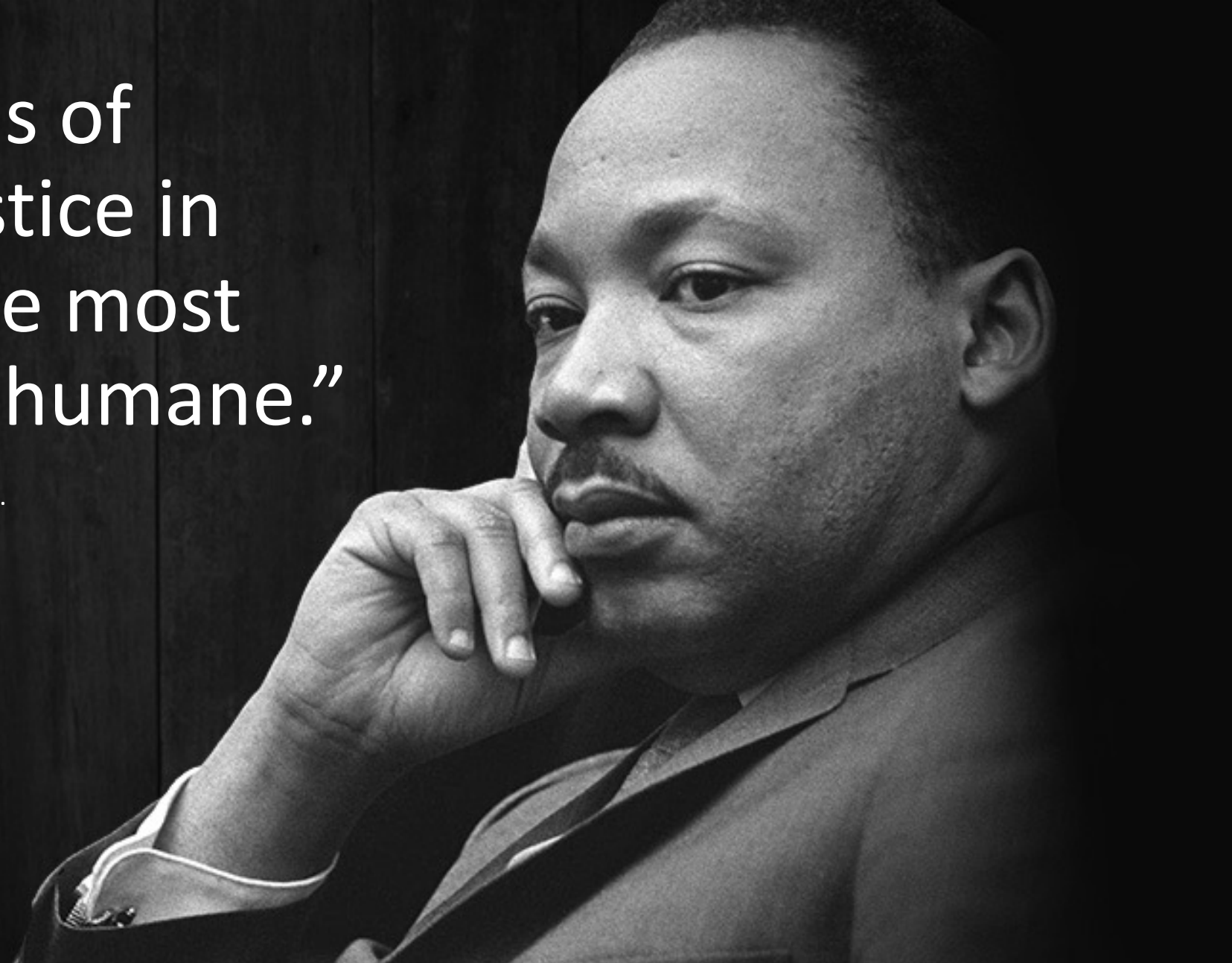


Responsible AI in Healthcare – Ensuring Quality Care for All

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“Of all the forms of inequality, injustice in healthcare is the most shocking and inhumane.”

-Dr. Martin Luther King, Jr.

