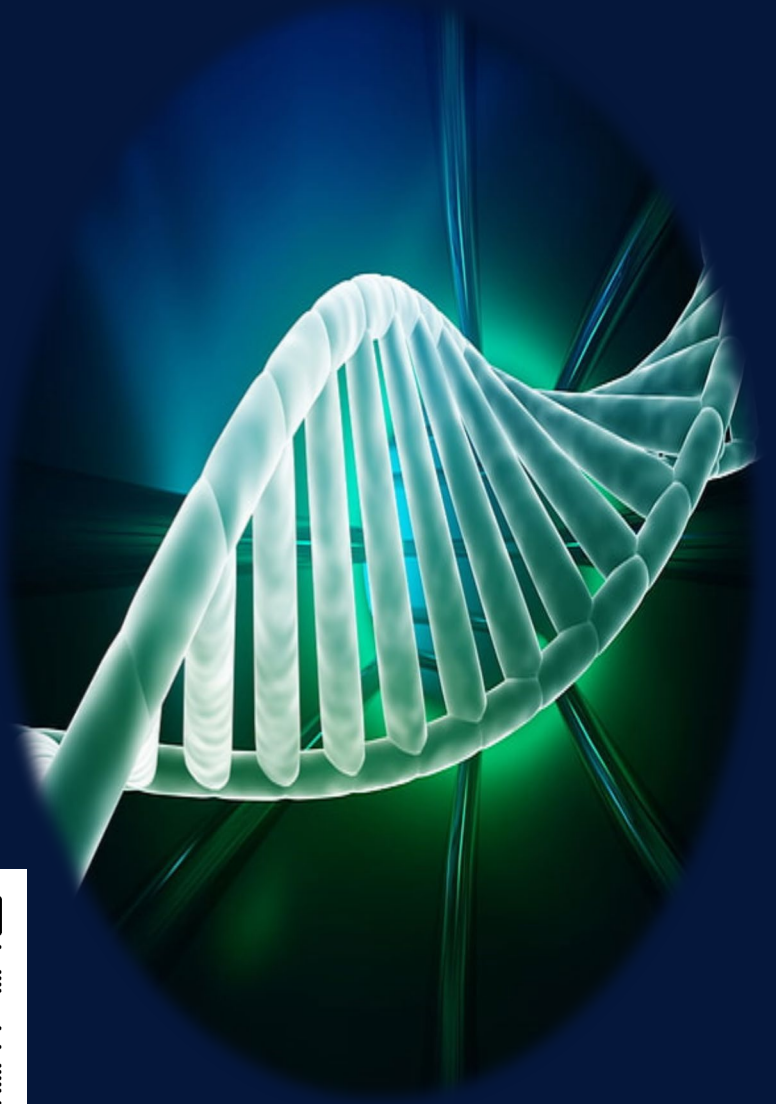
2002
iRobot launched a time is the vacuum cleaner robot in bulk

2009
Google built for self driving car for urban conditions

- **Moxie:** a social, emotional companion for kids is developed by Embodied
- Earth's first autonomous **beehive** is developed by beewise
- **TrialJectory** is an AI enable service to look for clinical trials
- **BrainBox AI** is an AI system to predict building's normal conditions
- Refine business process, more personalized recommendations, human like conversational skills

AI VIDEO GENERATION NOW





IS THIS A GUTENBERG MOMENT?

IS THIS A GUTENBERG MOMENT?

Envisioning the Healthcare Landscape with ChatGPT

New York Medical College Explores The Opportunities And Risks Of AI On The Healthcare Industry In The Following Article Written Entirely Using ChatGPT

February 13, 2023

Opinion > Kevin, M.D.

AI in Healthcare: Meeting HIPAA Standards With ChatGPT

— Patients deserve a commitment to privacy

by Harvey Castro, MD, MBA February 11, 2023

ChatGPT Passes US Medical Licensing Exam Without Clinician Input

ChatGPT achieved 60 percent accuracy on the US Medical Licensing Exam, indicating its potential in advancing artificial intelligence-assisted medical education.

THE LANCET
Digital Health

COMMENT | ONLINE FIRST

ChatGPT: the future of discharge summaries?

Sajan B Patel • Kyle Lam

Open Access • Published: February 06, 2023 • DOI: https://doi.org/10.1016/S2589-7500(23)00021-3 •

New and surprising evidence that ChatGPT can perform several intricate tasks relevant to handling complex medical and clinical information

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By Neha Mathur Feb 13 2023

Reviewed by Danielle Ellis, B.Sc.

FORBES > INNOVATION > HEALTHCARE

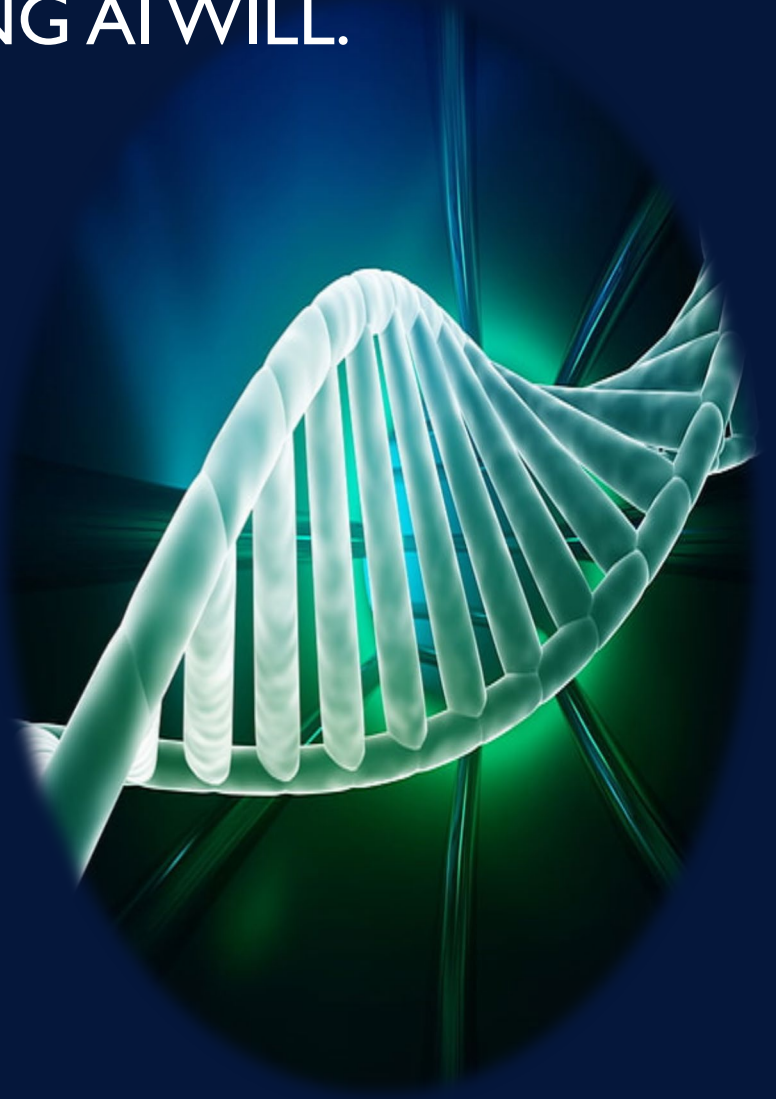
EDITORS' PICK

5 Ways ChatGPT Will Change Healthcare Forever, For Better

Robert Pearl, M.D. Contributor

Follow

AI WON'T REPLACE YOU. SOMEONE USING AI WILL.

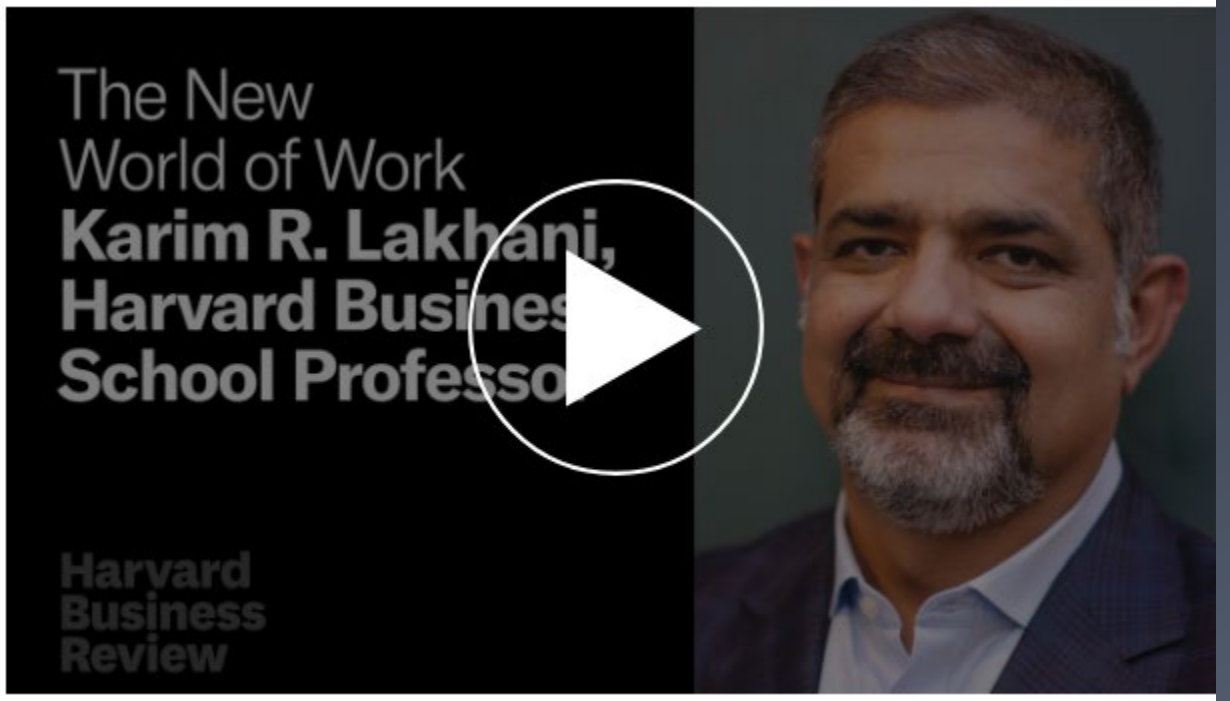


Original image created using beautiful ai

Business And Society

AI Won't Replace Humans — But Humans With AI Will Replace Humans Without AI

August 04, 2023



AI in Healthcare

Patient-Facing

AI Chatbots

buoy, Your.MD, medwhat, GYANT, Dr.AI

Wearables & Devices

physiQ, QARDIO, sano, QUANTTUS, kiwi.ai, BIOSERENITY, Jodytrak, DietSensor, Magnea, kinsa, SCANADU, aira, AliveCor, 19 Labs, CliniCloud

