Artificial Intelligence for Health

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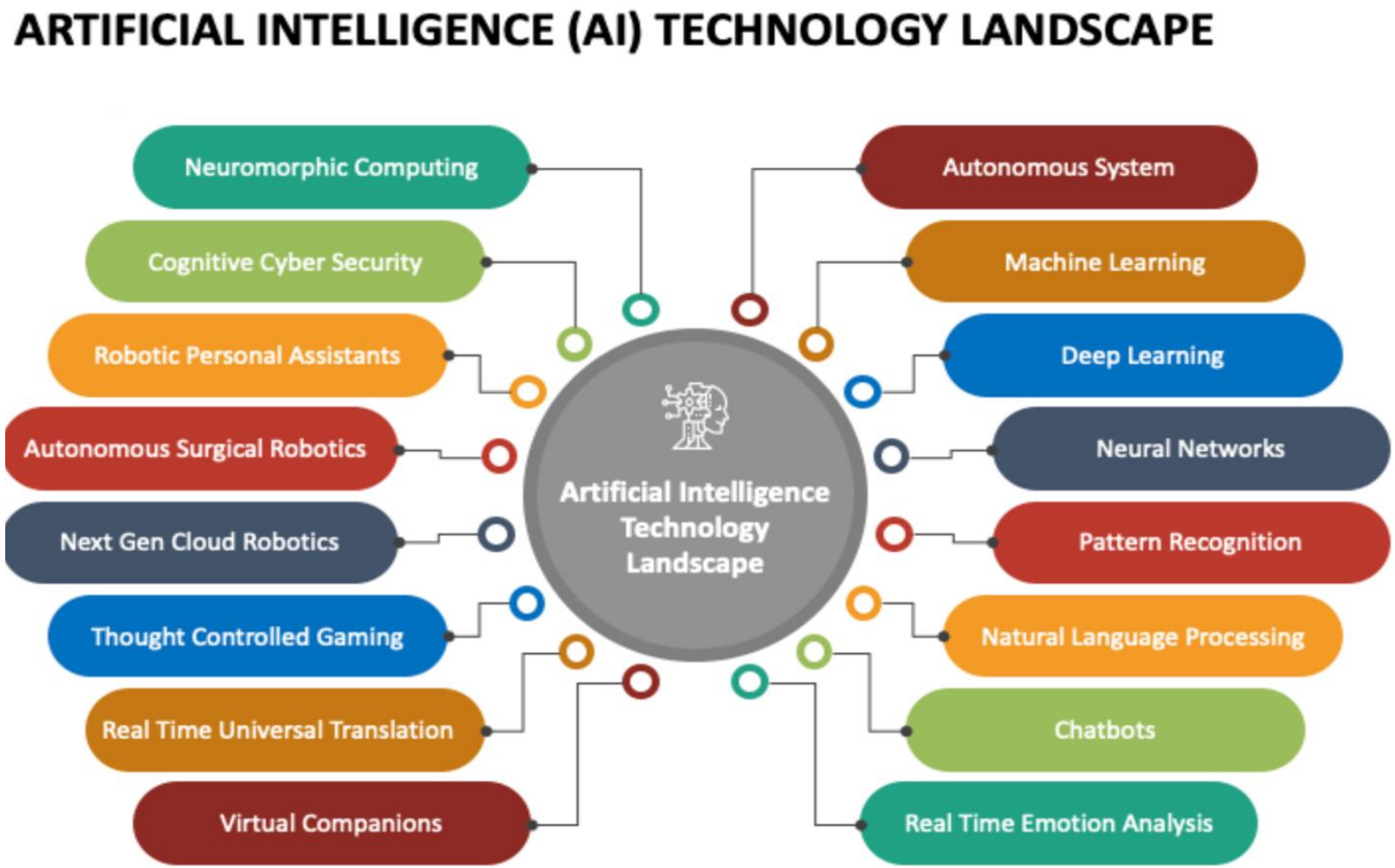
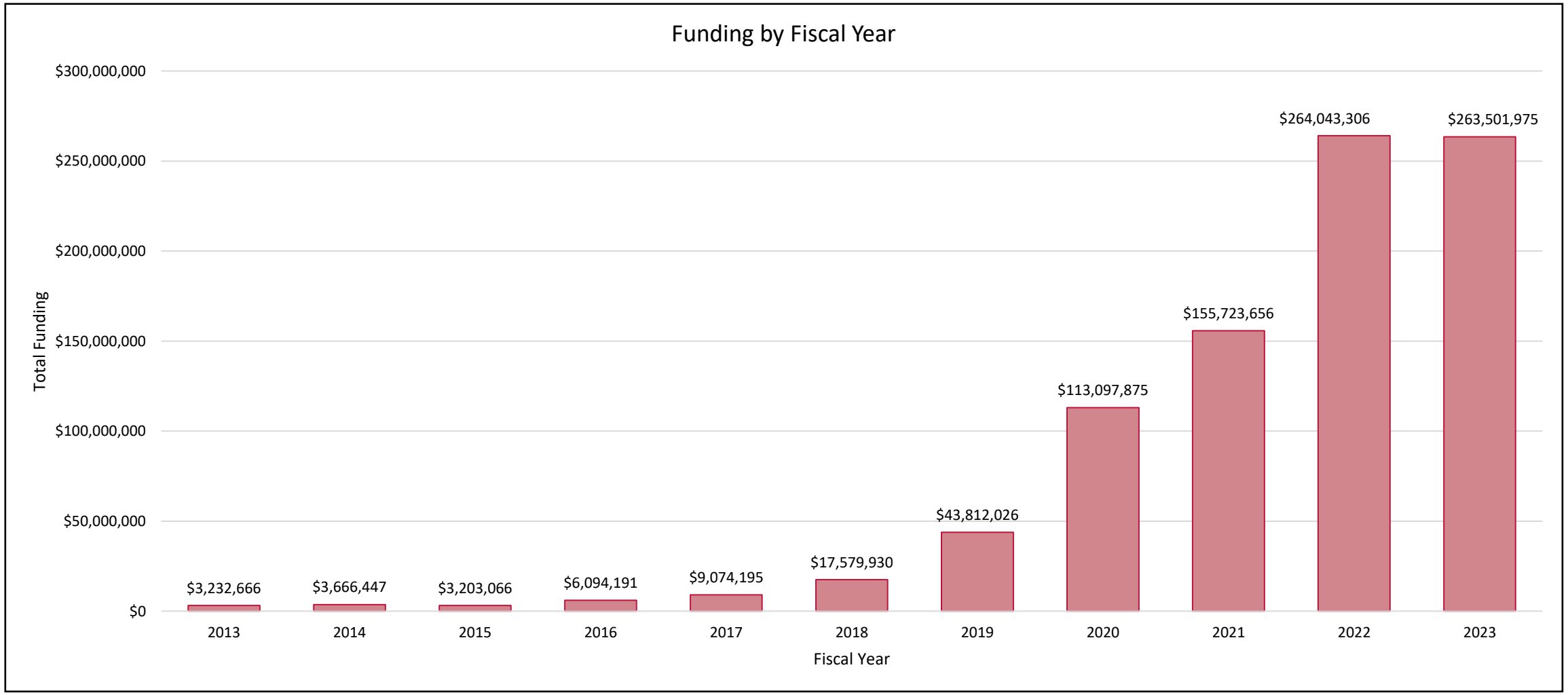
AI Technology Landscape

