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AI for Community Design, Data, and Decisions

Usha Sambamoorthi, MA, PhD
Professor

Associate Dean of Health Outcomes Pharmacotherapy

Health Equity through Artificial Intelligence (AI) and Machine Learning (ML)

March 2024

MPI https://aim-ahead.net/home

AIM AHEAD **A**rtificial **I**ntelligence/**M**achine Learning Consortium to **A**dvance **H**ealth **E**quity and Researcher **D**iversity

Outline

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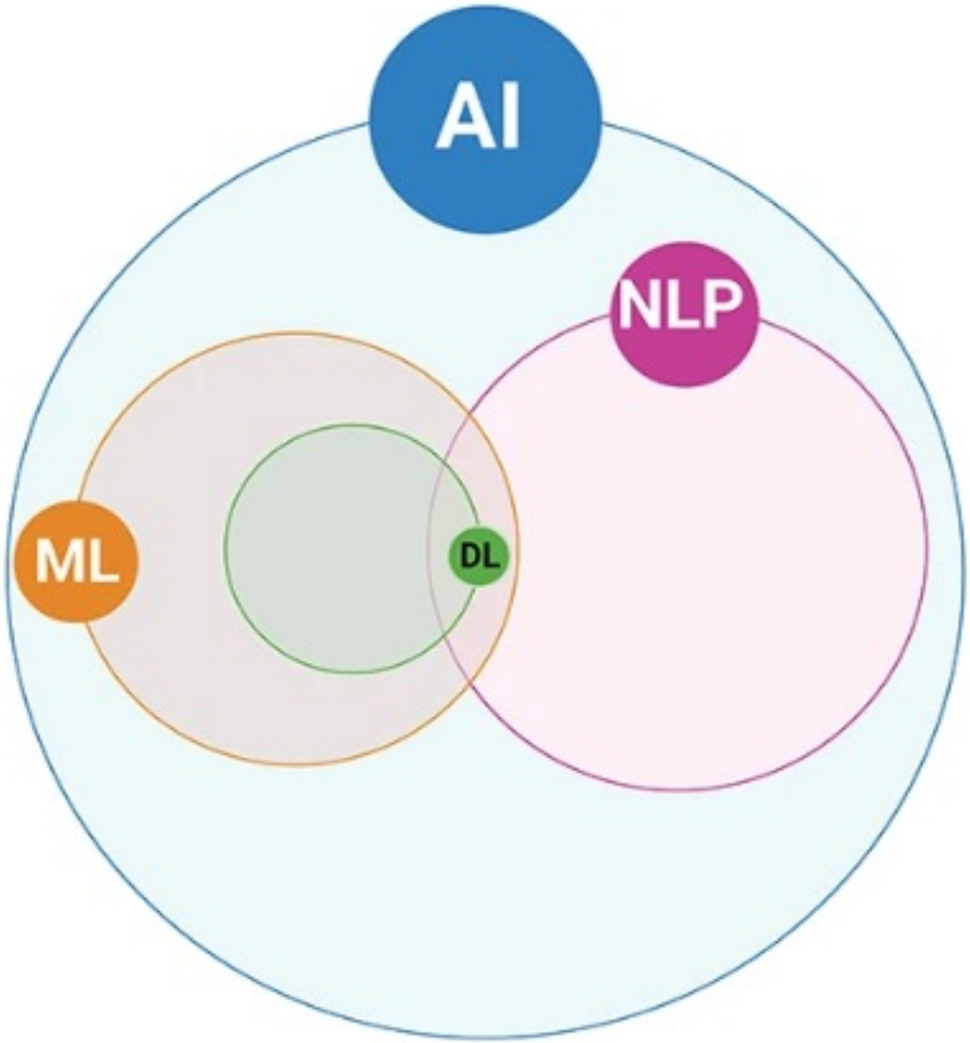
- Definitions to set the stage
  - What is AI? What is ML?
  - What is health equity? What is Health Disparity? What are SDOH?
  - AI Bias & AI Fairness
- AI for community and Health Equity
  - AI Bias Healthcare
  - Strategies for health equity
  - Building Bridges: Community Perspectives on AI
  - Building Bridges: AI for community – Challenges
  - Building Bridges: AI for community – Opportunities

AI, ML, DL, & NLP

AI: broad field that includes anything related to making machines smart.
NLP: branch of AI focused on teaching machines to understand, interpret, and generate human language.
ML: subset of AI that involves systems that can learn by themselves.
DL: subset of ML that uses models built on deep neural networks to detect patterns with minimal human involvement.



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10517477 /

What is Health Equity ?
What is Health Disparity?

- Health Equity
- everyone has a fair and just opportunity to be as healthy as possible; remove obstacles to health
- Health Disparity
- health difference between groups
- closely linked with economic, social, or other disadvantages
- Disparities in health and its determinants are the *metric for assessing health equity*

https://www.rwjf.org/en/library/research/2017/05/what-is-health-equity-.html

https://www.rwjf.org/en/insights/our-research/infographics/visualizing-health-equity.htm l

What is AI Bias ?
What is AI Fairness?

AI BIAS

"systematic error in decision-making processes that results in unfair outcomes" in AI

Ferrara E. Fairness and Bias in Artificial Intelligence: A Brief Survey of Sources, Impacts, and Mitigation Strategies
Sci **2024**, *6*(1), 3; https://doi.org/10.3390/sci6010003

AI Fairness

"the absence of prejudice or preference for an individual or group based on their characteristics" in AI systems and applications

