

9.1 Overview of Biomedical Research

10x10 – Introduction to Biomedical Informatics & Artificial Intelligence
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Biomedical research – who and where?

Academic medical centers – researchers, usually faculty, at universities and other medical centers

Government research laboratories

Private industry – usually focused on product research and development

Others – growing involvement and leadership by patient groups and others, facilitated by the Internet and social media, e.g., [PatientsLikeMe](#)

“Basic” vs. “clinical” science and other distinctions and terminology

Historical distinction of

- Biological vs. clinical
- “Wet” vs. “dry” lab

Organizing principle of schools of medicine

- Basic science departments mostly PhDs vs. clinical departments mostly MDs

Other important terminology

- Biobanks (Annaratone, 2021; Madhusoodanan, 2025)
- Registries (Labkoff, 2024)
- Team science (Cline, 2020) – sometimes at odds with academic promotion pathway
- Implementation science (Rubin, 2023)

Many roles for informatics

Biomedical research funding – mostly government

In US, Department of Health & Human Services (HHS) includes (among others)

- [National Institutes of Health \(NIH\)](#)
- [Agency for Healthcare Research & Quality \(AHRQ\)](#)
- [Centers for Disease Control and Prevention \(CDC\)](#)

Other countries, especially wealthier ones, have government funding as well, e.g.,

- [United Kingdom Medical Research Council \(MRC\)](#)
- [Canadian Institutes of Health Research \(CIHR\)](#)
- [Singapore National Medical Research Council \(NMRC\)](#)
- [South Africa Medical Research Council \(SAMRC\)](#)

National Institutes of Health (NIH)

Incomparable world leader in biomedical research funding and productivity (Gaind, 2025)

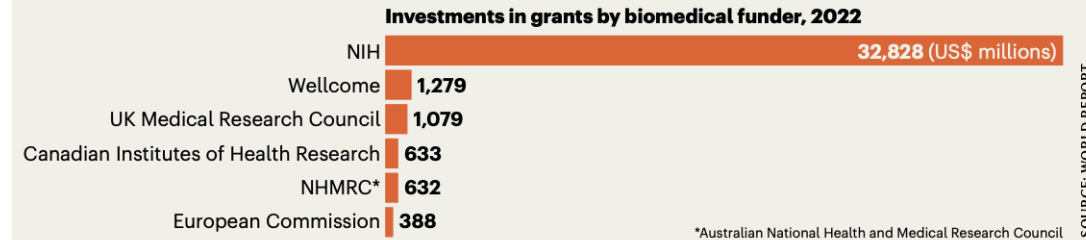
Annual budget in 2024 was ~\$48 billion, ~83% of which goes to fund extramural research

Consists of 27 institutes and centers (ICs)

- Most of which are disease-focused, e.g.,
 - National Cancer Institute (NCI)
 - National Heart, Lung, and Blood Institute (NHLBI)
- But some of which are more generic, e.g.,
 - National Library of Medicine (NLM) – 175 years of contributions (Slomski, 2011, Brennan, 2016; Humphreys, 2021)
 - National Institute of Biomedical Imaging and Bioengineering (NIBIB)