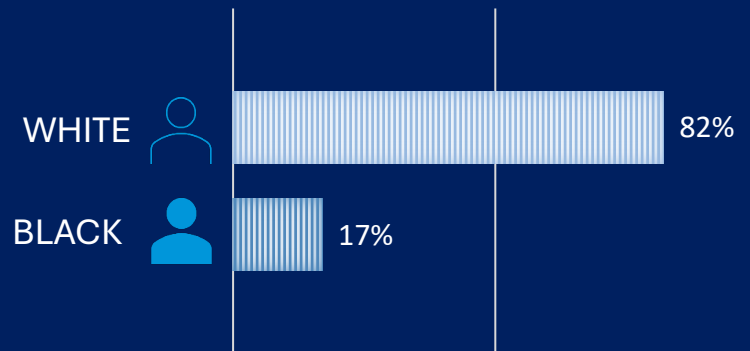


ALGORITHMIC BIAS...THE DARK SIDE OF AI

THE PROBLEM

“AI can be sexist and racist — it’s time to make it fair”¹

Dissecting racial bias in an algorithm used to manage the health of populations



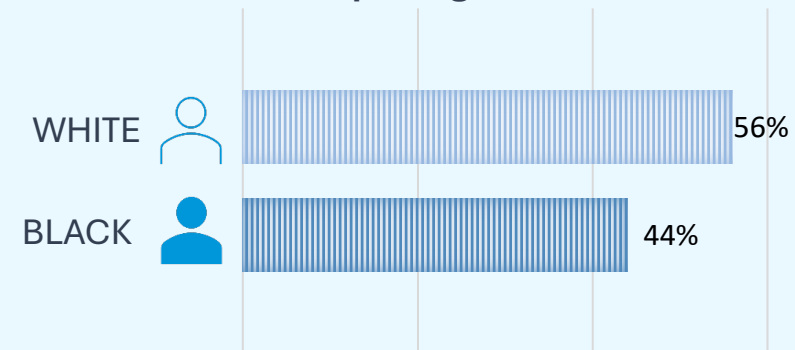
Pre: Black Patients were 50% less likely to be referred to case management despite being equally sick

by Ziad Obermeyer, Brian Powers, Christine Vogeli, and Sendhil Mullainathan

THE SOLUTION

Fairness Metric: Statistical Parity
Bias Mitigation Method: Better Proxy Label

Fair AI ML Tools Eliminates the AI Racial Bias By Repairing the Model



Post: Black Patients were just as likely to be referred to specialist when equally sick

Lost Opportunity Cost of a Biased Algorithm

80M

of Patients Exposed to Biased Case Management Algorithm

Approx.

\$1B

\$146M | Direct Healthcare Cost Savings Opportunity from CCM

\$830M | CMS Chronic Care Management Fee-For-Service Charge Capture

<https://www.ajmc.com/view/cost-effectiveness-of-case-management-a-systematic-review>

<https://signallamphealth.com/2023-medicare-cms-chronic-care-management-ccm-cpt-code-updates>

14 studies evaluated an algorithm effect on health or outcomes stratified by race/ethnicity