Personalized Genetics

iCarbonX, rthm, CG, DAY TWO, Positive Biosciences, LIFENOME, MEDICUS, 23andMe, VITAGENE, Arivale, habit, Suggestic, VIOME

Mental Health

Woebot, TOUCHKIN, BIOBEATS, Ginger.io, NeuroLex, AURA, koko

Women's Health

CYRCADIA HEALTH, bloomlife, celmatix, flutter, eva, Clue, elyse, 28, Natural Cycles

Skin

SkinVision, skinIO, skin analytics, SCANZ, skin, DOCTOR HAZEL, FIRST DERM

Telehealth

Telemedicine

ada, SENSELY, how are you feeling today?, babylon, anamnèse, Remedy, pager, spruce

Lifestyle Management

AiCure, MedAware, ovia health, next IT, Catalia Health, Healthcare lucina, Health Next Gen, Doctella, NarrativeDx, cardiogram, Wellframe, Welltok, CareAngel, Always Caring

Disease Management

prognos, INFOBIONIC, HealthReveal, HEALTH FIDELITY, DIABNEXT, SENTRIAN, TEMPUS, dreamed DIABETES, FLASHBACK TECHNOLOGIES, Healint, WIKAYA, EMPOWER PREVENTION, RxPREDICT, BELONG, Beating Cancer Together

Research

Drug Discovery

Mind the Byte, SaaS for Drug Discovery, DATAVANT, Quantitative Medicine, Standigm, BERG, RECURSION pharmaceuticals, ENVISAGENICS BioAnalytics, BenevolentAI, Athelas, Exscientia, DRIVEN BY KNOWLEDGE, NuMedii, healx, transcriptic, Numerate, twoXAR, Atomwise, Better medicines faster., INSILICO MEDICINE, CloudPharmaceuticals, Globavir

Information & Clinical Trials

trials.ai, INTELLIGENT TRIALS MANAGEMENT, PathAI, BenchSci, where science happens, CYCLICA, Mendel.ai, Qrativ, peptone, Brite Health, IQLEXUS, LIFE SCIENCES RESEARCH SIMPLIFIED, antidote, Plex Research, nference, RESULTCARE

Genetic Research

MolecularMatch, Blueprint Genetics, VERGE GENOMICS, NURITAS, diploid, HUMAN LONGEVITY, INC., SOPHIA GENETICS, freenome, FDNA, PATHWAY GENOMICS, deep genomics, DESKTOP GENETICS

Doctor-Facing

Medical Records

APIXIO, AUGMEDIX, clinithink, MODERNIZING MEDICINE, nimblr, saykara, emr.ai, WellSheet, hCue, patientory, SANSORO HEALTH, PROTENUS, BloomAPI

Data Analytics

ZEPHYR HEALTH, burstIQ, MD.ai, Infermedica, CLOUDMEDX, jvion, CareSkore, flatiron, ROAM, Hindsait, PROFILITY, Oncora MEDICAL, GRAIL, MEDALOGIX, ensodata, pulseData, healthcare.ai, KenSci, COMBINOSTICS, impacthealth, LYTICS

Medical Imaging

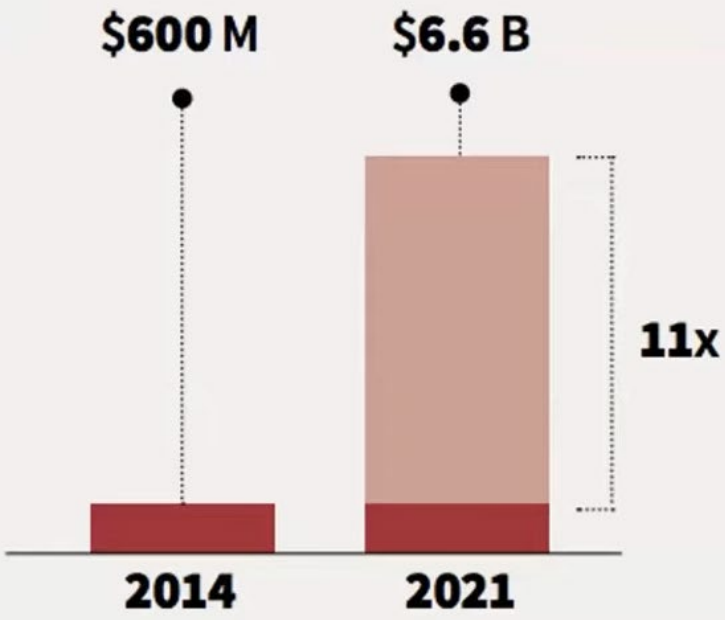
VIZ, AMARA HEALTH ANALYTICS, enlitic, zebra MEDICAL VISION, inferVISION, CureMetrix, BAYLABS, VUNO, ADVENIO, Transpiring Innovation, koios, BUTTERFLY Network, Inc., SIGTUPLE, Behold.ai, imagia, ARTERYS, IMAGEN, Mindshare MEDICAL, aidence, aidoc, Lunit, Cardiologs, Genetesis, HubMedX, DIA, SemanticMD, Blackford analysis

Hospital

FORWARD, Qventus, MedyMatch, gauss, orgo.ai, MEDASENSE, P3d, AURIS, VERB SURGICAL, Qualaris

https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence/

Health AI Market Size 2014 - 2021



Acquisitions of AI startups are rapidly increasing while the health market is set to register an explosive CAGR of 40% through 2021.

Source: Accenture (December 2017). Artificial Intelligence in Healthcare.

GLOBAL
ARTIFICIAL INTELLIGENCE
IN HEALTHCARE MARKET

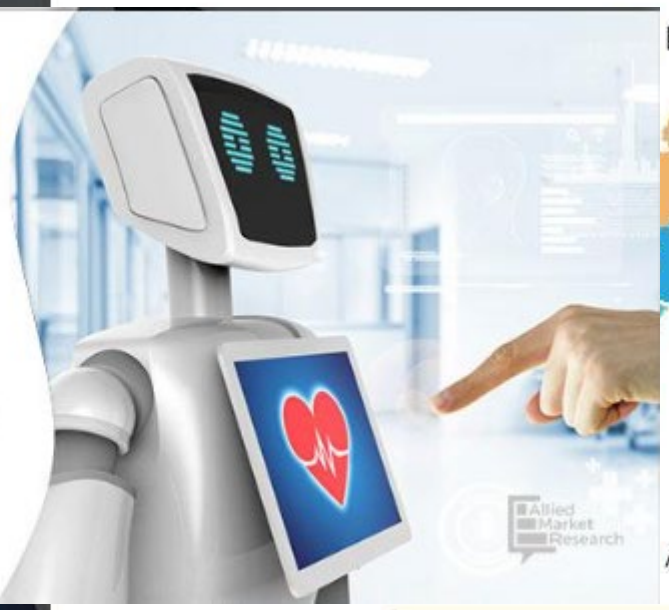
ARTIFICAL INTELLIGENCE (AI) IN HEALTHCARE Market

OPPORTUNITIES AND FORECAST, 2021-2030

Artifical Intelligence (AI) in Healthcare Market is expected to reach **194.14 Billion** by 2030.

Growing at a **CAGR of 38.1%** (2021-2030)

Growing at a **CAGR of 48.7%** (2017-2023)



GLOBAL ARTIFICIAL INTELLIGENCE IN HEALTHCARE MARKET

BY GEOGRAPHY

Asia-Pacific region would exhibit the highest **CAGR of 53.4%** during 2017-2023.

Source: Artificial Intelligence in Healthcare Market | Global Report – 2030 (alliedmarketresearch.com)


Shanghai 1990
Shanghai 2020

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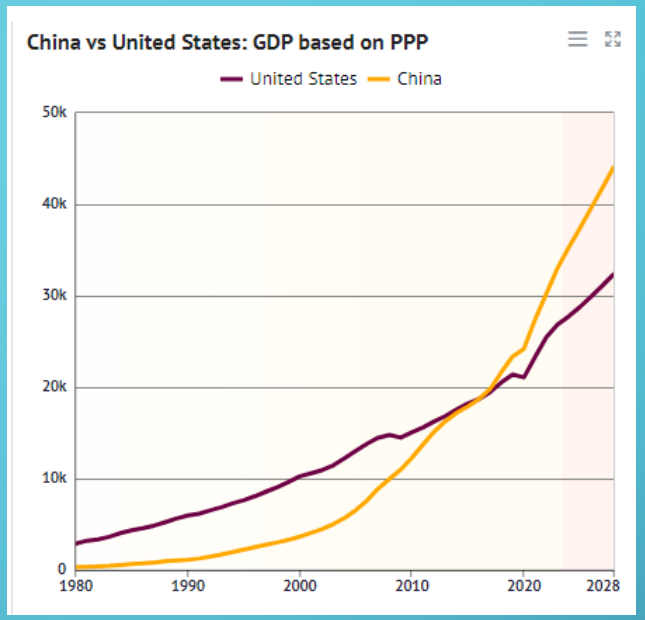
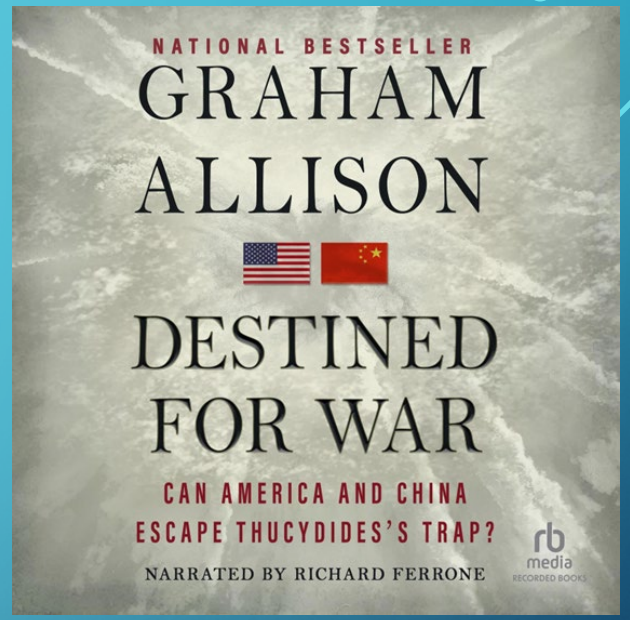
SPACE & PHYSICS

China Reaches New Milestone in Space-Based Quantum Communications

The nation's Micius satellite successfully established an ultrasecure link between two ground stations separated by more than 1,000 kilometers

By Karen Kwon on June 25, 2020 أعرض هذا باللغة العربية





What is China's GDP as per PPP?