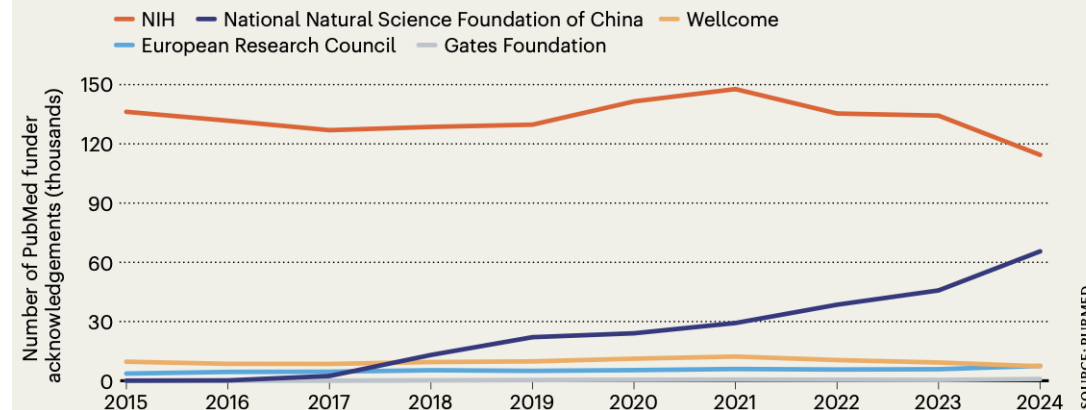
WORLD LEADER

The US National Institutes of Health (NIH) has a budget for biomedical-research grants that towers over the world's next-biggest funders of health research.