AI Publications

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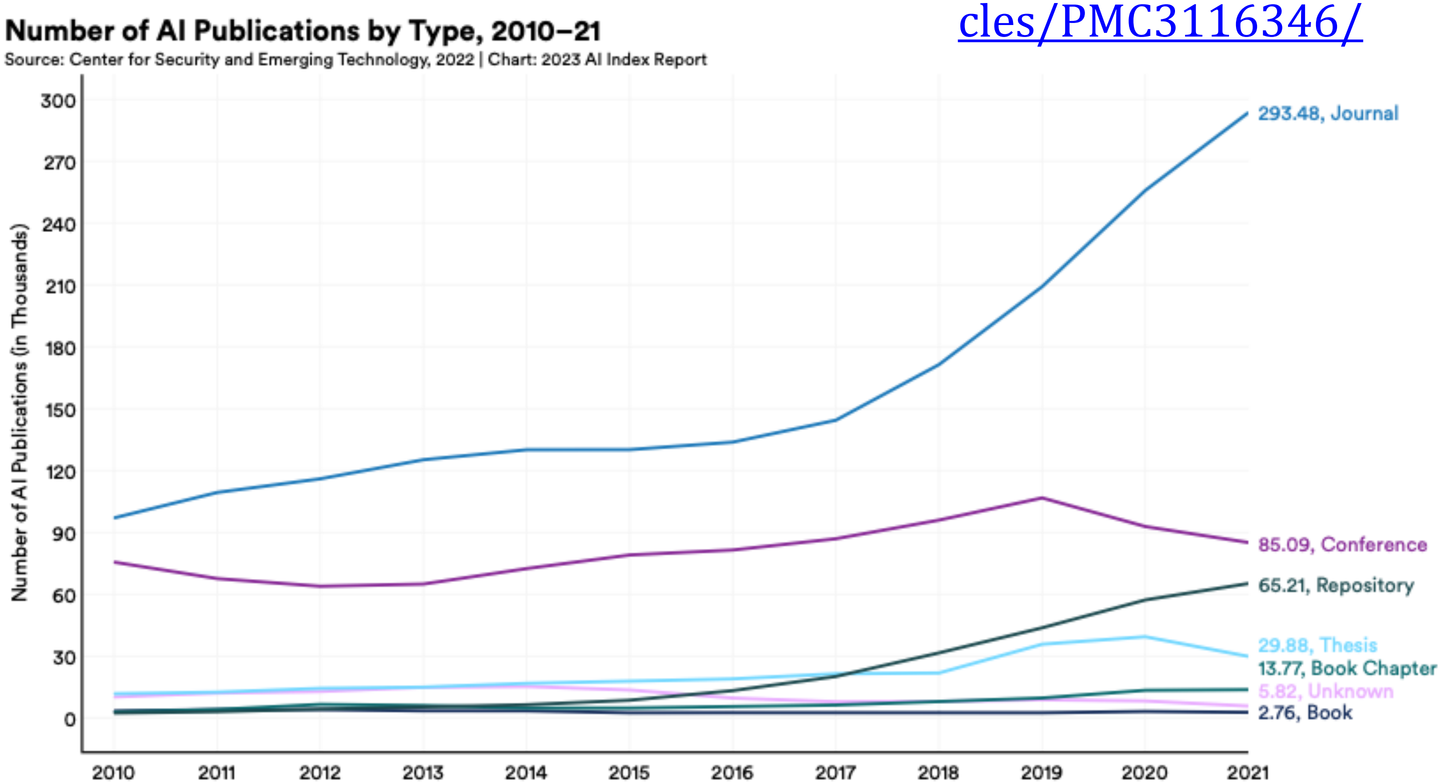
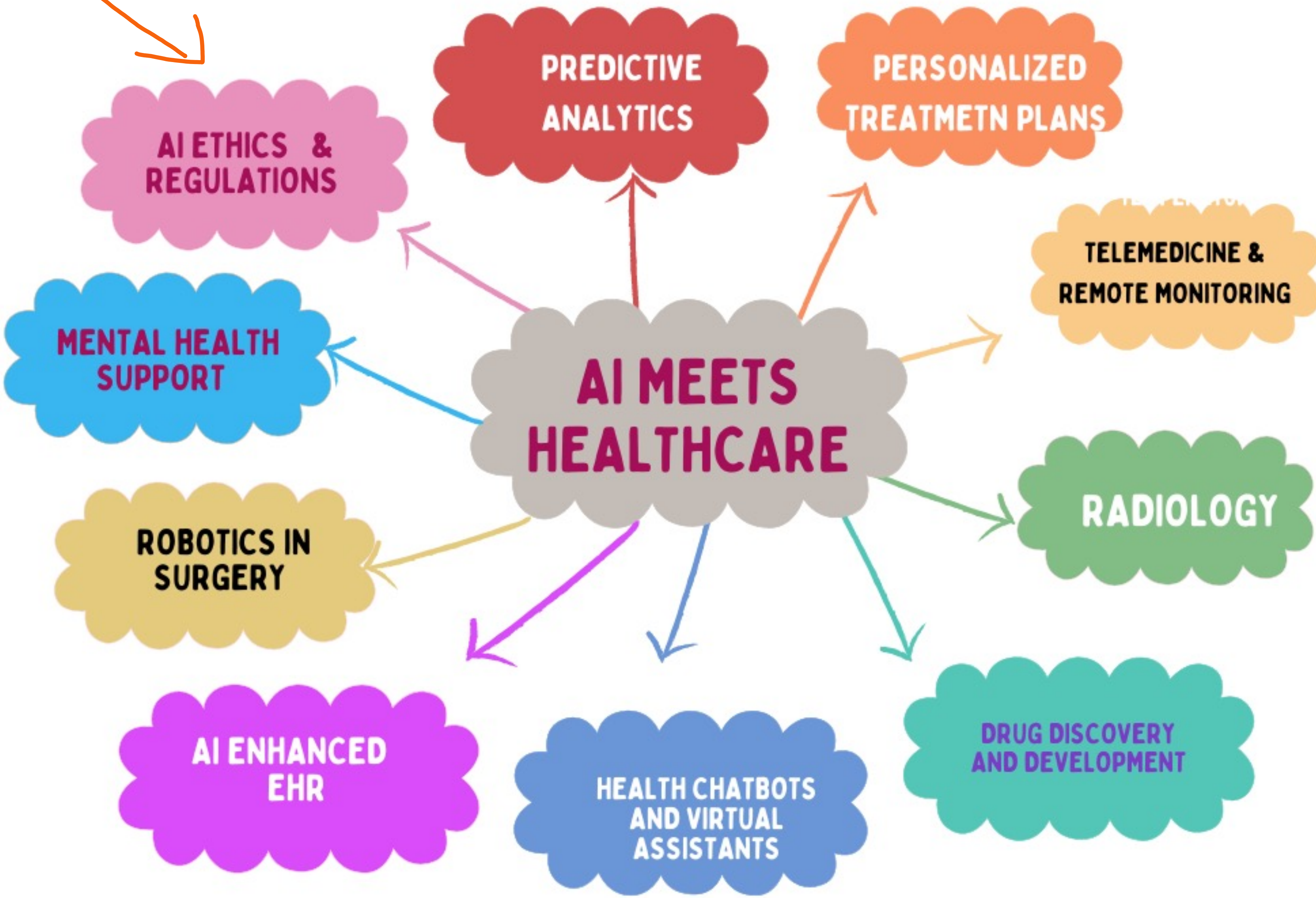
Doubling time of medical knowledge in 1950 was 50 years; in 1980, 7 years; and in 2010, 3.5 years. In 2020 it is projected to be 0.2 years—just 73 days. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3116346/