Economy of China

Statistics

GDP	$19.373 trillion (nominal; 2023 est.) **$33.014 trillion** (PPP; 2023 est.)
GDP rank	2nd (nominal; 2023) 1st (PPP; 2023)
GDP growth	8.4% (2021) 3.0% (2022) 5.2% (2023f) 4.5% (2024f)

Central Intelligence Agency (.gov)
https://www.cia.gov › field › country-comparison

Real GDP (purchasing power parity)

Rank	Country		Date of Information
1	China	$24,861,000,000,000	2021 est.
2	United States	$21,132,000,000,000	2021 est.
3	India	$9,279,000,000,000	2021 est.

Original Investigation

ONLINE FIRST FREE

April 28, 2023

Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum

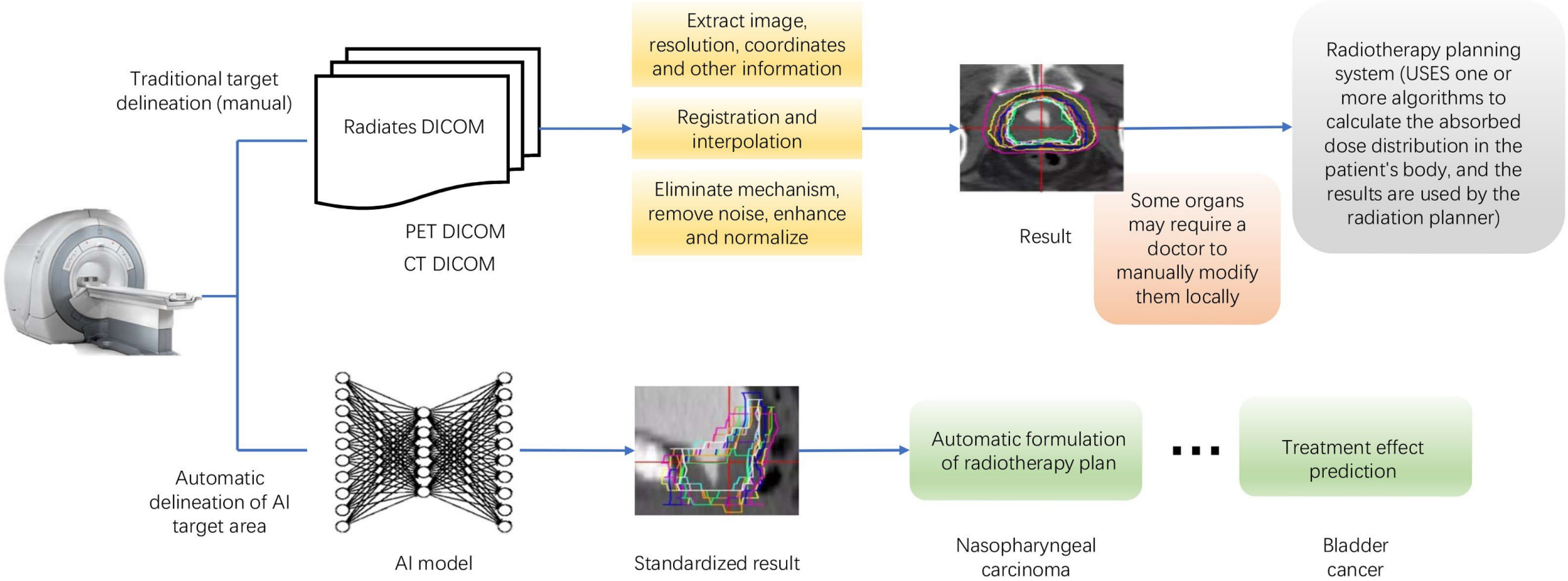
John W. Ayers, PhD, MA[1,2]; Adam Poliak, PhD[3]; Mark Dredze, PhD[4]; et al

Results Of the 195 questions and responses, evaluators preferred chatbot responses to physician responses in 78.6% (95% CI, 75.0%-81.8%) of the 585 evaluations. Mean (IQR) physician responses were significantly shorter than chatbot responses (52 [17-62] words vs 211 [168-245] words; $t=25.4$; $P<.001$). Chatbot responses were rated of significantly higher quality than physician responses ($t=13.3$; $P<.001$). The proportion of responses rated as *good* or *very good* quality (≥ 4), for instance, was higher for chatbot than physicians (chatbot: 78.5%, 95% CI, 72.3%-84.1%; physicians: 22.1%, 95% CI, 16.4%-28.2%;). This amounted to 3.6 times higher prevalence of *good* or *very good* quality responses for the chatbot. Chatbot responses were also rated significantly more empathetic than physician responses ($t=18.9$; $P<.001$). The proportion of responses rated *empathetic* or *very empathetic* (≥4) was higher for chatbot than for physicians (physicians: 4.6%, 95% CI, 2.1%-7.7%; chatbot: 45.1%, 95% CI, 38.5%-51.8%; physicians: 4.6%, 95% CI, 2.1%-7.7%). This amounted to 9.8 times higher prevalence of *empathetic* or *very empathetic* responses for the chatbot.

Conclusions In this cross-sectional study, a chatbot generated quality and empathetic responses to patient questions posed in an online forum. Further exploration of this technology is warranted in clinical settings, such as using chatbot to draft responses that physicians could then edit. Randomized trials could assess further if using AI assistants might improve responses, lower clinician burnout, and improve patient outcomes.

AI IN RADIATION ONCOLOGY

Automatic delineation of tumors and organs at risk



Comparison of sketch speed of target area:

AI takes 10-20 minutes
Manual work takes 4-5 hours

CAPACITY MANAGEMENT

LeanTaaS Overview

Silicon Valley, Charlotte and Boston based software company

- PhDs in Mathematics, Software Engineers, Product Managers, Operations Experts, Hospital Executives

$350+ Million invested in predictive analytics platform "iQueue"

Mission: Unlock capacity of scarce assets using predictive and prescriptive analytics:

- Improve patient access
- Increase volumes and revenues
- Reduce wait time for patients
- Reduce operating costs
- Defer the need for facility expansion

6 Patents Pending

Awards & 3rd Party Validation

605
Leading Hospitals

14 of top 20
Health Systems

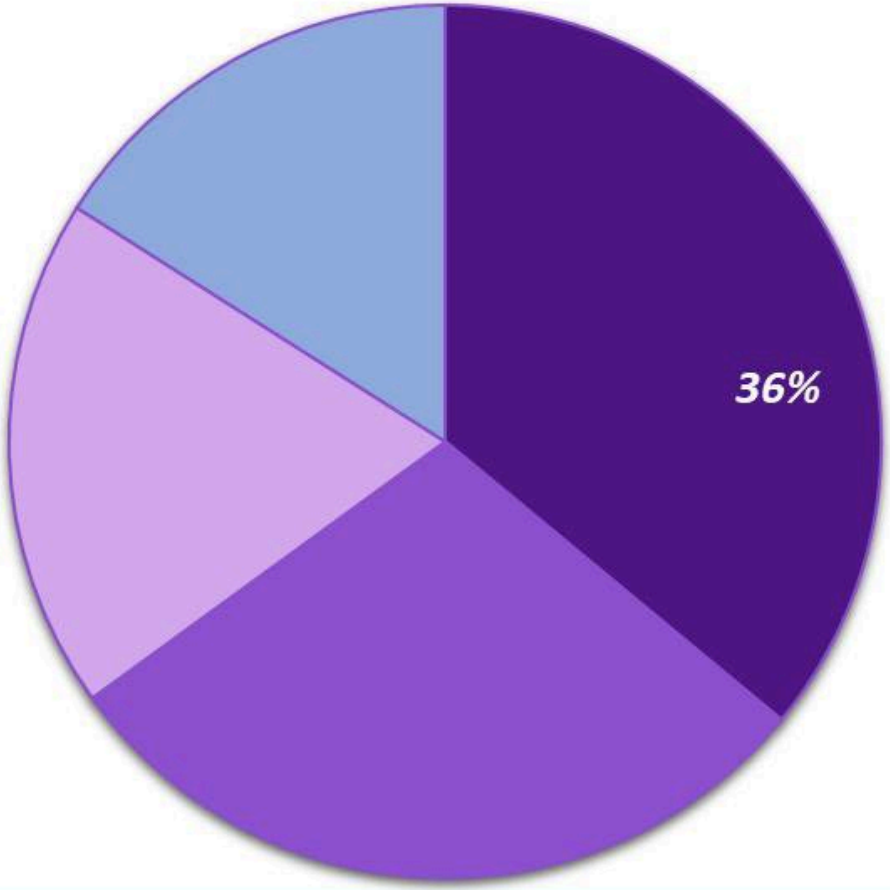
175
Health Systems

46
States in the U.S.

ECONOMIC POTENTIAL OF AI IN ONCOLOGY

Global Artificial Intelligence in Oncology Market

Share, by treatment type, 2022 (USD Million)