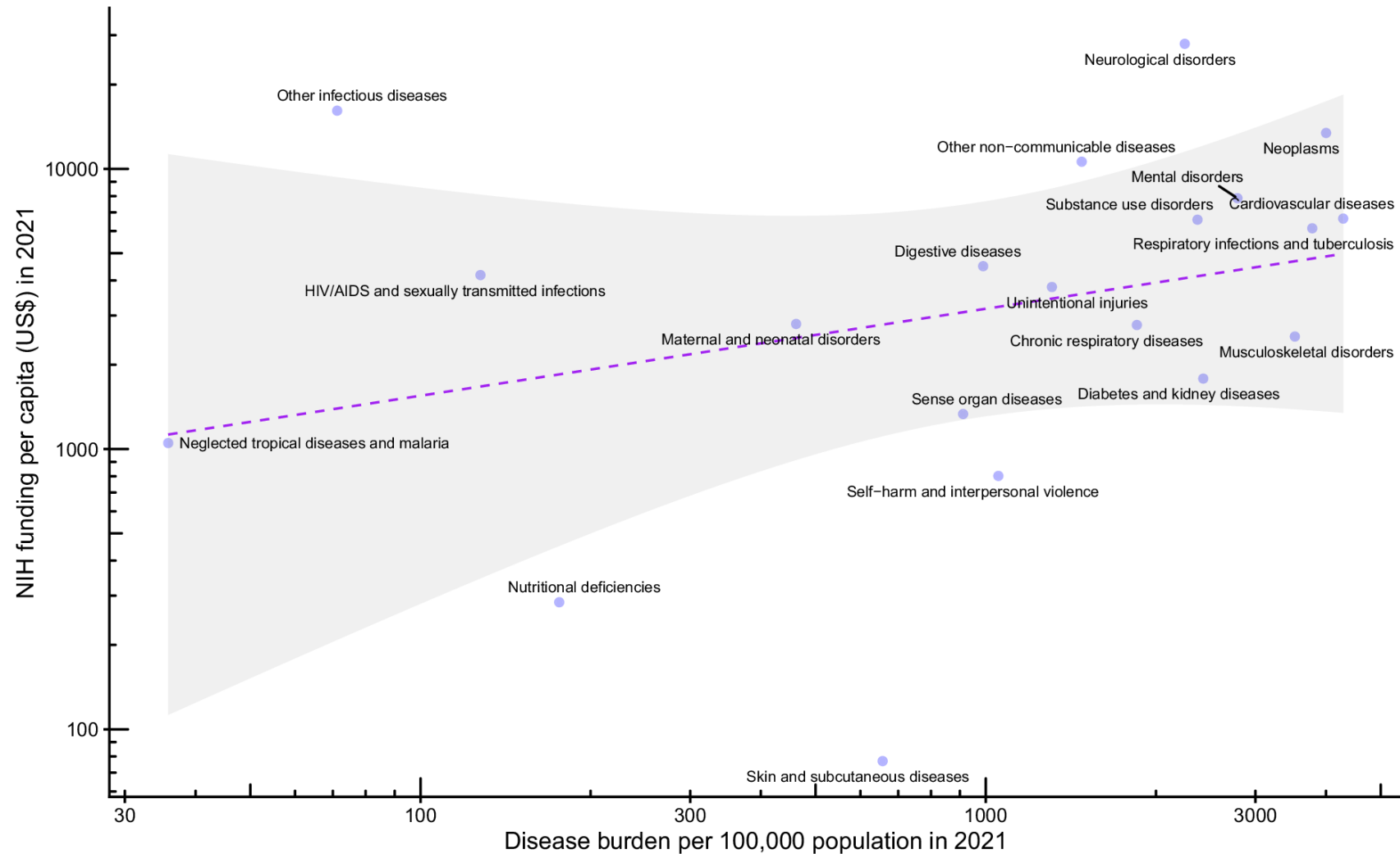


PUBLICATION PROWESS

The NIH has been acknowledged as a funder on more than 1.3 million biomedical-research papers indexed in the PubMed database over the past decade. The world's other major biomedical-research agencies are listed on just a fraction of publications in comparison.



NIH spending on diseases vs. burden (Gao, 2025)



Non-governmental research organizations

Quasi-public

- [Patient-Centered Outcomes Research Institute \(PCORI\)](#)
 - Created under Affordable Care Act
 - Funded by tax on health insurance plans (public and private)
 - Funded for \$3.5B through 2019, extended to 2029

Private non-profit – many organizations; some larger ones include

- [Robert Wood Johnson Foundation](#)
- [Howard Hughes Medical Institute](#)
- [American Cancer Society](#)
- [American Heart Association](#)
- In UK, [Wellcome Trust](#)

Some NIH initiatives especially pertinent to informatics

Common Fund

- Evolution of NIH Roadmap to “identify major opportunities and gaps in biomedical research that no single institute at NIH could tackle alone but that the agency as a whole must address”

AllOfUs (formerly, Precision Medicine Initiative)

- (Collins, 2015; Denny, 2019; Mayo, 2023)
- Approach to disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle
- Goal to create research cohort of >1M American volunteers who will share genetic data, biological samples, and diet/lifestyle information, all linked to their EHRs

Another NIH initiative – Clinical and Translational Science Award (CTSA)

From NIH National Center for Advancing Translational Science (NCATS)

Goal: accelerate translation of research into clinical care and community

About 60 centers funded around US to facilitate clinical and translational research

Informatics important?

- Centers required to have a biomedical informatics component
- Galvanized field of clinical research informatics
- Funded Clinical Data to Health (CD2H) that coalesced efforts around [National COVID Cohort Collaborative](#) (N3C; Haendel, 2021), which has transitioned to [National Clinical Cohort Collaborative](#) (N3C)

National Patient-Centered Clinical Research Network (PCORnet)

Established in 2014 with funding from Affordable Care Act to advance comparative effectiveness research using EHR data (Fleurence, 2014; Collins, 2014)

After 10 years of operation (Holve, 2026; Cohen, 2026; Marschhauser, 2026)

- 47 million unique patients through 8 Clinical Research Networks (CRNs) from over 70 partner organizations
- Over 300 research studies and publications
- Central role for patient voices (Merritt, 2026)
- Growing role for use of FHIR (Marsolo, 2026)

[Playbook](#) provides guide for using PCORnet

Other initiatives

[Sentinel Initiative](#) – US FDA effort to track safety of drugs, biologics, and medical devices

- Outgrowth was Observational Medical Outcomes Partnership (OMOP), which developed widely used data model now under purview of [Observational Health Data Sciences and Informatics \(ODHSI\)](#) (Hripcsak, 2015)

[Million Veteran Program \(MVP\)](#) – aims to collect blood samples and clinical data from 1M US veterans (Gaziano, 2016)

[UK Biobank](#) (Bycroft, 2018; Joseph, 2023) collecting clinical and biological data on over half-million citizens since 2006

Other initiatives (cont.)

[Health and Human Heredity in Africa \(H3Africa\)](#) – NIH- and Wellcome-funded project to advance genomic and clinical science in Africa (Mulder, 2018)

- Aimed to overcome “helicopter science” (Moodley, 2022)

[H3Africa Bioinformatics Support Network \(H3ABionet\)](#) – bioinformatics support network for H3Africa (Mulder, 2017)

[Data Science Initiative for Africa \(DSI Africa\)](#) – NIH-funded project to build human and data capacity in Africa

- Includes OHSU collaboration with University of Cape Town to develop new graduate program

Other initiatives (cont.)