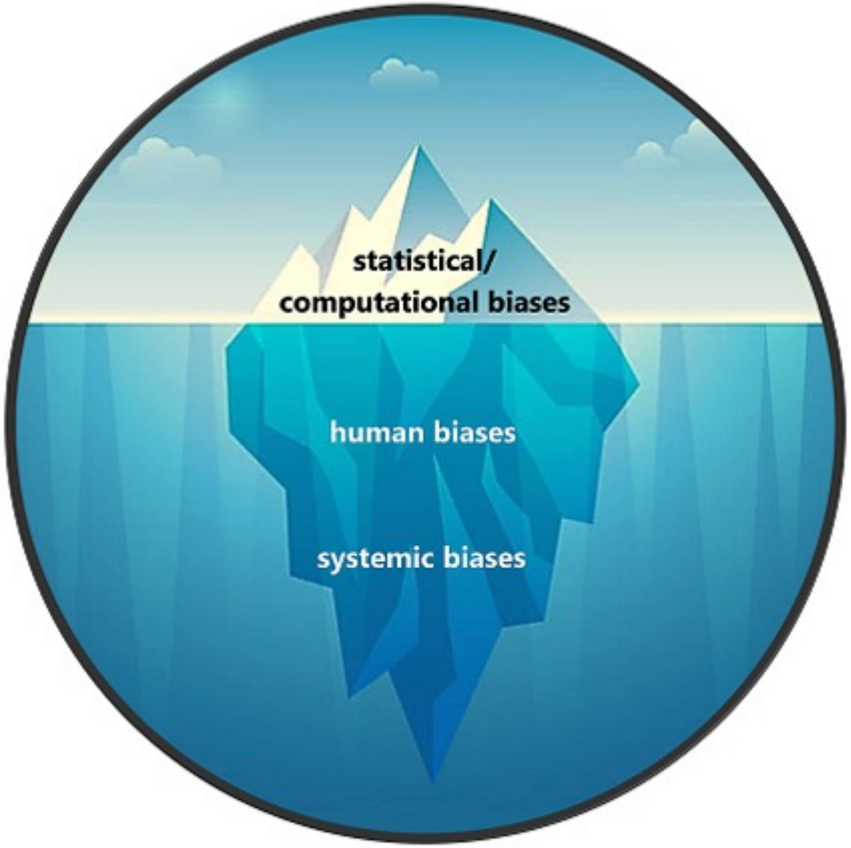
https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf hsc College of Pharmacy



https://www.analyticsinsight.net/ai-in-healthcare-10-transformative-trends-to-watch-in-2024/

AI Bias

The challenge of managing AI bias



“bias in AI is complex and multi-faceted. While there are many approaches for mitigating this challenge there is no quick fix.”

Human factors

- participatory design techniques
- multi-stakeholder approaches
- human-in-the-loop

important for mitigating risks related to AI bias.

https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=934464

AI Bias - Healthcare

African-American patients being denied access to healthcare or receiving subpar treatment. Obermeyer et al. 2020

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NBCBLK

Racial bias found in widely used health care algorithm

An estimated 200 million people are affected each year by similar tools that are used in hospital networks

Ethics and Justice, Healthcare, Machine Learning

The Geographic Bias in Medical AI Tools

Patient data from just three states trains most AI diagnostic tools.

Gender bias revealed in AI tools screening for liver disease

> N Engl J Med. 2020 Dec 17;383(25):2477-2478. doi: 10.1056/NEJMc2029240.

Racial Bias in Pulse Oximetry Measurement

The NEW ENGLAND JOURNAL of MEDICINE

Michael W Sjoding [1], Robert P Dickson [1], Theodore J Iwashyna [1], Steven E Gay [1], Thomas S Valley [1]

AI Bias – Healthcare

NIHCM FOUNDATION

DATA INSIGHTS

Racial Bias in Health Care Artificial Intelligence

Racial Bias in Health Care Algorithms

Algorithms and artificial intelligence are used as analytic tools to assess risk and guide care for patients. The tools can display racial bias in the following ways:

The explicit use of race to predict outcomes and assess risk. Physicians have recently begun to move away from this more obvious form of bias.

The use of data that inadvertently captures systemic racism. This form of bias, while unintentional, can result in additional inequities.

AI Bias - Hallucination

Journal of the American Medical Informatics Association, 30(7), 2023, 1237–1245
https://doi.org/10.1093/jamia/ocad072
Advance Access Publication Date: 22 April 2023
Research and Applications

Research and Applications

Using AI-generated suggestions from ChatGPT to optimize clinical decision support

Siru Liu[1], Aileen P. Wright[1,2], Barron L. Patterson[3], Jonathan P. Wanderer[1,4], Robert W. Turer[5,6], Scott D. Nelson[1], Allison B. McCoy[1], Dean F. Sittig[7], and Adam Wright[1]