- Chemotherapy
- Radiotherapy
- Immunotherapy
- Other Treatment Type

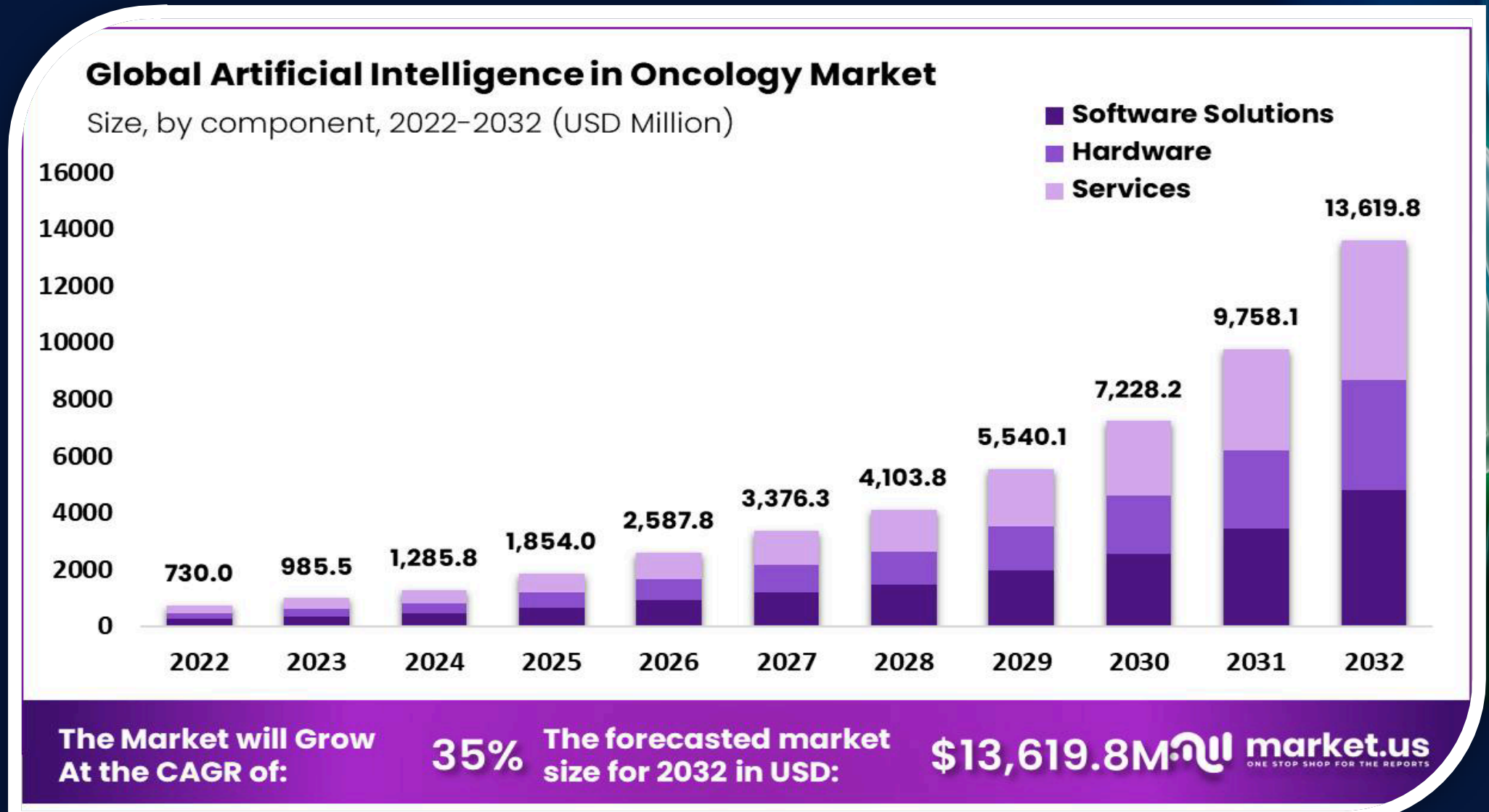
market.us
ONE STOP SHOP FOR THE REPORTS

730
Total Market Size (USD Million)

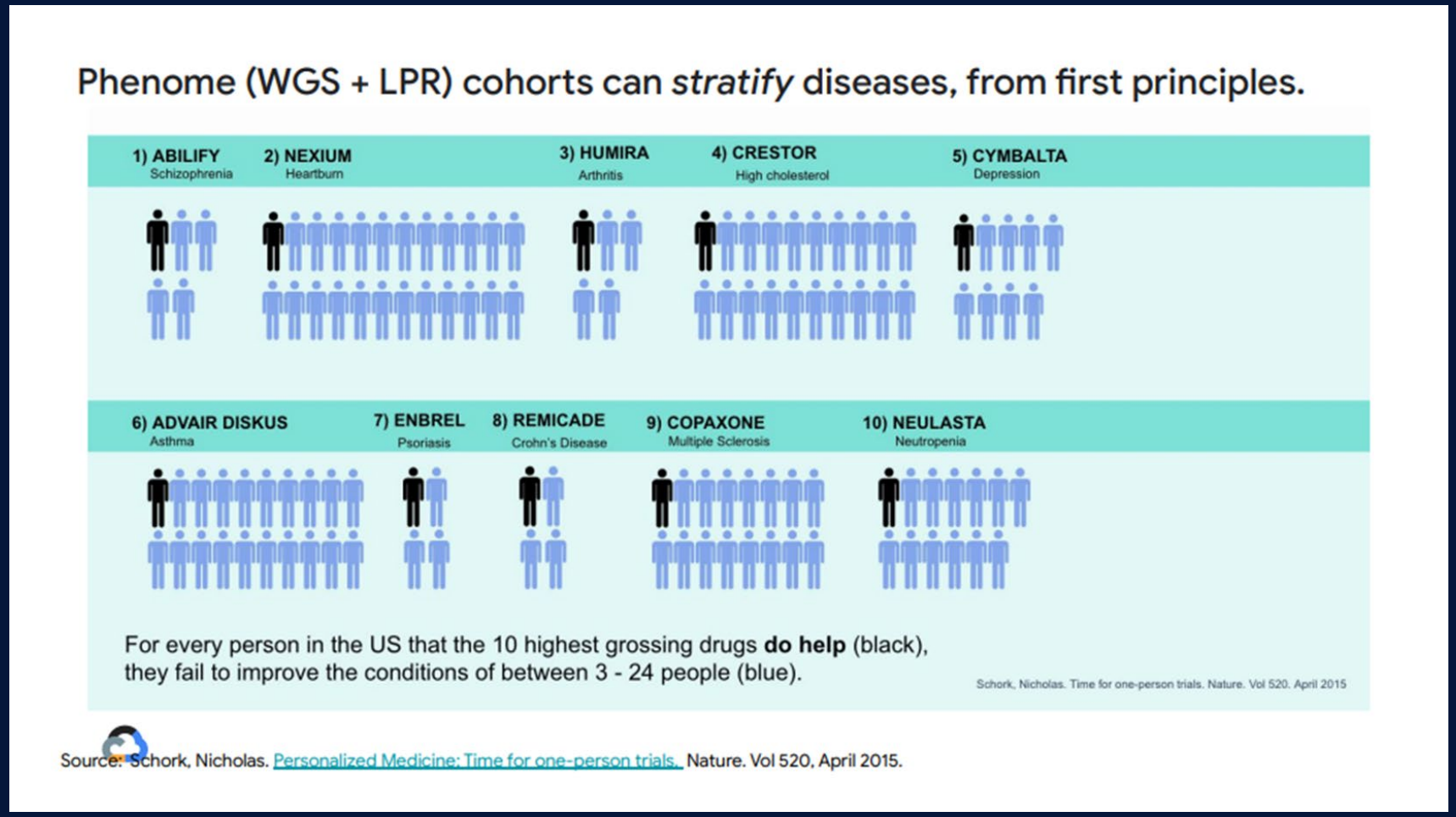
35%
CAGR 2023-2032

$

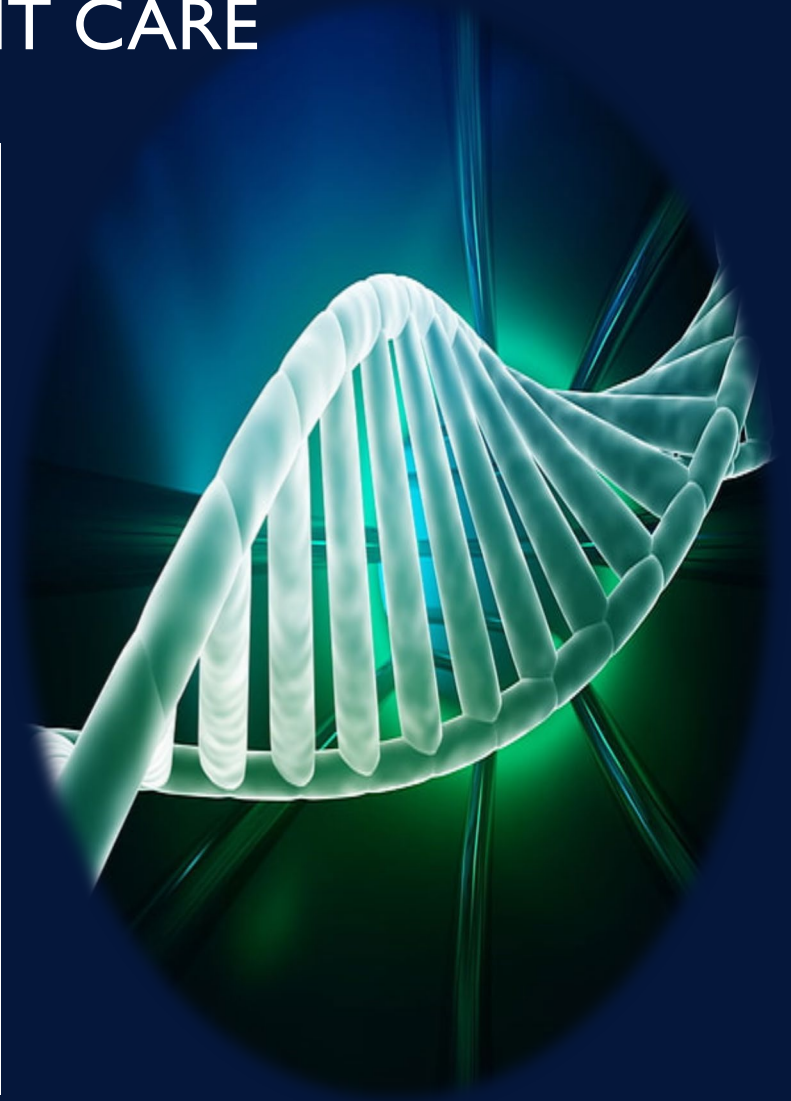
ECONOMIC POTENTIAL OF AI IN ONCOLOGY



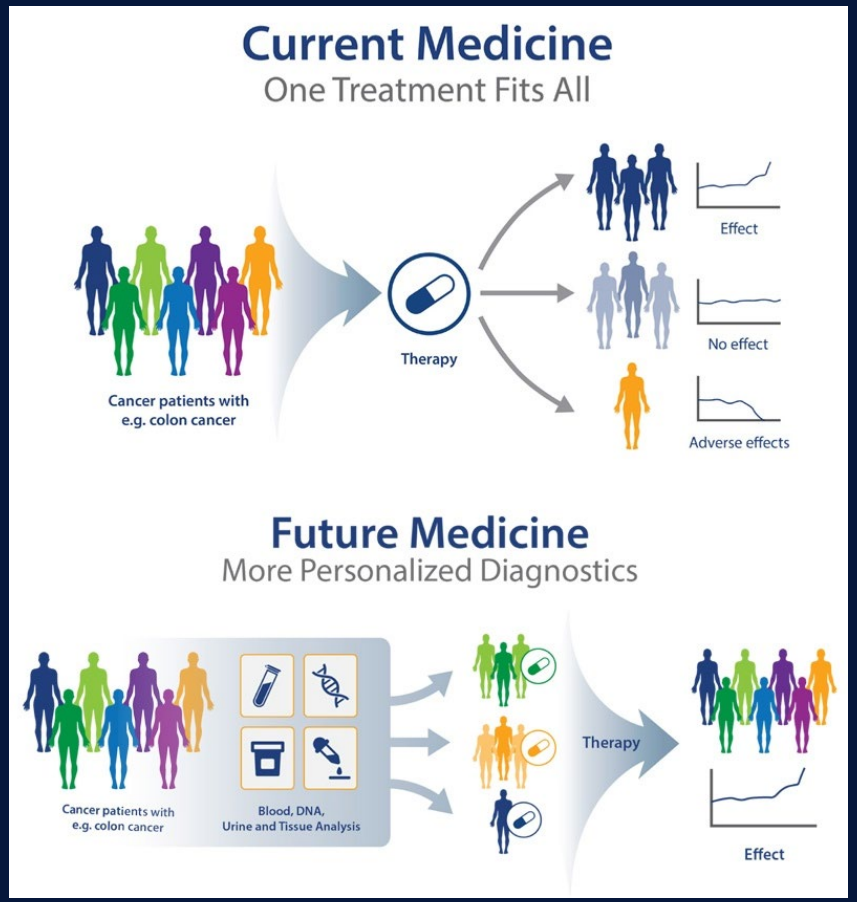
BRIDGING SCIENCE & PRECISION PATIENT CARE



Source: Schork, Nicholas. Personalized Medicine: Time for one-person trials. Nature. Vol 520, April 2015.