Impact of Healthcare Algorithms on Racial Disparities in Health and Healthcare

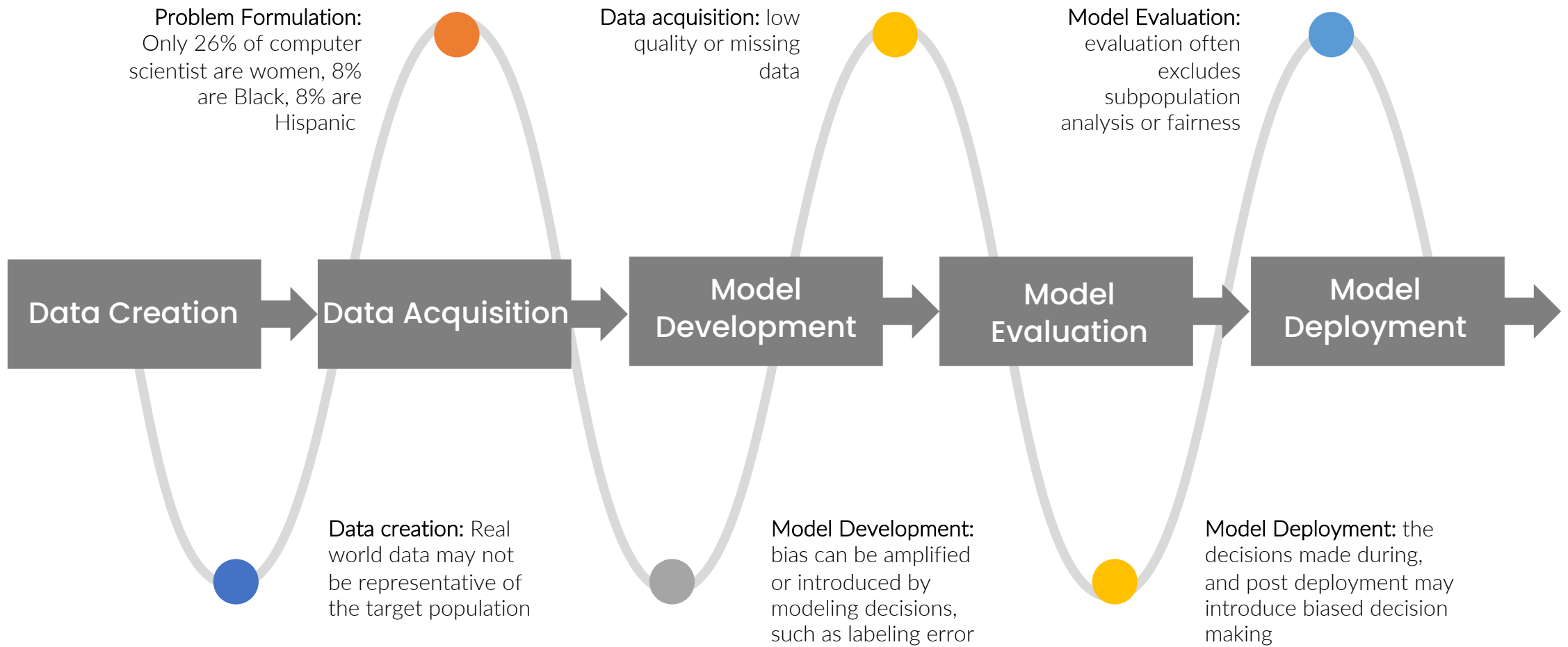
| Clinical Category | Algorithm | Key Question | Study | Study Design ^a | Disparities in Health outcome ^b | Disparities in Access ^b | Disparities in Quality ^b |
|---|--------------------------|--------------|------------------------------|---------------------------|--|------------------------------------|-------------------------------------|
| Kidney function measurement | eGFR ^c | KQ 2 | Ahmed 2021 ²¹ | Modelling ^d | * | ↑ | * |
| | eGFR ^c | KQ 2 | Inker 2021 ²² | Modelling ^d | * | * | ↑ |
| | eGFR ^c | KQ 2 | Casal 2021 ⁶¹ | Modelling ^d | * | ↑ | ↑ |
| | eGFR ^c | KQ 2 | Duggal 2021 ⁶² | Modelling ^d | ↑ | * | ↑ |
| | eGFR ^c | KQ 2 | Hoening 2022 ⁶⁴ | Modelling ^d | * | * | ↑ |
| | eGFR ^c | KQ 2 | Inker 2021 ⁶⁵ | Modelling ^d | * | * | ↑ |
| | eGFR ^c | KQ 2 | Mahmud 2022 ⁶⁷ | Modelling ^d | ↑ | * | * |
| | eGFR ^c | KQ 2 | Miller 2021a ⁶⁸ | Modelling ^d | * | * | ↑ |
| | eGFR ^c | KQ 2 | Panchal 2022 ⁶⁹ | Modelling ^d | ↑ | ↑ | * |
| | eGFR ^c | KQ 2 | Shi 2021 ⁷¹ | Modelling ^d | ↑ | * | * |
| | eGFR ^c | KQ 2 | Tsai 2021 ⁷² | Modelling ^d | ↑ | * | * |
| | eGFR ^c | KQ 2 | Yap 2021 ⁷⁴ | Modelling ^d | * | * | ↑ |
| | eGFR ^c | KQ 2 | Zelnick 2021 ⁷⁵ | Modelling ^d | ↑ | * | ↑ |
| | eGFR ^c | KQ 2 | Coresh 2019 ⁷⁸ | Modelling ^d | * | * | ↑ |
| Kidney transplant allocation | Kidney Donor Index | KQ 2 | Julian 2017 ⁸¹ | Modelling ^d | * | * | ↑ |
| | Revised KAS ^c | KQ 1 | Zhang 2018 ⁵⁸ | Pre-post | * | ↓ | * |
| Severity of illness scores for Crisis Standards of Care | SOFA | KQ 1 | Miller 2021b ⁵¹ | Modelling ^d | * | ↑ | * |
| | SOFA, LAPS2 | KQ 1 and 2 | Ashana 2021 ⁵⁸ | Modelling ^d | ↑ | ↑ | * |
| | APACHE Iva, OASIS, SOFA | KQ 1 | Sarkar 2021 ⁵⁴ | Modelling ^d | ↑ | * | * |
| Prostate Cancer Risk | PCPT ^c | KQ 1 | Carbanaru 2019 ⁵⁷ | Modelling ^d | * | * | ↓ |
| | KPCC RC ^c | KQ 1 | Presti 2021 ⁵³ | Modelling ^d | * | * | ↓ |