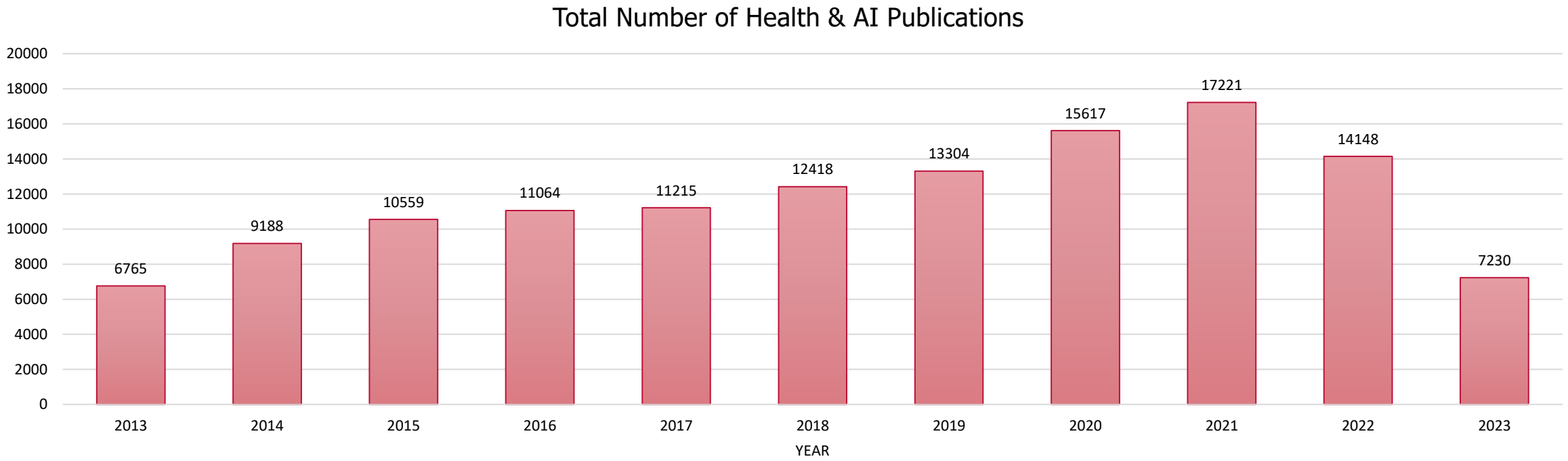


NIH Support for AI and Health



NIH PubMed Publications on AI and Health

"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." - World Health Organization



Digital Health Care Economy

- Equity markets in 2018: $9.5B
- $20B in 2019
- Major driver: healthcare data available for use in AI/ML come from Real world data at the point of care

https://www.zionmarketresearch.com/news/mhealth-apps-market

Government, Academia and Industry Partnership in Artificial Intelligence and Health

Training the Workforce to Make Data FAIR and AI/ML-Ready

Support Workforce Development at the Interface of Information Sciences, Artificial Intelligence and Machine Learning (AI/ML), and Biomedical Sciences (NOT-OD-21-079)

ODSS supported the development and implementation of curricular and training activities at the interface of information science, AI/ML, and biomedical sciences to develop the competencies and skills needed to make biomedical data findable, accessible, interoperable, reusable (FAIR) and AI/ML-ready.

23 Awards

- 6 IDeA States
- 4 Minority Serving Institutions
- 11 propose training on ethics of AI
- 8 with a diversity focus

Most common biomedical focus areas:
cancer, environmental health, ophthalmology

https://datascience.nih.gov/artificial-intelligence/initiatives/Workforce-Gap-Data-Governance-AI

Collaborations to Make Data FAIR and AI/ML Ready

NIH supported collaboration, bringing together expertise in biomedicine, data management, and artificial intelligence and machine learning (AI/ML) to make NIH-supported data AI-ready for AI/ML analytics.

FY21-FY22: 73 Awards

Most common biomedical focus areas:

Alzheimer's and Parkinson's disease, cardiovascular disease, cancer, and aging

Most common data types:

imaging, EHRs, -omics, microbes/pathogens, speech

NHGRI | NIA | NIBIB | NIDA | NIDCD | NIDCR | NIEHS | NIGMS | NIMH | NINDS | NCI | NLM | NIMHD | NIDDK | NICHD | NIAID | NIAMS | NHLBI

AI & Industry Collaborations for Aging Research

- Goal: Use AI/ML as foundational capabilities to help Americans live longer, healthier lives
- Platform
  - National hub and catalyst for AI and aging research and development by bringing together **academia, health, venture, industry, and government to translate research to application**
  - Dynamic hub with an entrepreneurial startup mentality outside of academic silos for fruitful collaborations
  - Website to serve as a national resource for AI and Healthy Aging; hosting a **networking, sharing, and learning platform for AI and healthy aging innovators; creating a marketing engine to promote pilot project competitions**, workshops, and industry achievements