BRIDGING SCIENCE & PRECISION PATIENT CARE



CHANGING THE HEALTHCARE LANDSCAPE

- Streamlining Workflows
- Reducing Costs
- Improving Collaboration
- Advancing Research
- Empowering Patients

Technology changes…….

What Can A Quantum Computer Do Better?

Quantum computing will solve a class of problems that are unsolvable today, opening up a new realm of applications.

03

SEARCHING BIG DATA

DESIGNING BETTER DRUGS & NEW MATERIALS

MACHINE LEARNING

Illumina
bioinformatics
biology
genetics
Bio
Popular Posts

Buttrcup is a risque image site that pays creators

Snap CEO Evan Spiegel got a $637 million bonus last year

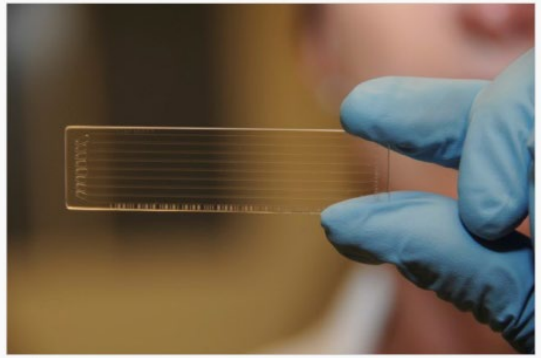
Blockchain is entering the valley of despair phase, and that's a m...

SpaceX misses catching Falcon 9 rocket fairing with a giant net on a big ship

Illumina wants to sequence your whole genome for $100

Posted Jan 10, 2017 by Sarah Buhr (@sarahbuhr)

Next Story



The first sequencing of the whole human genome in 2003 cost roughly $2.7 billion, but DNA sequencing giant Illumina has now unveiled a new machine that the company says is "expected one day" to order up your whole genome for less than $100.

Crunchbase

Illumina

FOUNDED 1998

OVERVIEW
At Illumina, their goal is to apply innovative technologies and revolutionary assays to the analysis of genetic variation and function, making studies

How CRISPR works

1. The Cas9 protein forms a complex with guide RNA in a cell

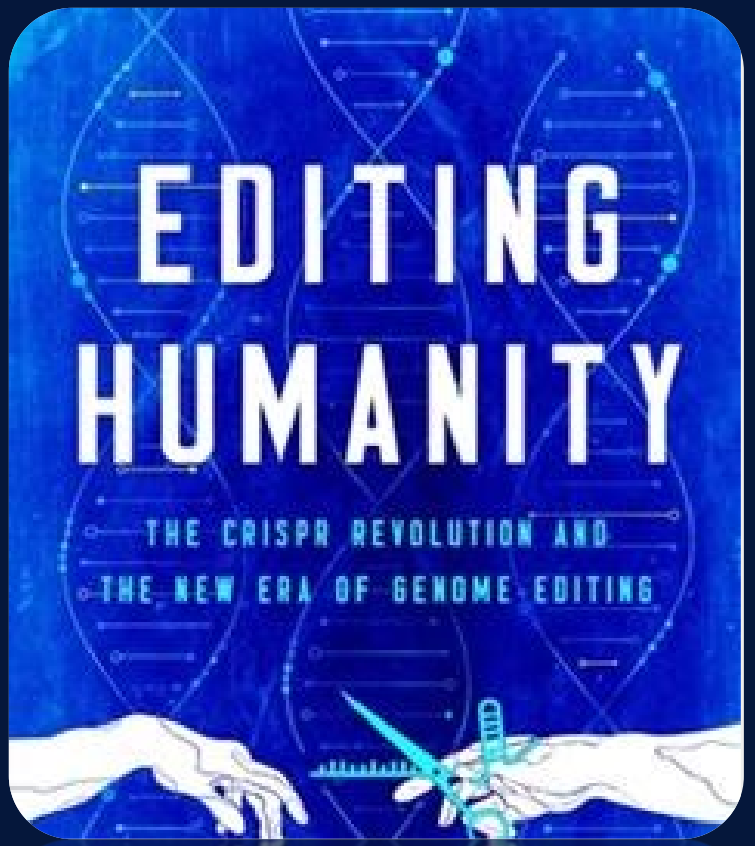
2. This complex attaches to a matching genomic DNA sequence adjacent to a spacer (yellow segment)

Cas9

Guide RNA

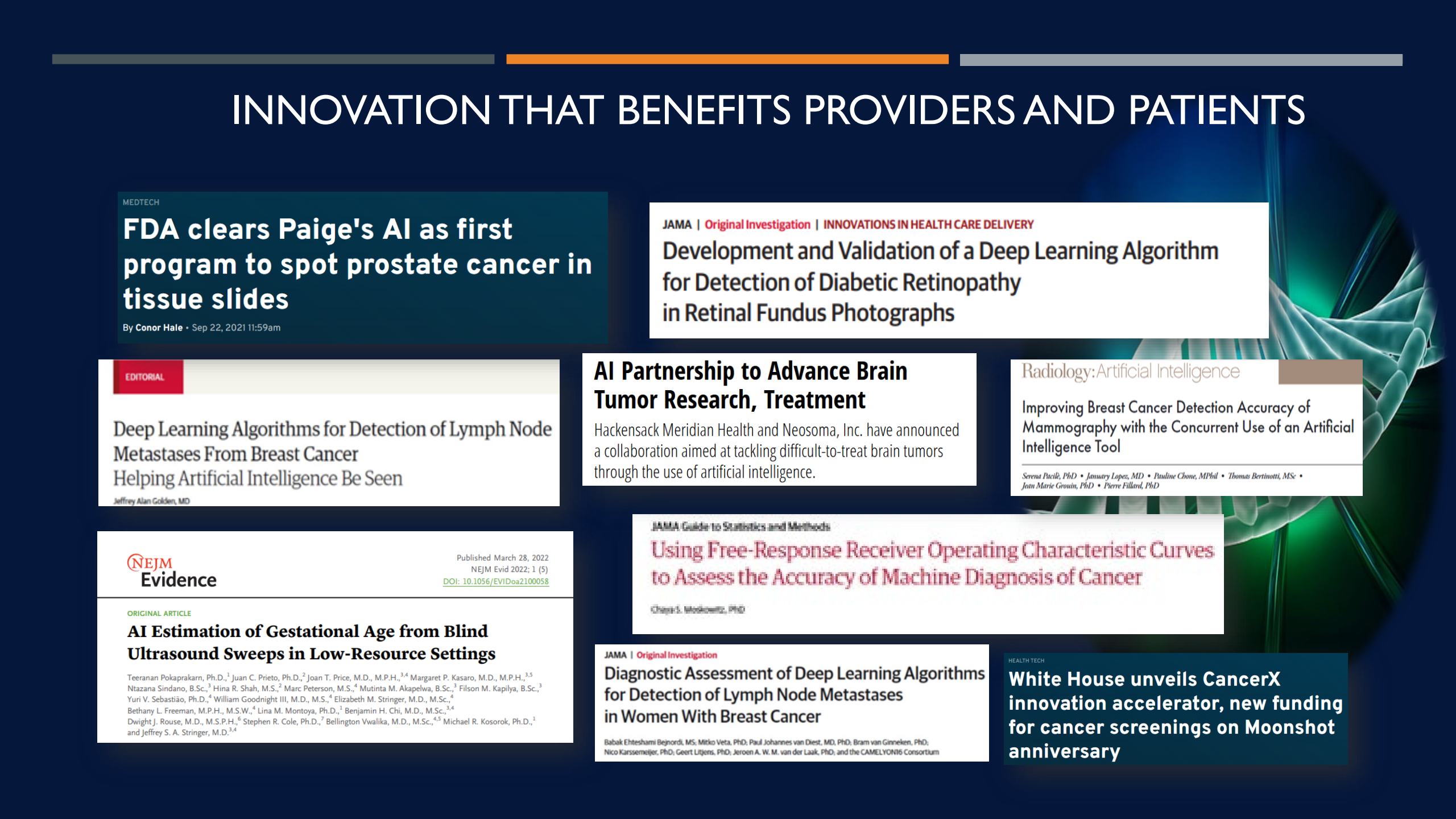
In 2012, scientists at the University of Leicester decided to print out a complete version of the human genome. When they were done, they had a 130-volume monument to humanity's essence—a seemingly endless sequence of As, Ts, Cs, and Gs in four-point type. Curiously, the printing project's costs already exceeded the costs of actually sequencing the genome anew. Since then, the price differential has only grown. Cas Kramer (Univ. Leicester) »

THE CRISPR REVOLUTION



“The term ‘Holy Grail’ is overused in science,” Davies writes, “but if fixing a single letter in the genetic code of a fellow human being isn’t the coveted chalice of salvation, I don’t know what is.”

INNOVATION THAT BENEFITS PROVIDERS AND PATIENTS



MEDTECH

FDA clears Paige's AI as first program to spot prostate cancer in tissue slides

By **Conor Hale** • Sep 22, 2021 11:59am

JAMA | Original Investigation | INNOVATIONS IN HEALTH CARE DELIVERY

Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs

EDITORIAL

Deep Learning Algorithms for Detection of Lymph Node Metastases From Breast Cancer

Helping Artificial Intelligence Be Seen

Jeffrey Alan Golden, MD

AI Partnership to Advance Brain Tumor Research, Treatment

Hackensack Meridian Health and Neosoma, Inc. have announced a collaboration aimed at tackling difficult-to-treat brain tumors through the use of artificial intelligence.