| Clinical Category | Algorithm | Key Question | Study | Study Design ^a | Disparities in Health outcome ^b | Disparities in Access ^b | Disparities in Quality ^b |
|-----------------------------|---|--------------|----------------------------------|--------------------------------|--|------------------------------------|-------------------------------------|
| Liver transplantation | Donor Risk Index | KQ 2 | Shores 2013 ⁸⁶ | Modelling ^d | * | * | ↑ |
| Cardiovascular risk | ASCVD ^c | KQ 2 | Weale 2021 ⁷³ | Modelling ^d | * | * | ↑ |
| | Modified ASCVD ^c | KQ 2 | Topel 2018 ⁷⁹ | Modelling ^d | ↑ | * | * |
| | ASCVD ^c | KQ 2 | Fairman 2020 ⁷⁶ | Modelling ^d | ↑ | ↑ | * |
| | Pooled cohort equations ^c | KQ 2 | Yadlowsky 2018 ⁸⁰ | Pre-post | * | * | ↑ |
| | Framingham risk score ^c | KQ 2 | Fox 2016 ⁸² | Modelling ^d | * | ↑ | * |
| | Framingham risk score ^c | KQ 2 | Drawz 2012 ⁶⁷ | Modelling ^d | * | * | ↑ |
| | Lung Cancer Screening | USPSTF-2013 | KQ 1 | Pasquinelli 2021 ⁵² | Modelling ^d | * | ↑ |
| USPSTF-2013 | | KQ 1 | Han 2020 ⁵⁶ | Modelling ^e | * | * | ↑ |
| USPSTF-2020 | | KQ 1 | Landy 2021 ⁶⁶ | Modelling ^d | ↑ | ↑ | * |
| Lung Transplant Allocation | Lung Allocation System | KQ 1 | Wille 2013 ⁵⁹ | Pre-post | * | ↓ | * |
| Lung Function | GLI Spirometry Equation | KQ 2 | Baugh 2022 ⁶⁰ | Modelling ^d | * | * | ↑ |
| | GLI Spirometry Equation | KQ 2 | Elmaleh-Sachs 2021 ⁶³ | Modelling ^d | ↑ | * | * |
| Anticoagulation | Warfarin dosing algorithms ^c | KQ 2 | Kimmel 2013 ⁸⁵ | RCT | ↑ | * | * |
| | Warfarin dosing algorithms ^c | KQ 2 | Limdi 2015 ⁸⁴ | Prospective cohort | ↑ | * | * |
| | CHA ₂ DS ₂ -VASc | KQ 2 | Kabra 2016 ⁸³ | Modelling ^d | * | * | ↑ |
| Emergency Department Triage | HEART Pathway | KQ 1 | Snavely 2021 ⁵⁵ | Pre-post | ↔ | * | ↑ |
| Other | Novel algorithm for high-risk care management | KQ 1 and 2 | Obermeyer 2019 ⁵ | Modelling ^d | * | ↑ | * |
| | Natural language processing algorithm | KQ 1 and 2 | Thompson2021 ⁸⁹ | Modelling ^d | * | * | ↑ |