21st Century Cures Act (Hudson, 2017; Kesselheim, 2017)

- Passed by Congress in late 2016 by large bipartisan majorities
- Provided additional funding for
 - [Brain Research through Advancing Innovative Neurotechnologies \(BRAIN\) Initiative](#)
 - Precision Medicine Initiative (PMI) – now [AllOfUs](#)
 - [Cancer Moonshot](#)
 - Regenerative medicine

[Advanced Research Projects Agency for Health](#) (ARPA-H; Collins, 2021)

- Supporting transformative high-risk, high-reward research to drive biomedical and health breakthroughs – ranging from molecular to societal to provide transformative solutions for all patients

Benefits from research

NIH and other government research provides important basic research that industry does not fund

- Of 26 “transformative” drugs approved between 1984-2009, most were developed by academic researchers funded by NIH (Kesselheim, 2015)
- 354 of 356 (99.4%) drugs approved by FDA between 2010-2016 received some NIH funding; over 90% of funding represented basic research related to biological targets for drug action (Galkina Cleary, 2018)
- Economic return on investment – each \$1 spent generates \$2.56 in new economic activity (United for Medical Research, 2025)

Cancer death rates continue to decline (Sherman, 2025)

Basic discoveries lead to societal benefit, sometimes in unanticipated ways (Marshall, 2025)

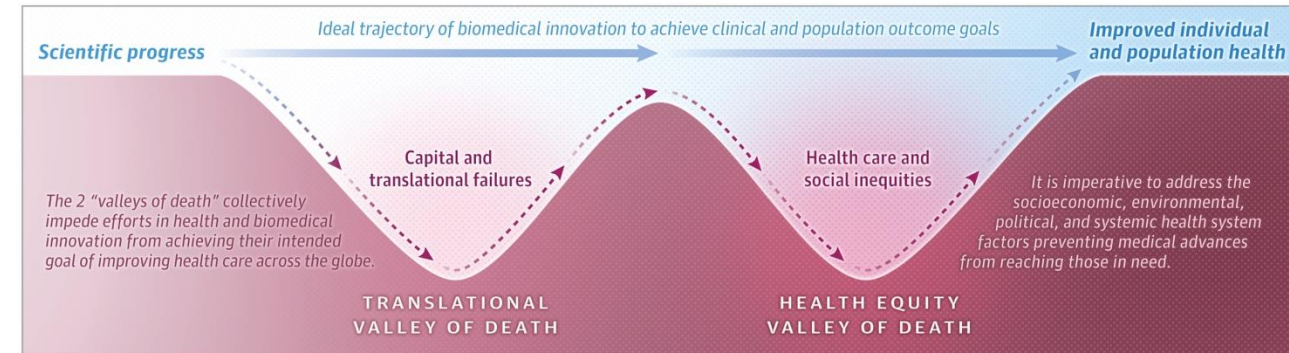
Challenges for research

“Chasms” for research – translational and equity (Dzau, 2024)

Reproducibility and replicability (NAP, 2019)

- Opportunities for EHR data to replicate clinical studies (Wang, 2022)

Need for meta-research (Ioannidis, 2024)?



		Data	
		Same	Different
Code	Same	Reproducible	Replicable
	Different	Robust	Generalisable

(Adler-Wagstyl, 2018)

Challenges (cont.)

Career support for scientists (Daniels, 2018), especially clinician scientists (Utz, 2022; O’Rahilly, 2023); solutions include (NAP, 2018)

- Create predictable and sustainable funding
- Broaden career paths for trainees
- Mentoring by established scientists

National Academy of Medicine (NAM, 2024) advocated strategies for addressing challenges

- Strategic vision
- Funding
- Health equity
- Coordination and convergence science
- Workforce development

What portends future of research support and funding (Walensky, 2025; Laine, 2025; Altmann, 2025)?