Radiology: Artificial Intelligence

Improving Breast Cancer Detection Accuracy of Mammography with the Concurrent Use of an Artificial Intelligence Tool

Serena Puelli, PhD • January Lopez, MD • Pauline Chone, MPhil • Thomas Bertinotti, MSc • Jean Marie Grouin, PhD • Pierre Fillard, PhD

NEJM Evidence

Published March 28, 2022
NEJM Evid 2022; 1 (5)
DOI: 10.1056/EVIDoa2100058

ORIGINAL ARTICLE

AI Estimation of Gestational Age from Blind Ultrasound Sweeps in Low-Resource Settings

Teeranan Pokaprakarn, Ph.D.,[1] Juan C. Prieto, Ph.D.,[2] Joan T. Price, M.D., M.P.H.,[3,4] Margaret P. Kasaro, M.D., M.P.H.,[3,5] Ntazana Sindano, B.Sc.,[3] Hina R. Shah, M.S.,[2] Marc Peterson, M.S.,[4] Mutinta M. Akapelwa, B.Sc.,[3] Filson M. Kapilya, B.Sc.,[3] Yuri V. Sebastião, Ph.D.,[4] William Goodnight III, M.D., M.S.,[4] Elizabeth M. Stringer, M.D., M.Sc.,[4] Bethany L. Freeman, M.P.H., M.S.W.,[4] Lina M. Montoya, Ph.D.,[1] Benjamin H. Chi, M.D., M.Sc.,[3,4] Dwight J. Rouse, M.D., M.S.P.H.,[6] Stephen R. Cole, Ph.D.,[7] Bellington Vwalika, M.D., M.Sc.,[4,5] Michael R. Kosorok, Ph.D.,[1] and Jeffrey S. A. Stringer, M.D.[3,4]

JAMA Guide to Statistics and Methods

Using Free-Response Receiver Operating Characteristic Curves to Assess the Accuracy of Machine Diagnosis of Cancer

Chaya S. Moskowitz, PhD

JAMA | Original Investigation

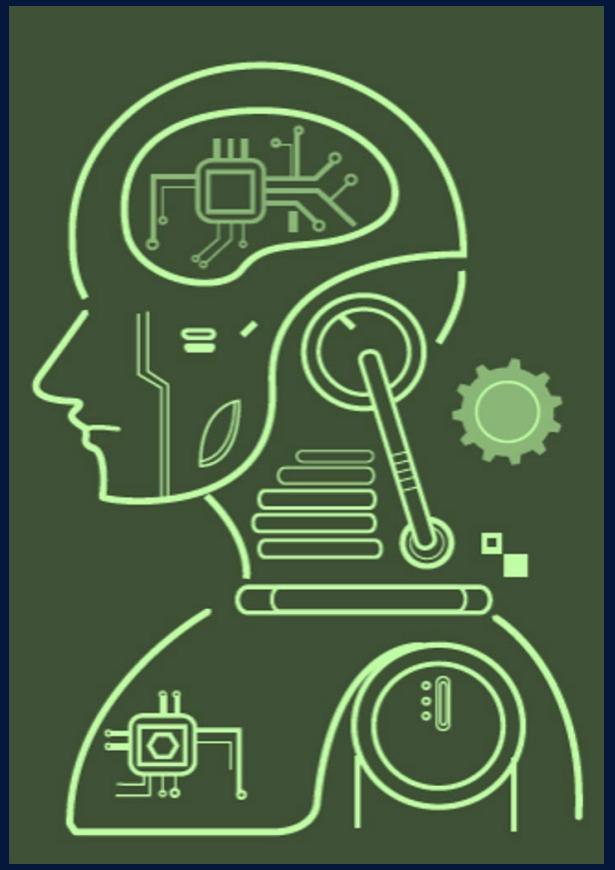
Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer

Babak Ehteshami Bejnordi, MS; Mitko Veta, PhD; Paul Johannes van Diest, MD, PhD; Bram van Ginneken, PhD; Nico Karssemeijer, PhD; Geert Litjens, PhD; Jeroen A. W. M. van der Laak, PhD; and the CAMELYON16 Consortium

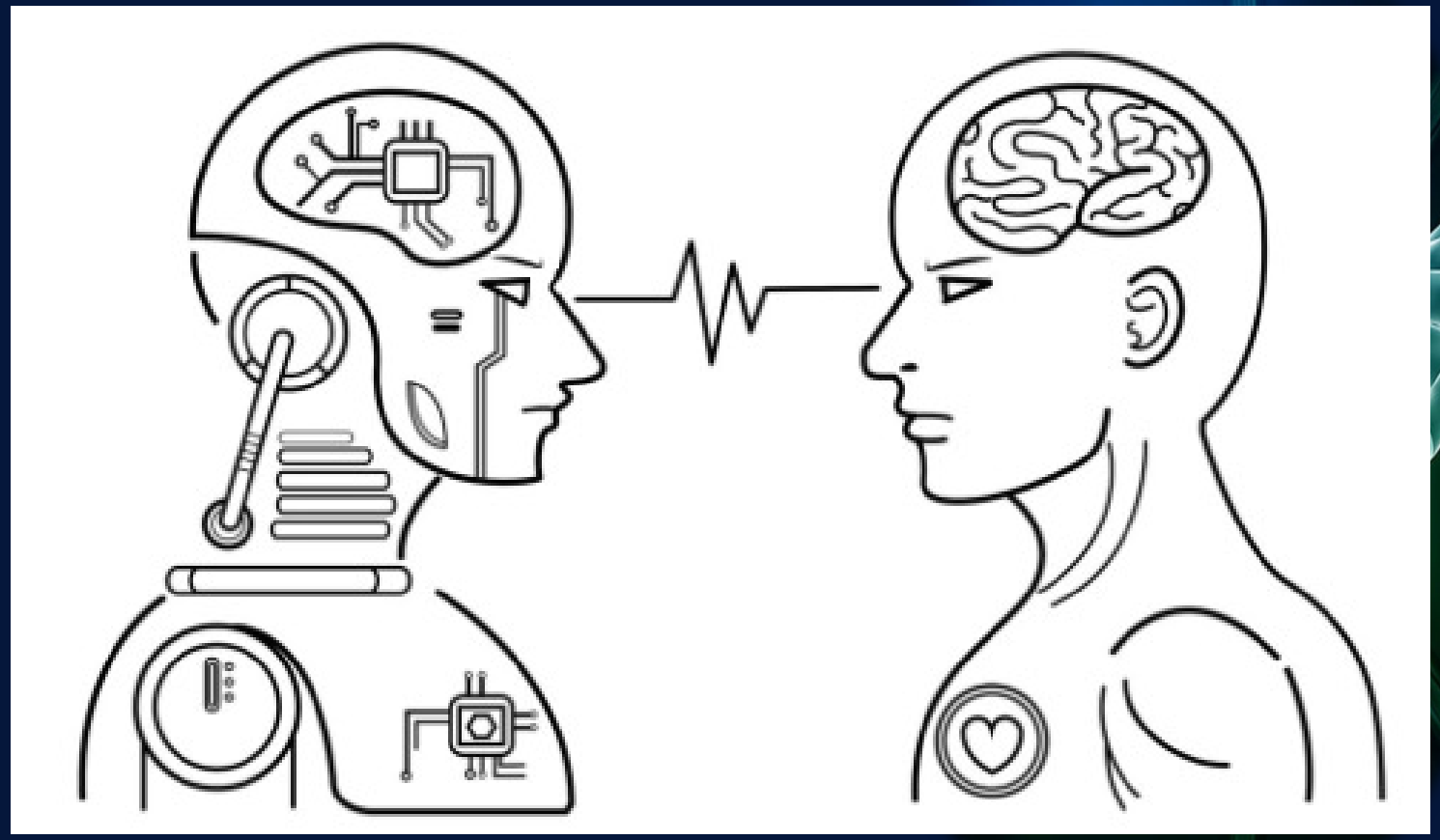
HEALTH TECH

White House unveils CancerX innovation accelerator, new funding for cancer screenings on Moonshot anniversary

WHAT IS AUGMENTED INTELLIGENCE?



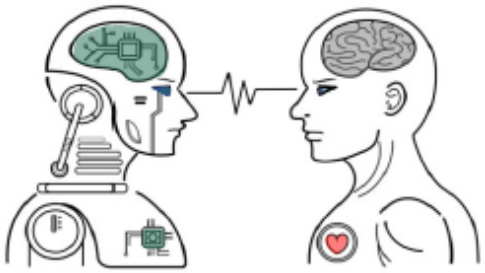
ARTIFICIAL INTELLIGENCE (AI)
Incorporating human intelligence into machines