Direction of Effect: (arrow direction)

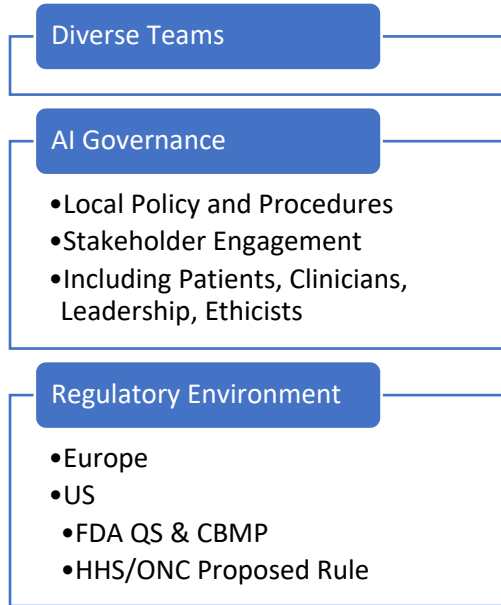
- ↑ Increase
- ↓ Decrease
- ↔ No effect
- *Not reported

Bias Occurs Throughout The AI Lifecycle

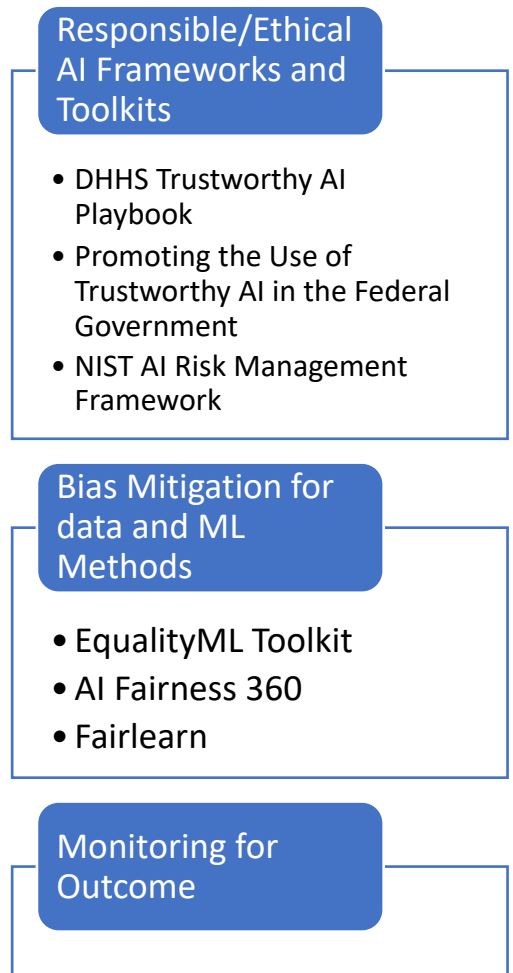
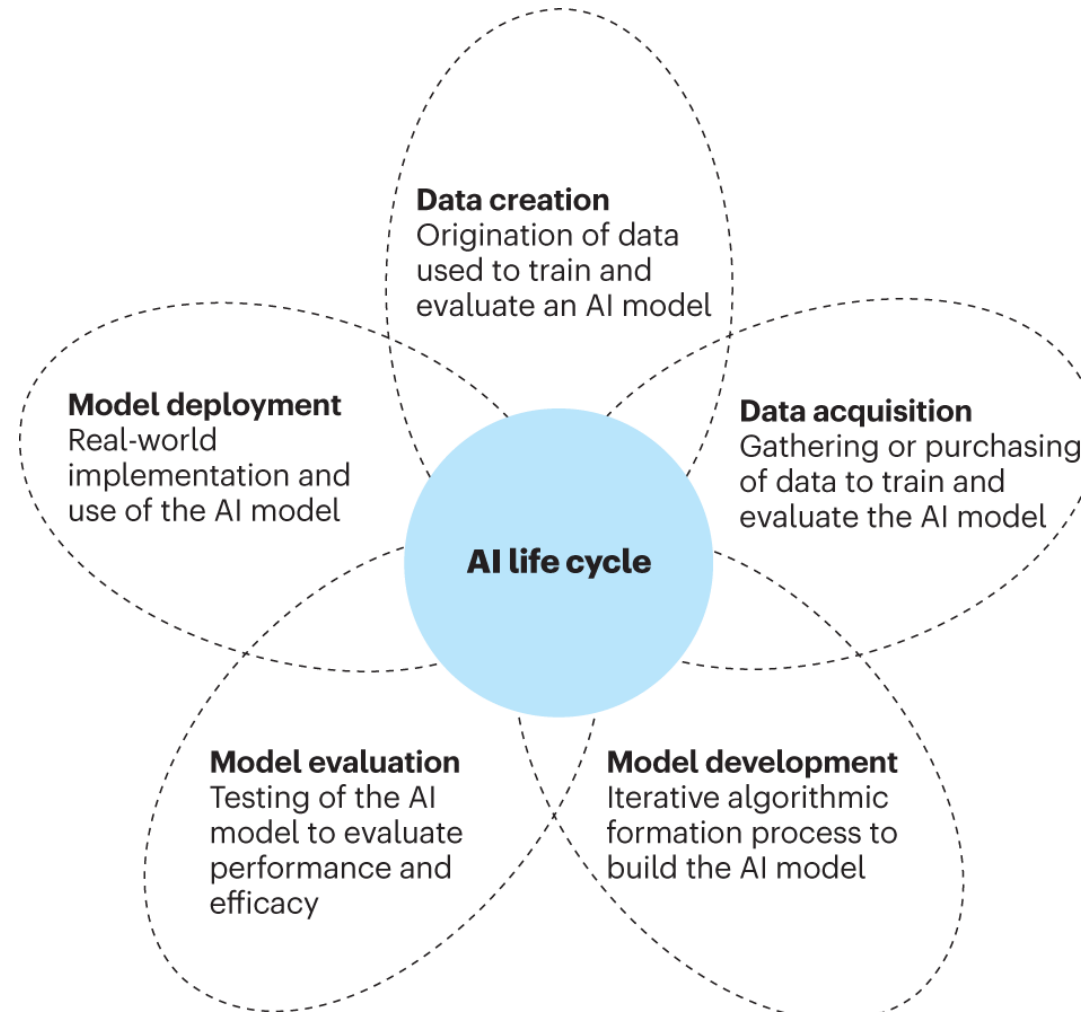


Bias Mitigation Methods Applied Throughout The AI Lifecycle

Social Mitigation Methods



Technical Mitigation Methods



The AI Promise: Unlocking Unprecedented Value in Healthcare

$$\text{Value} = \frac{Q}{C} \times E$$



Value in healthcare

Value is defined as the ratio of quality over cost multiplied by the patient experience

Quality in healthcare

Quality refers to the effectiveness of treatment and patient outcomes

Cost in healthcare

Cost includes the total healthcare expenses for diagnosis, treatment, and care

Patient experience

Patient experience includes factors like waiting times, communication with doctors, amenities, and overall satisfaction

Defining AI value in healthcare by assessing improved quality, decreased cost, and improved patient and provider experience.

The Total Cost of Deployment of AI Without an AI Safety and Management System

1. Bias in AI Systems:

- **Risk of Inequitable Care:** Amplify disparities in diagnosis/treatment for underrepresented groups.
- **Regulatory and Compliance Risks:** Expose healthcare providers to legal challenges, regulatory penalties, and reputational damage from biased AI.