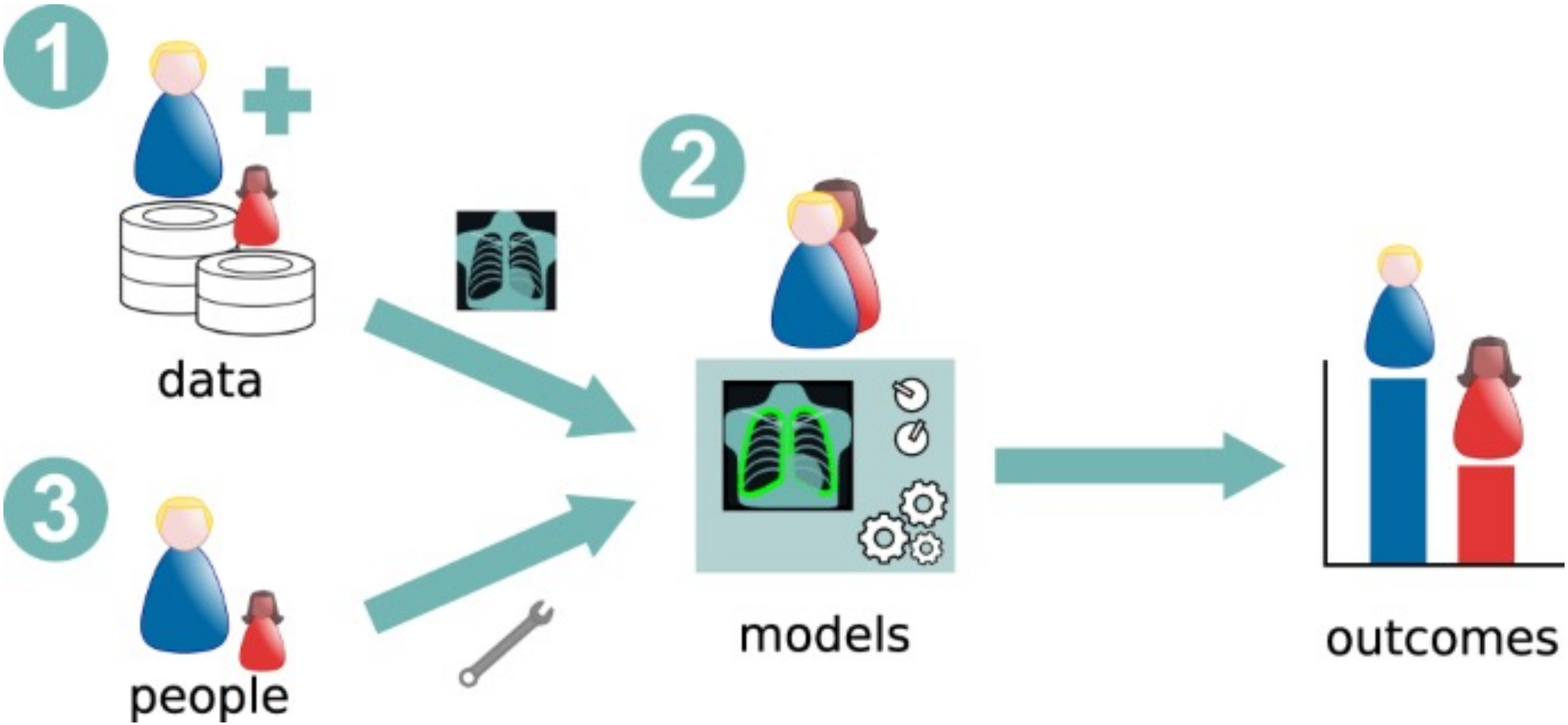
A Call to Address AI "Hallucinations" and How Healthcare Professionals Can Mitigate Their Risks

Cureus September 5, 2023

Hallucination

AI BIAS – Sources of Bias

Medical Imaging: Main potential sources of bias in AI



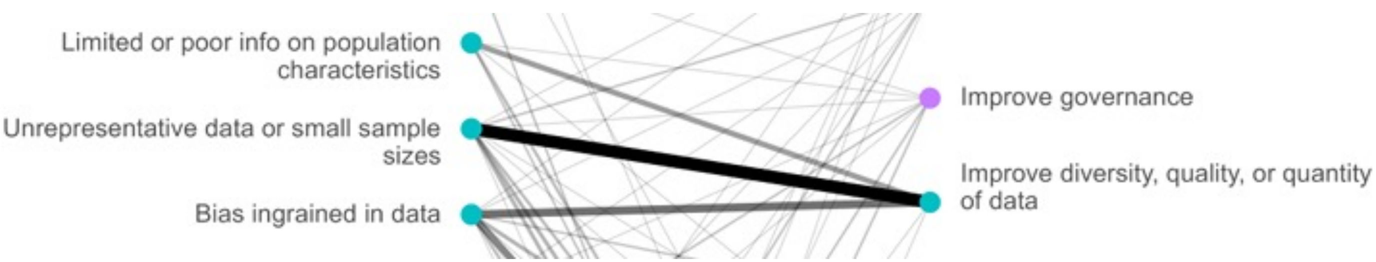
Ricci Lara MA, Echeveste R, Ferrante E. Addressing fairness in artificial intelligence for medical imaging. Nat Commun. 2022 Aug 6;13(1):4581. doi: 10.1038/s41467-022-32186-3. PMID: 35933408; PMCID: PMC9357063.

Strategies: Artificial Intelligence and Health Equity

Berdahl CT, Baker L, Mann S, Osoba O, Girosi F
Strategies to Improve the Impact of Artificial Intelligence on Health Equity: Scoping Review
JMIR AI 2023;2:e42936 doi: 10.2196/42936

Engage the broader community

almost two-thirds of all issue-strategy pairs are related to data.



Emerging AI Community engagement/participation/empowerment

Communities: Individuals, organizations, and groups affected by or concerned with AI technologies and their impact on society.

- **Examples:** Academics, ethicists, civil rights organizations, marginalized communities, policymakers, industry experts, and advocacy groups

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Artificial **I**ntelligence/**M**achine Learning Consortium to **A**dvance **H**ealth **E**quity and Researcher **D**iversity

Designing AI Tools for Underserved Populations from the Ground Up – Purposeful AI for the minority

A Call for Universities to Develop Requirements for Community Engagement in AI Research

Artificial Intelligence Community of Practice (AI CoP) – Gov't

Empowering local communities using artificial intelligence

https://www.aim-ahead.net/
https://casmi.northwestern.edu/news/articles/2023/designing-ai-tools-for-underserved-populations-from-the-ground-up.html
Hsu YC, Huang T', Verma H, Mauri A, Nourbakhsh I, Bozzon A. Empowering local communities using artificial intelligence. Patterns (N Y). 2022 Mar 11;3(3):100449. doi: 10.1016/j.patter.2022.100449. PMID: 35510187; PMCID: PMC9058901. https://pubmed.ncbi.nlm.nih.gov/35510187/
https://coe.gsa.gov/communities/ai.html
https://www.cs.cmu.edu/afs/cs.cmu.edu/user/emilybla/www/CHI2020_extended_abstract.pdf

Building Bridges: Community Perspectives on AI and Health Equity

Community: Individuals, organizations, and groups interested in or affected by or concerned with AI technologies and their impact on society.