AUGMENTED AI
Use of artificial intelligence to improve human performance

Credit Dr. Andrew Smith

GOALS OF AUGMENTED AI



Accuracy

Precision
Standardization

Efficiency

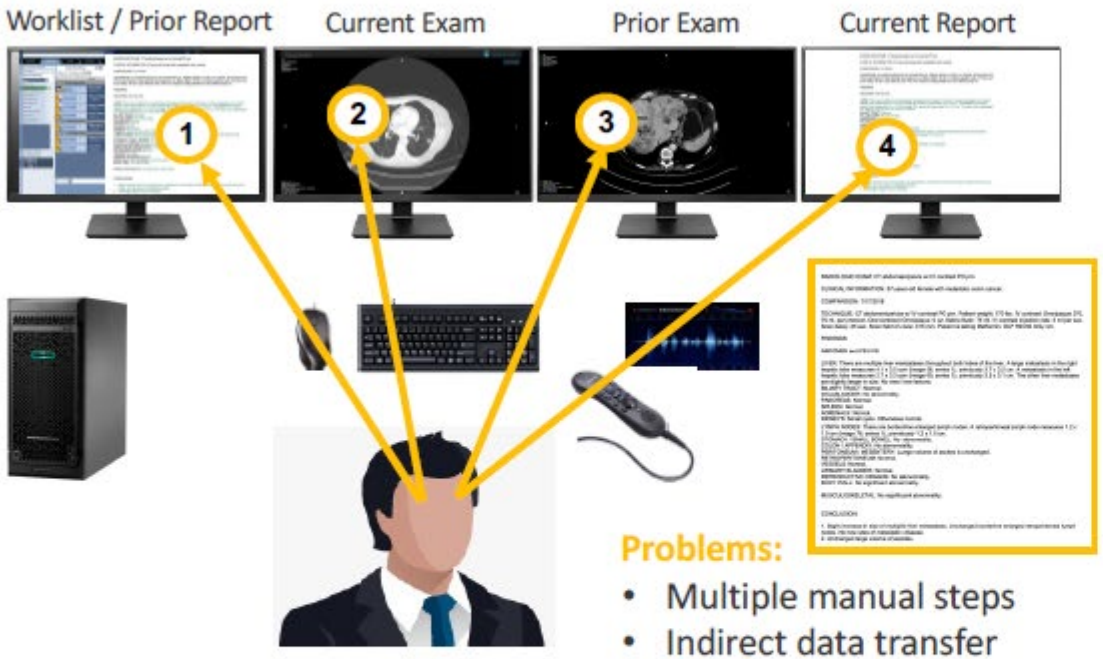
Major Errors
Omissions

Clarity of
Communication

Credit Dr. Andrew Smith

STANDARD OF CARE VS AUGMENTED INTELLIGENCE

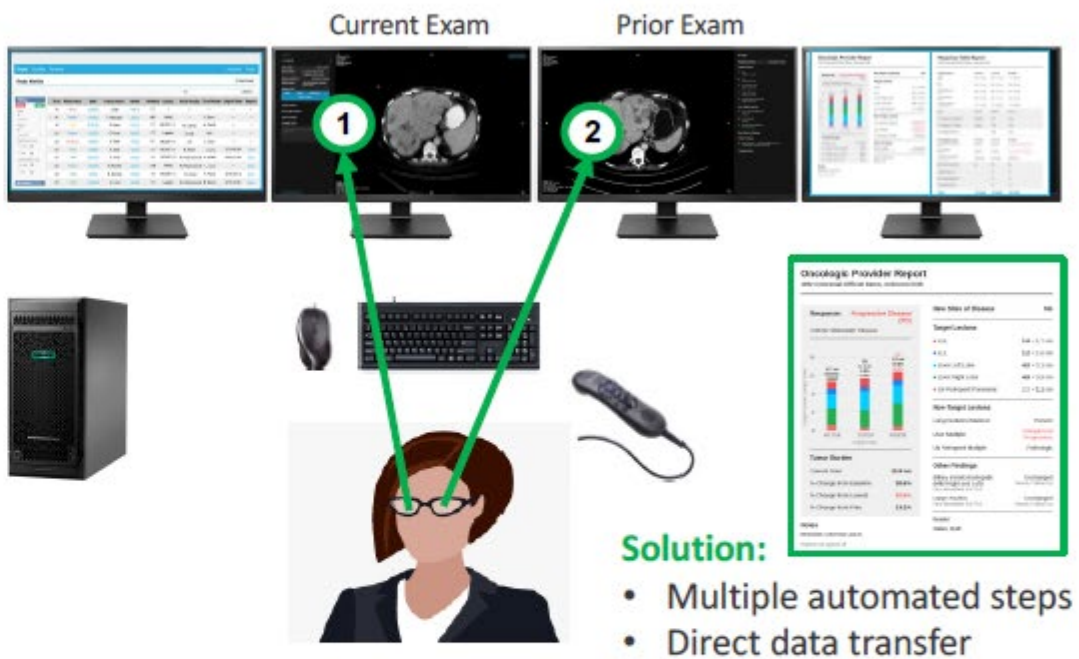
Standard of Care



Problems:

- Multiple manual steps
- Indirect data transfer
- Inconsistent
- Errors
- Omissions
- No tumor burden calculation
- Ineffective communication
- Inefficient

Augmented Intelligence

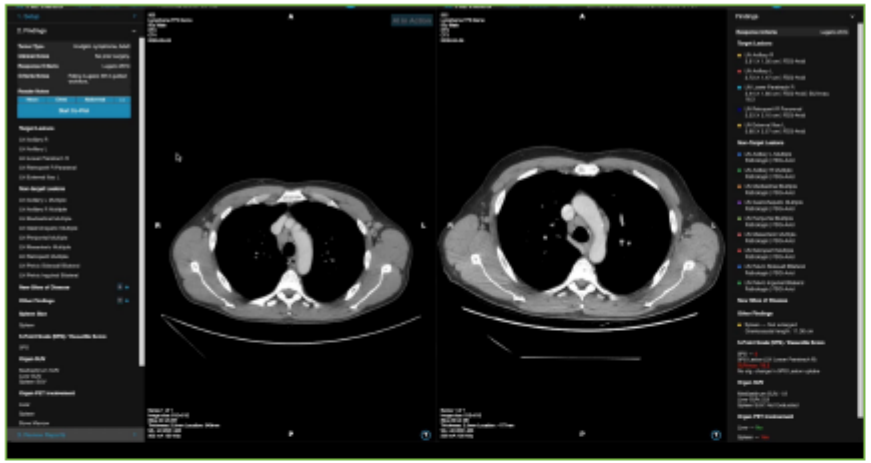


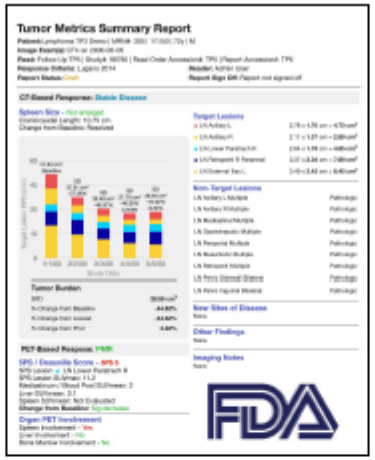
Solution:

- Multiple automated steps
- Direct data transfer
- Standardized
- Reduced errors
- Omissions eliminated
- Tumor burden calculated
- Effective communication
- Efficient

Credit Dr. Andrew Smith

AUGMENTED INTELLIGENCE FOR ADVANCED CANCER





25%
Accuracy

2X
FASTER

Radiologists prefer AI Guided Workflow

24 Radiologists
20 Oncologists

99%
Major Errors

58%
Inter-Observer Agreement

Oncologists prefer AI Reports

Clinical Value:

- Reduces errors / omissions
- Improves accuracy / reporting

Simplicity:

- Fully integrated but requires training and change management

ROI:

- New income for clinical trials
- Increased radiologist efficiency

Credit Dr. Andrew Smith

“If you’re teaching today what you were five years ago; either the field is dead or you are.”

-- Noam Chomsky

AI STANDARDS AND ADOPTION
FUTURE TRENDS AND INNOVATIONS

Evidence

Equity

Sustainability

Policy

Education

"People Analytics" and Large Scale Databanks: Blurring the Boundaries Between Medical Research, Clinical Care and Daily Life

- every monitored event (clinical and non-clinical) is a potential data point
- every individual is a data node
- every individual is a research asset
- every individual is their own control

21st century curricular emphasis

- **Knowledge capture and curation:** Teaching students to distinguish between information and knowledge. Stresses knowledge capture and curation not information retention.
- **Deep understanding of probabilistic reasoning:** understanding probabilities and communicating and applying them meaningfully
- **Collaboration with and management of AI applications**
- **Cultivation of empathy and compassion**

CURRENT LIMITATIONS AND CHALLENGES

Healthcare Algorithms Are Biased, and the Results Can Be Deadly

Deep-learning algorithms suffer from a fundamental problem: They can adopt unwanted biases from the data on which they're trained. In healthcare, this can lead to bad diagnoses and care recommendations.

How Bias Can Creep into Health Care Algorithms and Data

Health care is rife with bias. Without careful attention, AI will perpetuate those inequities.

Amazon Still Pushing Biased Facial-Recognition Software To Law Enforcement, MIT Researcher Contends

Biases in Artificial Intelligence Led to Healthcare Disparities

Researchers from the US and China note that several biases found in artificial intelligence design perpetuate healthcare disparities.

Racial bias in a medical algorithm favors white patients over sicker black patients

A US government study confirms most face recognition systems are racist

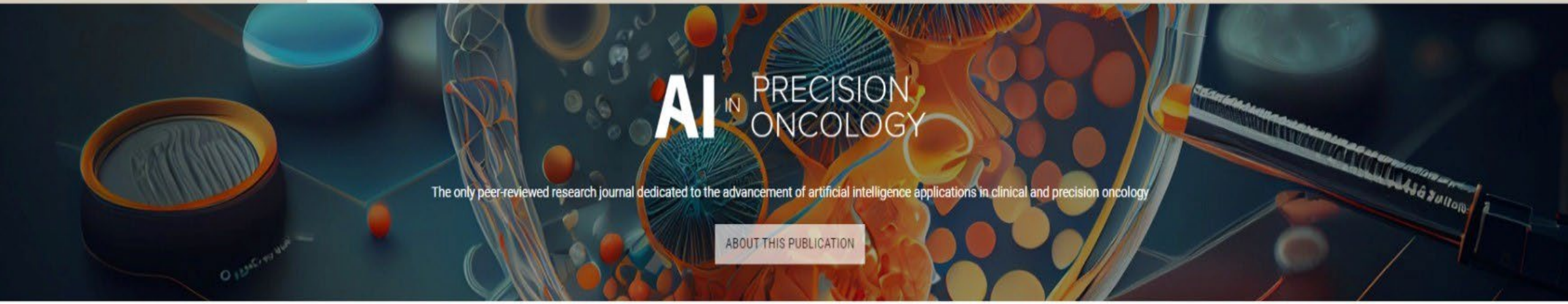
TANGIBLE BENEFITS AND ROI

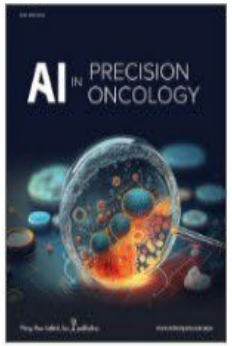
Improves Data Analysis

Better Diagnosis and Treatment Predictions

Frees Medical Staff from Administrative Burdens

Contrary to fears that machines will replace human workers, AI in healthcare may help “re-humanize” healthcare