2. Misalignment with AI Transformation and Health Equity Goals:

- **Missed Opportunity Cost for Health Equity:** AI investments not aligned with health equity goals limit transformative potential.

3. Underperformance of AI Investments:

- **AI Benefits not Fully Realized:** Lack of strategic alignment and governance restricts AI's potential in improving outcomes and reducing costs.
- **Lack of Transparency in AI Models:** Poor AI system management erodes trust, hindering adoption and utilization.



Equality AI Solutions

A Holistic Approach to AI Transformation in Healthcare:
Technical Platform with Professional Services and Change Management

Equality AI Products: For Each Stage of Responsible AI Transformation

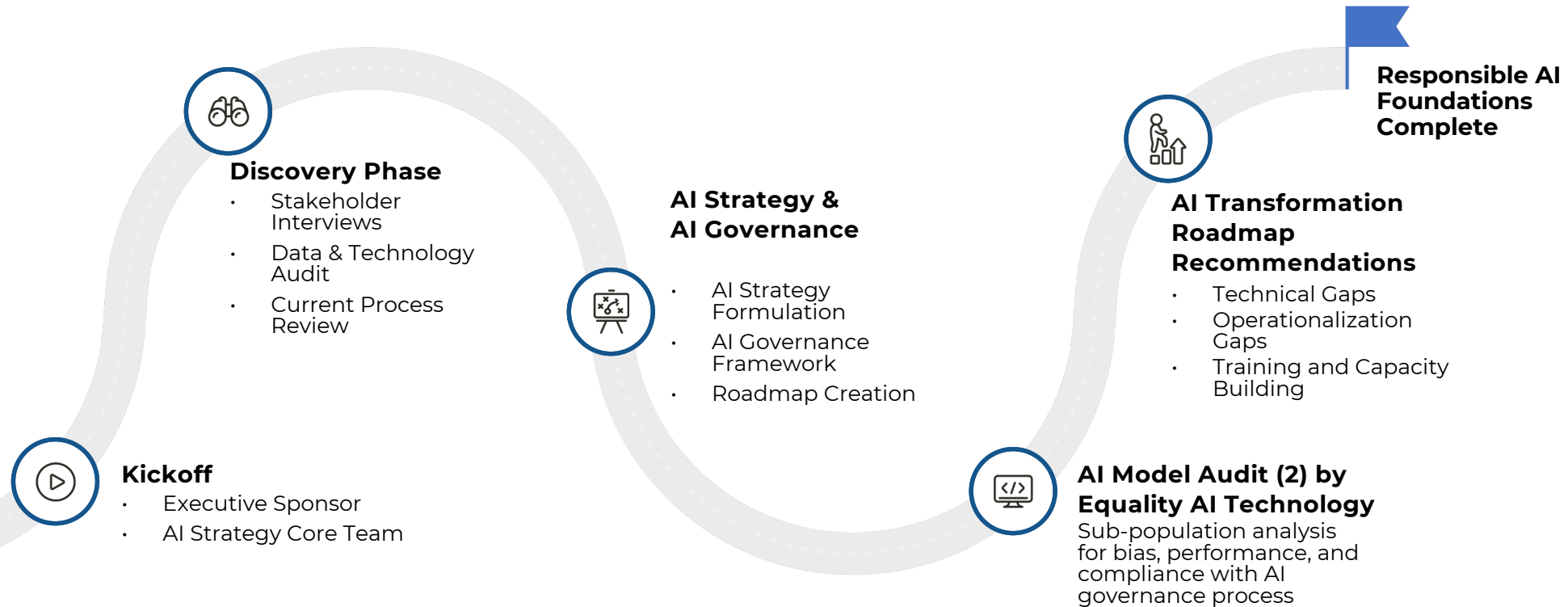
Stage 1: Equality AI Foundations is the starting point for most healthcare organizations, offering a structured approach to ensure effective and ethical AI integration with enterprise strategy and AI governance capability. AI model audits are performed by Equality AI using Equality AI technology.