- **Examples:** Academics, ethicists, physicians, payers, civil rights organizations, marginalized communities, policymakers, industry experts, and advocacy groups

Think global, act local

Diversity, Diversity, Diversity

AI/ML becomes a household term

Barriers exist, but can be overcome

Open science platform for health equity

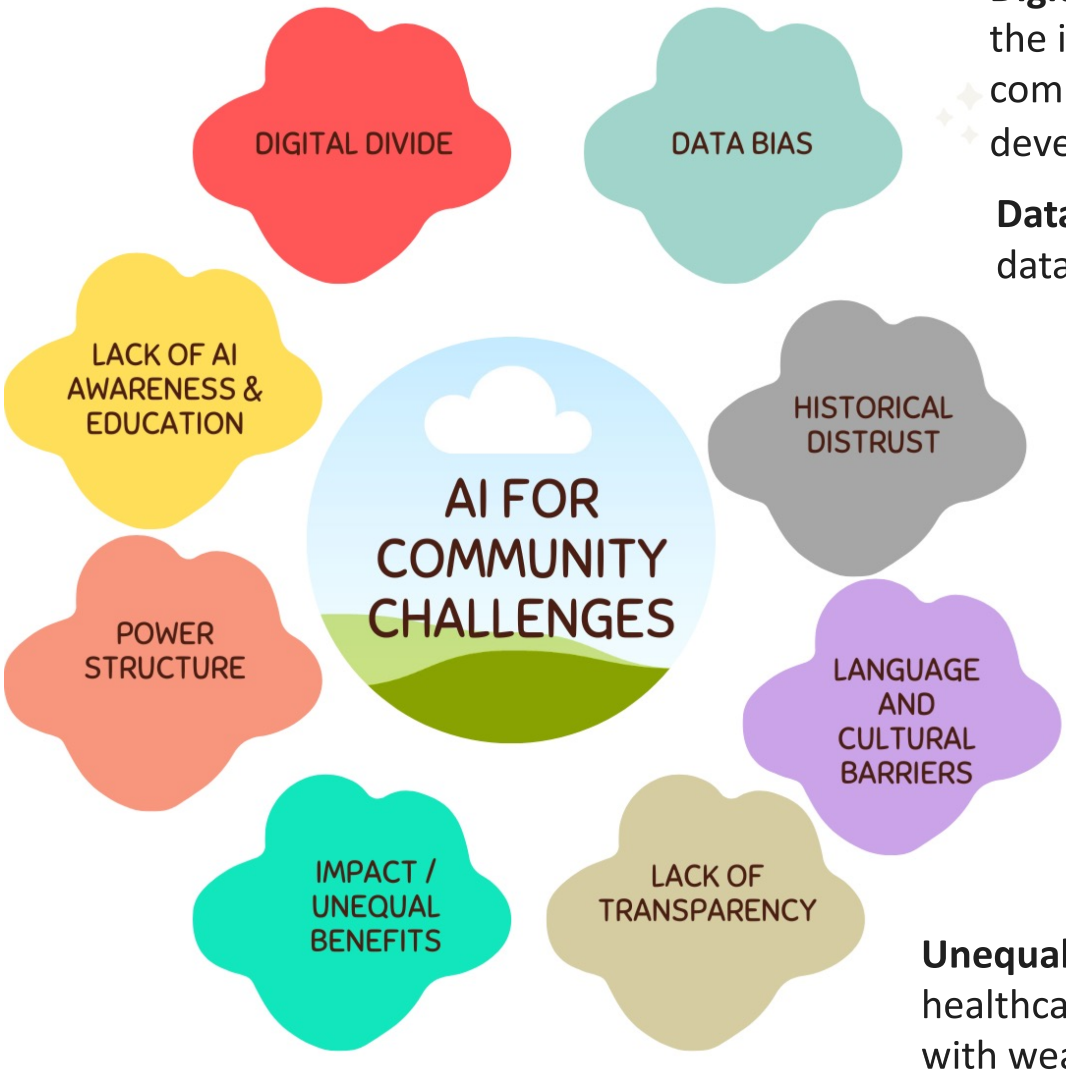
Paving pathways to success

Vishwanatha JK, Christian A, **Sambamoorthi U,** Thompson EL, Stinson K, Syed TA. Community perspectives on AI/ML and health equity: AIM-AHEAD nationwide stakeholder listening sessions. PLOS Digit Health. 2023 Jun 30;2(6):e0000288. doi: 10.1371/journal.pdig.0000288. PMID: 37390116; PMCID: PMC10313007.

https://pubmed.ncbi.nlm.nih.gov/37390116/

Building Bridges: AI for Community

Challenges



Digital Divide: Lack of access to technology and the internet can exclude vulnerable communities from participating in AI development and deployment in healthcare.

Data Bias: Algorithms trained on biased data can perpetuate health disparities.

Limited Trust: Communities with historical mistreatment by healthcare systems may be hesitant to engage with AI in healthcare.

Lack of Transparency: Difficulties understanding how AI works and how data is used can create suspicion and hinder community involvement.

Unequal Benefits: Concerns exist that AI in healthcare may exacerbate existing inequities, with wealthier communities benefiting more from new technologies.