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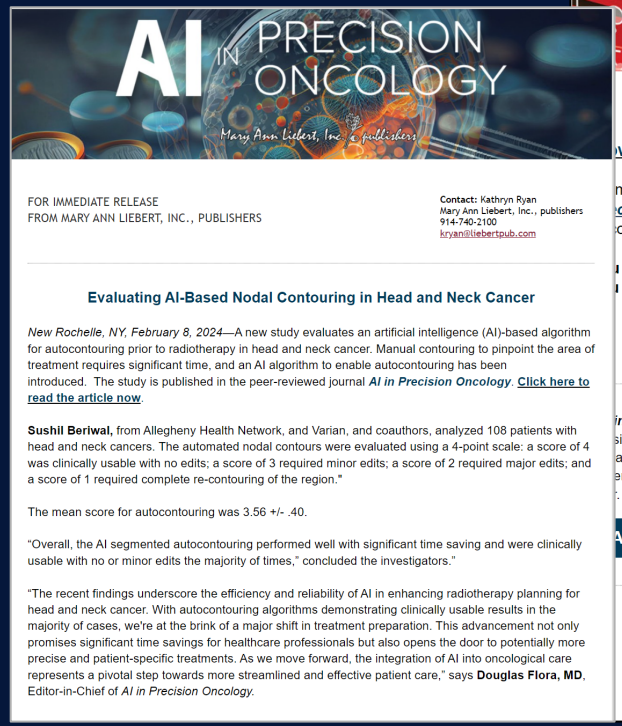
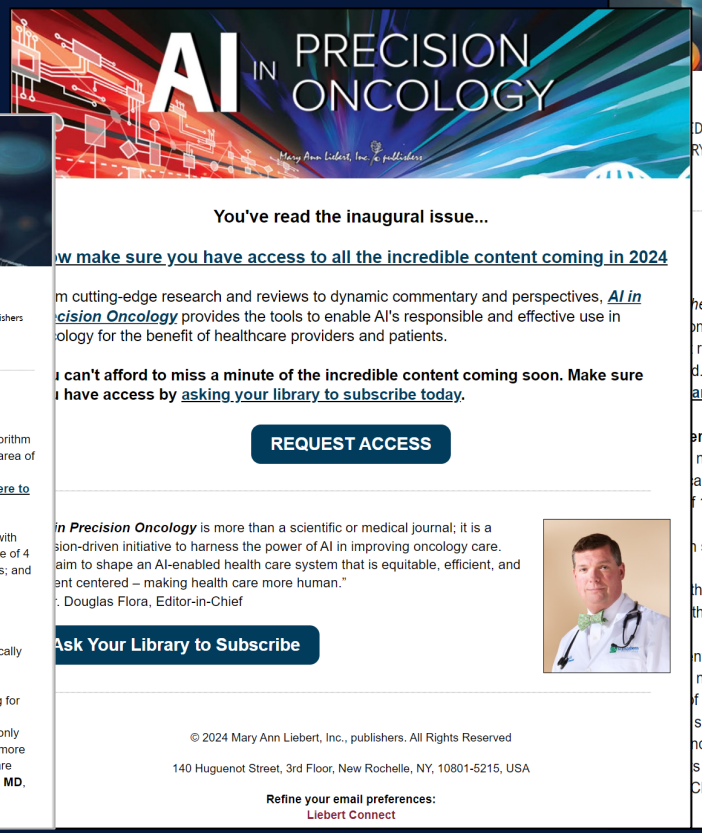
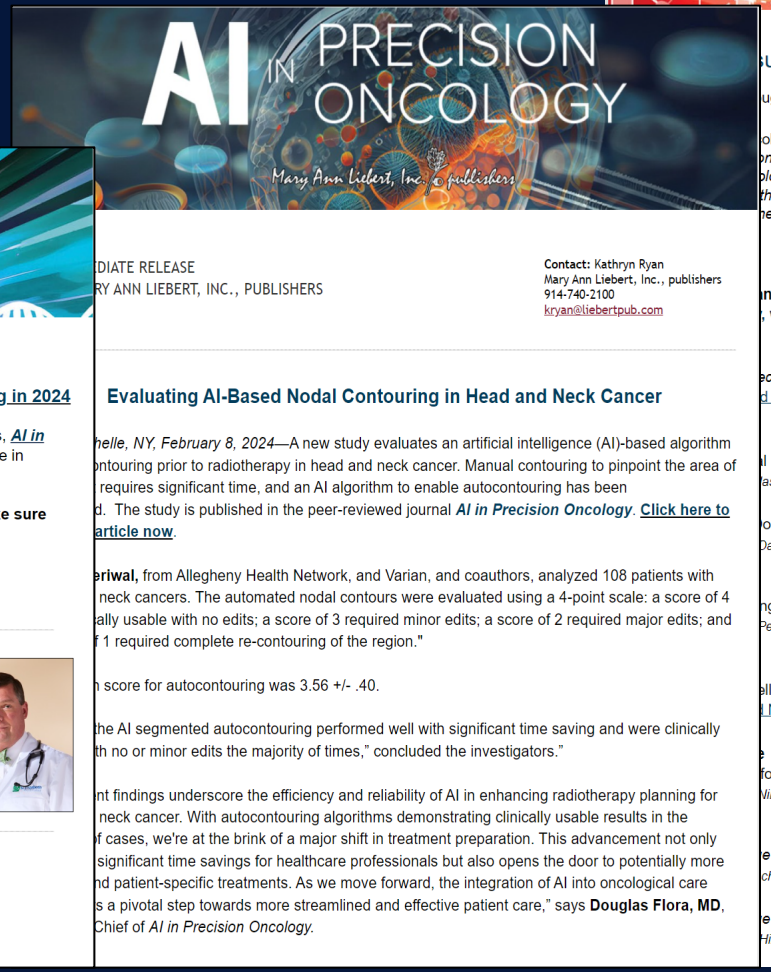
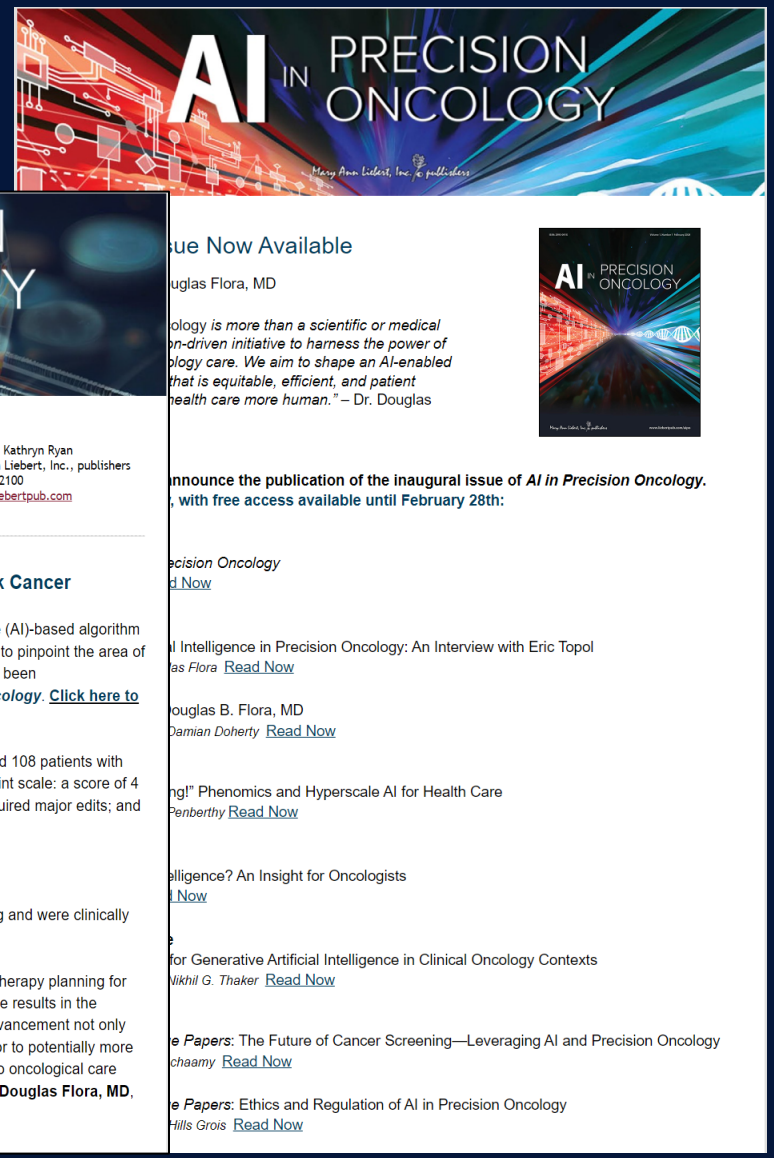








Easter Parades in New York City

Year 1900: One Motor Vehicle

Year 1913: One Horse & Carriage

Change is accelerating

Stay alert & engaged

Be open to possibilities

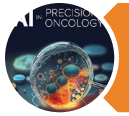
…and buckle up!


The future is bright!


Thank you!

THANK YOU!

dp4j@uvahealth.org



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Q & A

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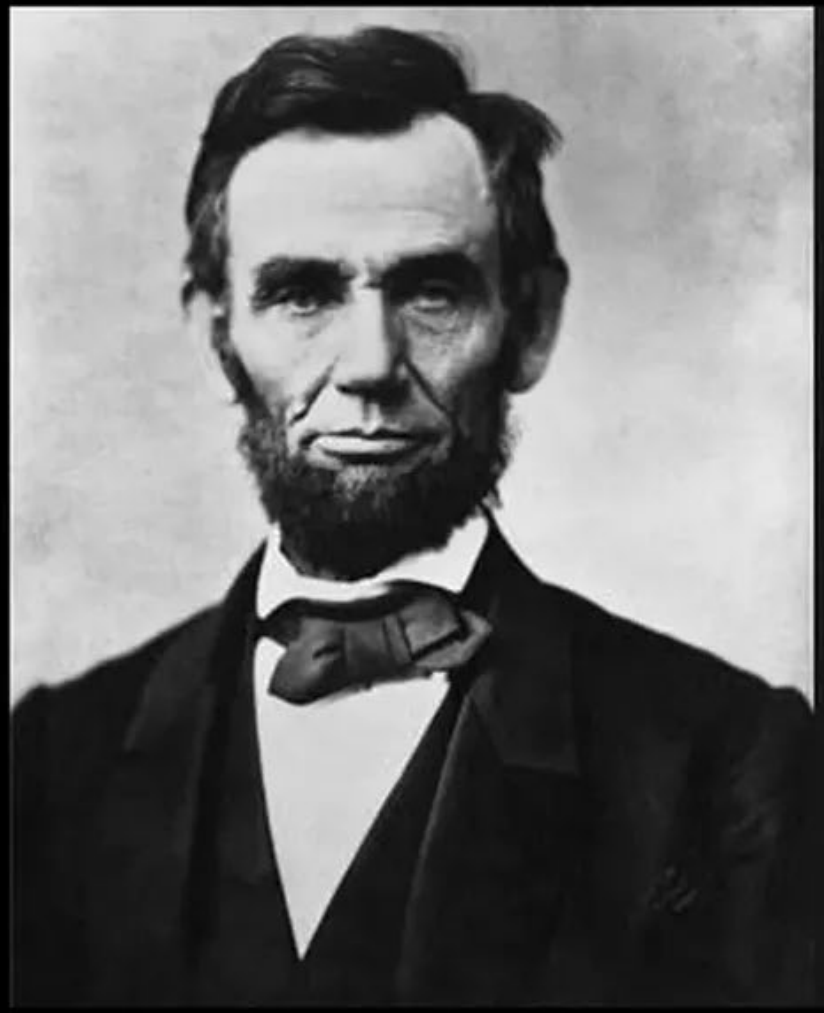

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—Abraham Lincoln


TO THE BEACH