AI for Cancer Research

- NCI's partnership with the Department of Energy on advanced computing and AI
- Extends NIH investments in Precision Medicine Initiative, the National Strategic Computing Initiative and the Beau Biden Cancer Moonshot
- DoE partnership involves **multiple HPC vendors**, which addresses a shared need across the pilots to develop predictive models using large-scale data. Exploiting **exascale technologies** and capabilities anticipated for deep and machine learning
- Deliver an open source, collaboratively developed **software platform** providing deep learning methodologies to the community that will be used to advance precision oncology

AI in the Pharmaceutical Arena

- **Precision drug discovery**: use of deep learning, super computers
  - Time saved: from years to days
- Identifying **targets in drug design**
- **Predicting drug response** requires data on:
  - Molecular profiles
  - Genomic aberrations
  - Point mutation
  - Deletions
  - Insertion
  - Translocation
- Clinical Profiles

NIH Partnership with Communities: Cancer Screening Chatbot

Colorado, Hispanic/Latino community:

- User-facing artificially intelligent (AI) text message program on cancer screening, diagnosis and treatment
- Culturally relevant for the Latino community
- Build technology platform and **algorithms to generate questions and answers using AI, NLP and ML**
- Beta-test matching responses to user questions at least 75% of the time
- **Integrate the chatbot with appointment scheduling options**
- Determine acceptability and feasibility of the chatbot

Artificial Intelligence Applied at the Point of Care

AI-Based Diagnosis of Coronary Artery Disease (HeartFlow)®

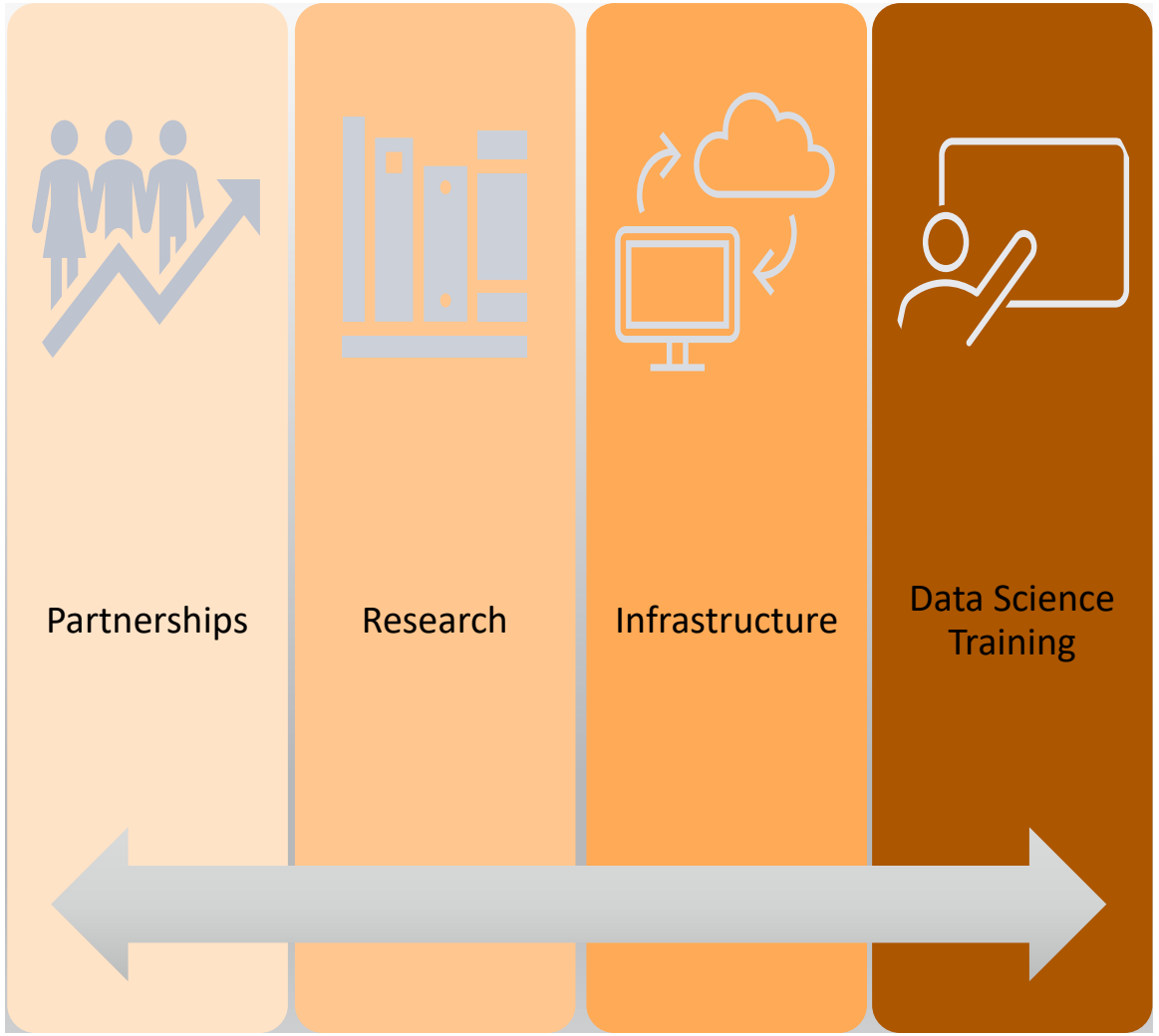
- FDA- approved software for non-invasive diagnosis and management of coronary artery disease (CAD)
- Based on a coronary computerized tomography angiography (CCTA) scans and patient characteristics
- Images showing signs of CAD are sent to a cloud-based HeartFlow® server for post-processing by a set of algorithms.
- ML and DL algorithms are used to build a physiological model of a patient's heart to estimate blood pressure, velocity, and flow.
- A personalized, color-coded 3-dimensional model of a patient's coronary arteries is constructed, indicating functional information about each blockage to a physician