Building Bridges: AI for Community
Comprehensive Approach

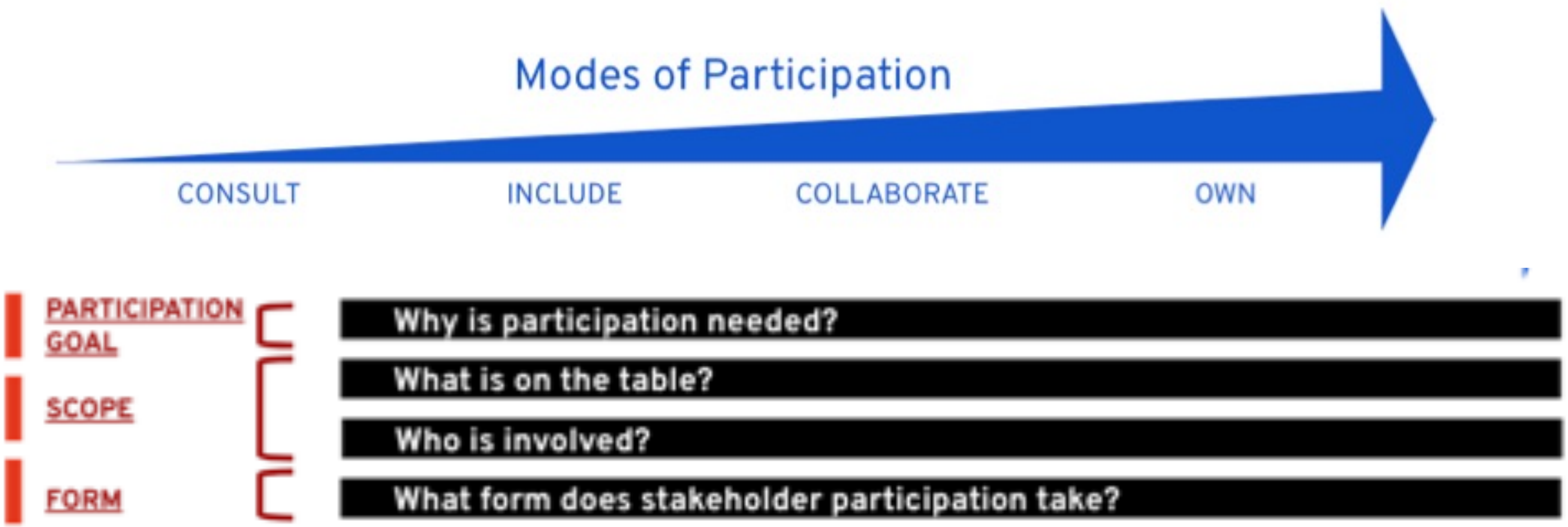
Socio-technical approach

- Collaborative and Participatory Approach from designing to implementing and sustaining
- DEI (multi- and diverse stakeholders)
- Education
- Keeping communities (humans) in the loop
- Interpretation of model output

Explanation in artificial intelligence: Insights from the social sciences: https://pdf.sciencedirectassets.com/271585/1-s2.0-S0004370218X00125/1-s2.0-S0004370218305988/main.pdf?

Building Bridges: AI Participatory Approach

Parameters of Participation



Multi-stakeholder engagement

- Variety of stakeholders
- Diverse stakeholder along social lines where bias is a concern (racial diversity, gender diversity, age diversity, geographical diversity)

The Participatory Turn in AI Design: Theoretical Foundations and the Current State of Practice. https://arxiv.org/pdf/2310.00907.pdf

Building Bridges: AI Participatory Approach

The Participatory Turn in AI Design: Theoretical Foundations and the Current State of Practice. https://arxiv.org/pdf/2310.00907.pdf

Building Bridges: Education
AI Knowledge and Skills

Community Stakeholders may not be familiar with ML, data science, computer science, or other fields traditionally associated with AI

- Algorithmic Literacy:
  - Awareness that algorithms are not neutral; Differen by SES
- AI training series.
  - Fundamental
  - Advanced
  - Targeted Training
- Equip with Tools
  - Responsible AI
  - Effective AI implementation

AIM AHEAD

GEORGETOWN UNIVERSITY | Health Informatics Data Science

AIM-AHEAD Introductory Course: AI for Health Care

AI/ML for Frontline Healthcare Workers

Practical AI/ML Knowledge to Enhan...

Course Description Designed with Frontline Healthcare Workers in mind, this asynchronous course offers a unique opportunity to unlock the potential of

More Info

https://journals.sagepub.com/doi/abs/10.1177/1461444823118262 – about algorithmic literacy

Building Bridges: Opportunities

https://detroitcommunitytech.org/

Citizen science - Community-Empowered Air Quality Monitoring System - https://dl.acm.org/doi/pdf/10.1145/3025453.3025853

- Installation of hardware, software, and mobile applications, visualizations

Building Bridges: Opportunities

DATA BIAS

The Gender Shades project piloted an intersectional approach to inclusive product testing for AI. Gender Shades was active from January 2017 to August 2020 http://gendershades.org/overview.html

Lindenfeld Z, Pagán JA, Chang JE. **Utilizing Publicly Available Community Data to Address Social Determinants of Health**: A Compendium of Data Sources. Inquiry. 2023 Jan-Dec;60:469580231152318. doi: 10.1177/00469580231152318. PMID: 36803137; PMCID: PMC9940168. - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9940168/

Figure 1: Dataset samples and the deployed camera system.

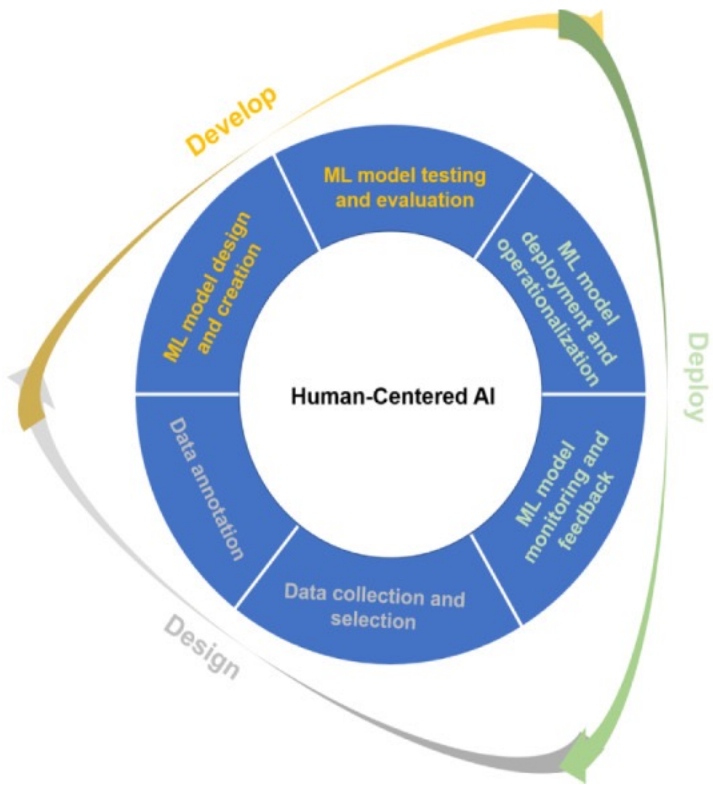
Citizen Science Framework: RISE, the first large-scale video dataset for Recognizing Industrial Smoke Emissions

Building Bridges: Community (humans) in the loop

While statistical methods are indeed necessary, they are not sufficient for addressing the AI bias challenges associated with datasets.