Angehrn, Z. et al, Front Pharmacol, 2020, June 18, 11:759

Strategies to Address Health Equity

Artificial Intelligence/Machine Learning Consortium to Advance Health Equity and Researcher Diversity (AIM-AHEAD)

AIM-AHEAD Goals



1. Increase participation and representation of researchers and communities currently underrepresented in the development of AI/ML models.

2. Address health disparities and inequities using AI/ML

3. Improve the capabilities of this technology, including the use of electronic health records (EHR) and other diverse data such as social determinants of health

Impactful Change in Health Disparities

Data analysis is not enough to truly have an impact on decreasing health disparities.

What might also be needed?

Case Study: Integrating clinical services with multilevel social services for minority communities in Baltimore

Clinical decision support tool: integrate both clinical and non-clinical large-scale databases (e.g., EHRs, social risk assessments, and neighborhood characteristics) to develop a comprehensive social risk score. In collaboration with the **Maryland Health Information Exchange**, also develop an interoperable closed loop referral system between primary care practices and 3 community based (social service) organizations (CBOs).

Cautionary Note with AI and Health Equity: Bias

- Problem selection: selecting studies based on differential research priorities and funding that don't address health disparity raise **principle of justice** consideration
- Data collection: broad and diverse representation of communities in training and test datasets are crucial for the model to be generalizable
- Variable selection: structural inequity in healthcare systems may lead to biased outcomes
- Algorithm development: from data that are not broadly representative of diverse communities would violate the principles of justice and beneficence
- Post deployment consideration: transparency and validation of models to protect patient safety

E. Uche-Anya et al, Gut 2022 Sep; 71(9): 1909-1915

Applying AI to Health Equity

AI research

- Requires large, diverse, publicly available, and curated datasets
- Needs to include ethnoracial elements in training datasets to improve accuracy of predictive models
- Needs to avoid bias in datasets
- Guided by ethical principles: informed representation, privacy, safety, autonomy, respect, transparency and accountability

AI technologies

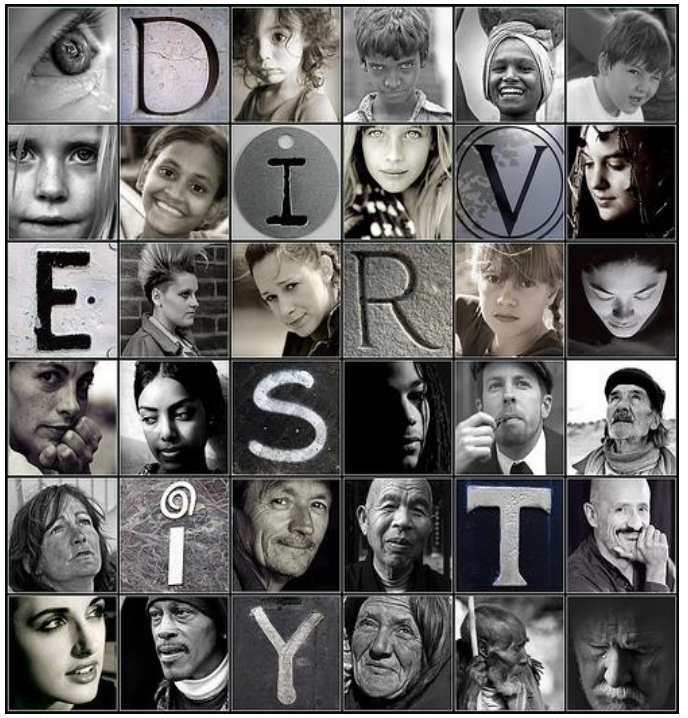
- Requires access to computing power; cloud computing

Cultural changes

- Data sharing
- Interdisciplinary collaborations
- Engagement with diverse communities

Equity and Disparity Issues

- Data and Information are not Neutral
- Stigma: People/Groups/ Communities/Phenotypes
- Inclusion: Basic/Applied/ Clinical Trial Research
- Diversity and Workforce Issues
- Citizen Science and *Community Engagement*
- Inclusion, Equity, and Data The Haves and Have Nots



AI vs Radiologists: Interpreting Screening Mammogram

- **Crowdsourcing competition:** Can artificial intelligence (AI) algorithms meet or beat radiologists' interpretive screening mammography performance in predicting likelihood that a woman will be diagnosed with breast cancer within the next 12 months.
- **Results:** Algorithms specificity and sensitivity were lower than community-practice radiologists. However, by combining top-performing algorithms and US radiologist assessments resulted in a higher area under the curve of 0.942 and achieved a significantly improved specificity (92.0%) at the same sensitivity.
- **Conclusion:** Integrating artificial intelligence to mammography interpretation could yield significant performance improvements, with the potential to reduce health care system expenditures.

JAMA Netw Open. 2020 Mar; 3(3): e200265.

ChatGPT vs. Tumor Board

Test case: Comparing decision making between ChatGPT and a tumor board for glioma adjuvant therapy

- *What is the best adjuvant treatment?*
- *What would be the regimen of radiotherapy and chemotherapy for this patient?*

Results: ChatGPT scored well overall, but less accurate on incorporating the functional status of the patient.

Potential: Integrate the newest trial and bench science information into multidisciplinary decision-making and help TB direct patients to potential applicable treatments.

http://orcid.org/0000-0001-5998-8541Julien Haemmerli; BMJ Health Care Inform: first published as 10.1136/bmjhci-2023-100775 on 30 June 2023

AI and Health Care: Points to Consider

- Privacy and data management
- Data Ownership/Viewership
- Quality of care/Patient Safety
- Provider Integrity
- Responsibility/Accountability
- Potential Care Inequities

Generative AI Prohibited for NIH Peer Review Process

NOT-OD-23-149

Release Date: June 23, 2023

- NIH is revising its Confidentiality Agreements for Peer Reviewers to clarify that reviewers are prohibited from using AI tools in analyzing and critiquing NIH grant applications and R&D contract proposals.