Keeping humans at the center of AI design

Human-centered design (HCD) is an approach to the design and development of a system or technology that aims to improve the ability of users to effectively and efficiently use a product



Chen Y, Clayton EW, Novak LL, Anders S, Malin B. Human-Centered Design to Address Biases in Artificial Intelligence. J Med Internet Res. 2023 Mar 24;25:e43251. doi: 10.2196/43251. PMID: 36961506; PMCID: PMC10132017. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10132017/

Building Bridges: Keeping humans in the loop

Bonnevie E, Lloyd Td, Rosenberg Sd, Williams K, Goldbarg J, Smyser J. Layla's Got You: developing a tailored contraception chatbot for Black and Hispanic young women. *Health Educ J.* 2020 Dec 18;80(4):413–424.
doi: 10.1177/0017896920981122.

Focus groups were conducted among 31 women, during which participants selected the campaign's logo and chatbot name and created the tagline.

Participants reviewed chatbot responses and designed Layla's appearance and features, and Black/Hispanic women are featured in website and promotional photos.

A community campaign manager pairs digital strategies with grassroots partnerships among a diverse group of stakeholders, including social media influencers, hair salons and health clinics.

Building Bridges: Interpretability matters

Interpretability: refers to the ability to understand the decision-making process of an AI model

•Builds Trust: When we understand how AI models arrive at decisions, we can trust their outcomes more readily.

•Identifies Bias: Interpretability helps us detect and mitigate bias within the data or model's algorithms.

•Improves performance: Understanding the model's inner workings allows for easier identification and correction of errors.

•Enhances Transparency: Interpretability fosters clear communication about AI decision-making processes

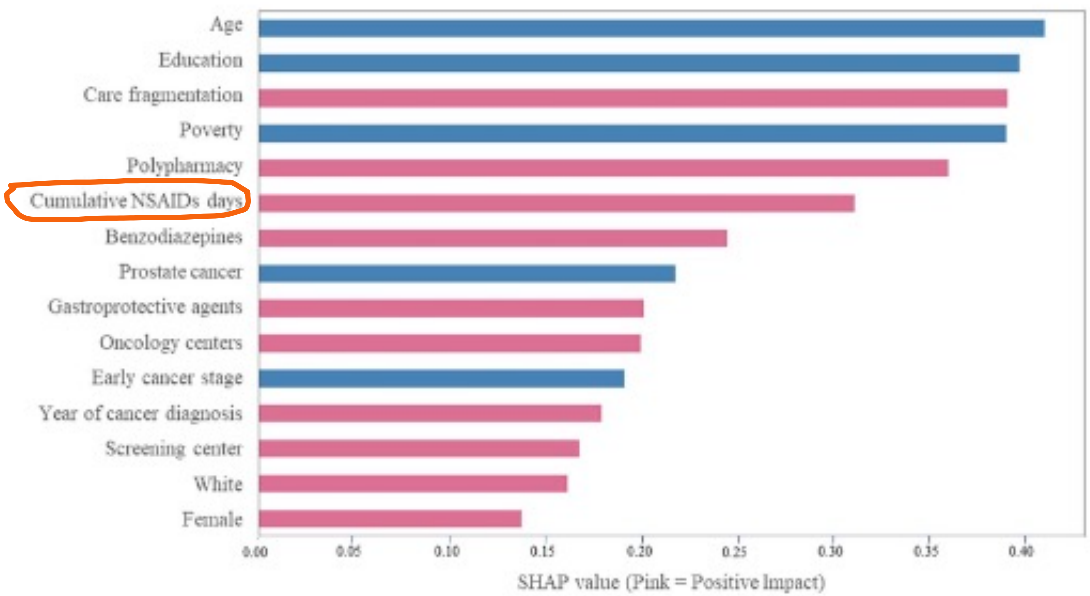
•**Feature Importance**: Identifies the most influential features used by the model to make predictions.
•**Partial Dependence** Plots: Show the average effect of a single feature on the model's output.

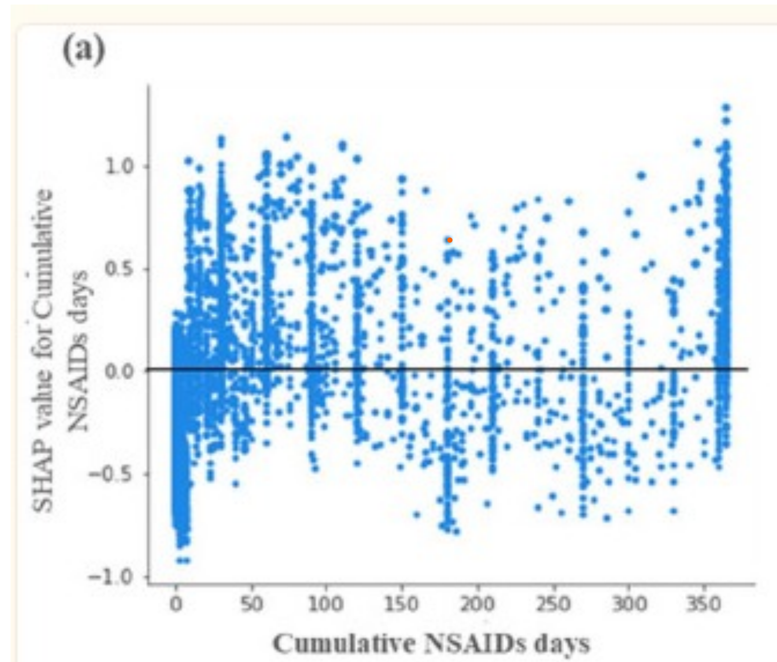
Example: Global Interpretation - Predictive Analytics –Low Value Care & Costs

Iloabuchi C. Dwibedi N, LeMasters T, Shen C, **Sambamoorthi U.** Low-Value Care and Excess Out-Of-Pocket Expenditure Among Older Adults with Incident Cancer: A Machine learning approach. *Journal of Cancer Policy, October 2021,*