AI Requires Big Data: Challenges

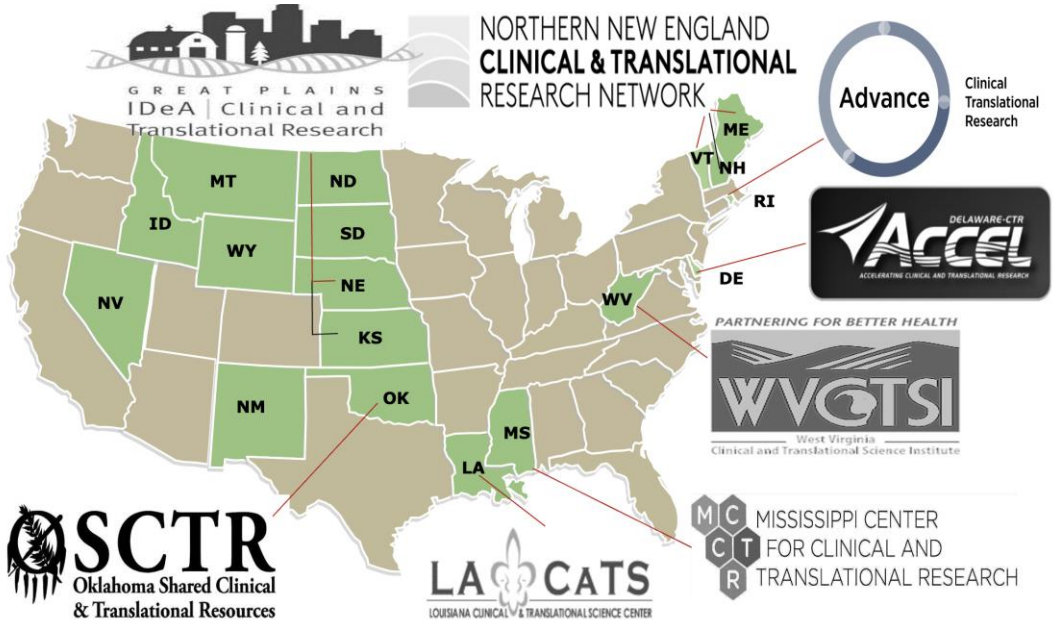
- Integration of diverse data types including images, EHRs,
- Requires standardization of data labels, common data elements including social determinants of health
- Requires unified semantic systems
- Sharing of AI model architectural structures

Fast Healthcare Interoperability Resources

ODSS and NIGMS recently completed FHIR training at 8 Institutional Development Award Networks for Clinical and Translational Research (IDeA-CTR) institutions

- UNDERSTAND
- OPEN SCIENCE
- CROSS-LINK
- COLLABORATE
- SCALE
- SHARE

HL7® FHIR®



IDeA-CTR FHIR Training

Common Data Elements and Social Determinants of Health

- CDEs are standardized, defined questions paired with a set of specific allowable responses. These are the **foundation for interoperability among data systems**.
- Enable sharing and comparing data systematically across different sites and studies
- Social determinants of health (SDOH) are data pertaining to environments where people were born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks. (https://health.gov/healthypeople/priority-areas/social-determinants-health)
- SDoH is crucial in achieving health equity and reducing health disparities.

All of Us Participant Surveys

Participants in the *All of Us* Research Program responded to 9 surveys spanning a variety of topics: The Basics, Lifestyle, Overall Health, Personal Medical History, Healthcare Access and Utilization, Family Health History, COPE, COVID-19 Vaccines, and *Social Determinants of Health*

→ "Neighborhood Quality"

→ "Social Isolation/Connection"

All of Us THE FUTURE OF HEALTH BEGINS WITH YOU | The Precision Medicine Initiative

NIH Leadership Working Group on CDE

- Charge: to enhance and broaden the development, adoption and use of CDEs for research on various disease/conditions, including but not limited to **autoimmune disease and immune-mediated conditions**
- Issue a **RFI** to solicit input for disease-focused CDEs from researchers, patients and stakeholders
- Convene a **workshop** to discuss strategies to encourage adoption and use of CDEs in research, including approaches and methods for cross-studies analysis
- Develop an NIH action plan to implement the Congressional report on CDEs

Stay tuned!
Participate in RFI & funding opportunities for demonstration projects.