N = 27,067

Example: Interpretable Predictive Analytics – Treatment





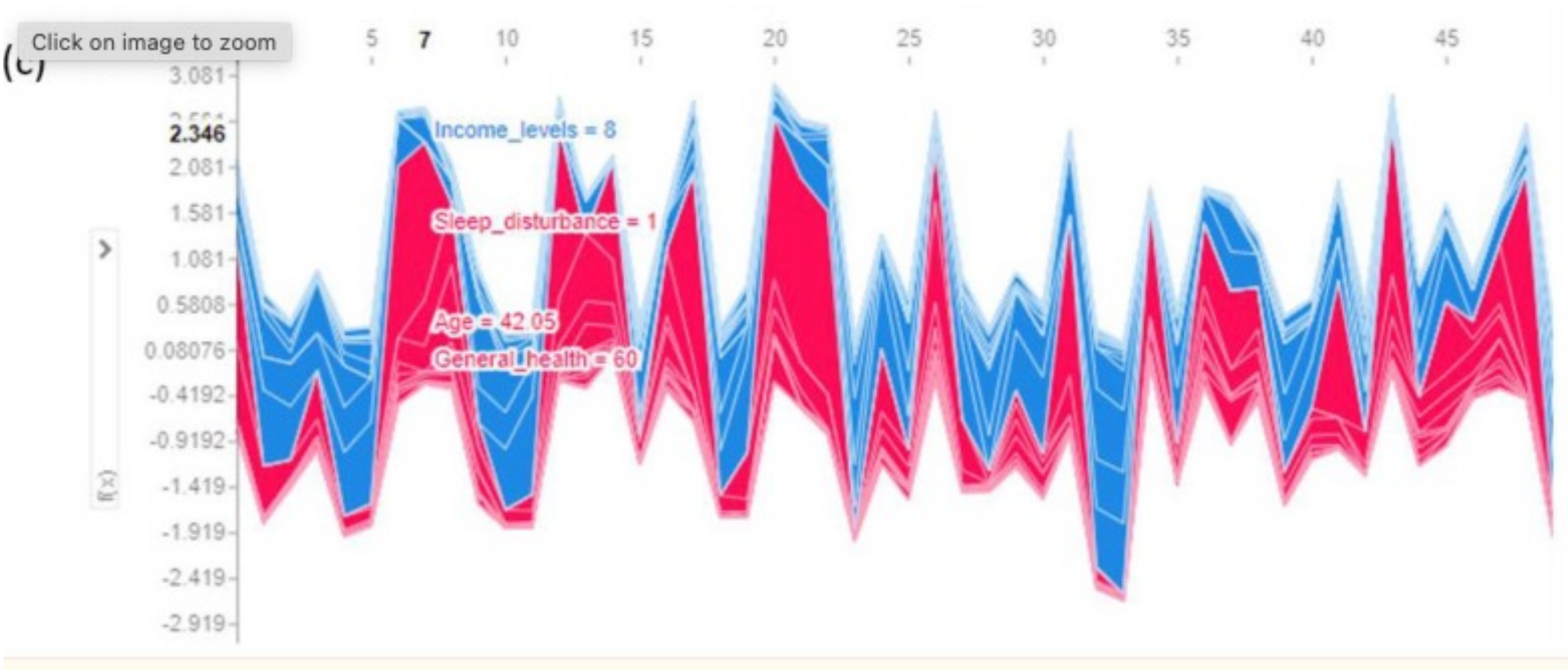
Original Research

Prescription Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) and Incidence of Depression Among Older Cancer Survivors With Osteoarthritis: A Machine Learning Analysis

Nazneen Fatima Shaikh[1], Chan Shen[2,3], Traci LeMasters[1], Nilanjana Dwibedi[4], Amit Ladani[5], and Usha Sambamoorthi[6]

N = 14, 992

Example: Local Interpretable Predictions



Ikram M, Shaikh NF, Vishwanatha JK, **Sambamoorthi U**. Leading Predictors of COVID-19-Related Poor Mental Health in Adult Asian Indians: An Application of Extreme Gradient Boosting and Shapley Additive Explanations. Int J Environ Res Public Health. 2022 Dec 31;20(1):775. doi: 10.3390/ijerph20010775. PMID: 36613095; PMCID: PMC9819341.

Tools: Evaluation of AI output

- Ensure scientific validity, clarity of presented results, reproducibility, and adherence to ethical standards
- CLAIM (Checklist for Artificial Intelligence in Medical Imaging)
- STARD-AI
- TRIPOD-AI
- PROBAST-AI
- SPIRIT-AI
- CONSORT-AI
- FUTURE-AI
- MI-CLAIM (Minimum Information about Clinical Artificial Intelligence Modelling)
- MINIMAR (MINimum Information for Medical AI Reporting)
- Radiomics Quality Score (RQS)

Guidelines for Reporting AI Research by Michail Klontzas, MD, PhD, https://pubs.rsna.org/page/ai/blog/2022/09/ryai_editorsblog0928

AI For community – Have Participation, Monitoring and Controls at Every stage

Design

Data

Algorithm training /testing

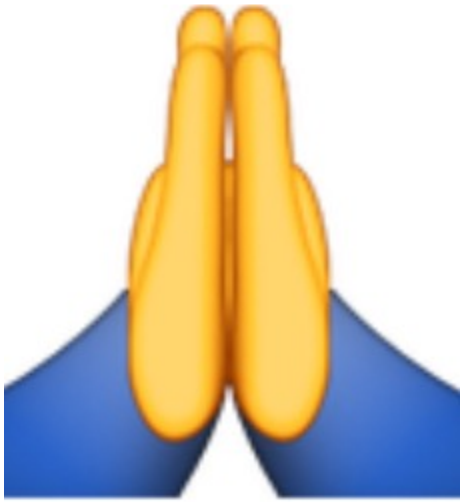
Implementation/Deployment

Continuous updates of the design, data, and algorithm

Responsible AI takes the ethically created AI applications to individuals at the implementation level – Explaining and making sure there is no Bias or inequity when an individual receives the benefits of AI

Thank You!!!!

All my collaborators



All credit goes to You!!!

Questions?

Contact:

usha.sambamoorthi@unthsc.edu