Stage 2: Equality AI Builder provides all the benefits of Foundations plus access to the Equality AI Studio, enhancing the team's capabilities in developing responsible AI ML models, and empowering the data science team with Responsible AI tools and training. It also includes an enhanced AI model audit, measuring both AI model technical performance and adherence to AI governance process using the NIST AI Risk Management Framework or ISO/IEC 42001 AI Management System.

Stage 3: Equality AI Enterprise combines the features of the Foundations and Builder stages with advanced functionalities of the Equality AI Studio Enterprise version, offering comprehensive management of AI models, outcomes dashboard, configuration and implementation support, AI analytics and dashboarding tools, and custom API integration with the organization's data ecosystem.

Equality AI Foundations

A Structured process that establishes the foundation to a responsible AI transformation aligned with enterprise strategy and health equity. AI model audits are performed by Equality AI using Equality AI technology.



AI Strategy Alignment: Focus on High-Value Domains & Health Equity



AI Strategy Alignment

$$\text{Value} = \frac{Q}{C} \times E$$



Prioritizes Health Equity

Serve all patient populations fairly
Advances inclusive healthcare

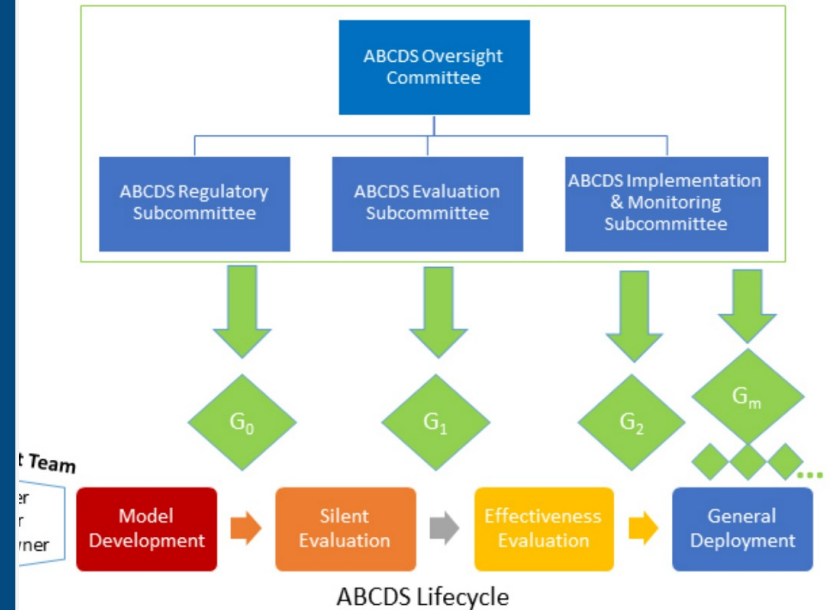
AI Governance Committees

Algorithmic Bias Playbook

Ziad Obermeyer
Rebecca Nissan
Michael Stern
Stephanie Eaneff
Emily Joy Bembeneck
Sendhil Mullainathan

June, 2021

CHICAGO BOOTH | The Center for Applied Artificial Intelligence



RESPONSIBLE AI AUDIT PROCESS

RESPONSIBLE AI FRAMEWORK

ROBUST &
RELIABLE

RESPECTFUL OF
PRIVACY

SAFE & SECURE

FAIR & IMPARTIAL

TRANSPARENT &
EXPLAINABLE

RESPONSIBLE &
ACCOUNTABLE

Technical Audit of AI Models

- Equality AI uses our technology to measure biases and model performance
- Provide actionable insights for AI governance team and data scientists to improve the model

Process Audit: Adherence to Institution AI Governance Processes

- Ensure effective and responsibly managed AI initiatives
- Critical tool for AI governance team to oversee and manage AI lifecycle

EQUALITY AI TECHNOLOGY:

USER PAIN POINTS

- 1 **Healthcare real-world data is messy: biased and incomplete**
- 2 **Data Scientists are siloed from the Clinical SME**
- 3 **Don't know how to evaluate for Fairness**
- 4 **The regulations are moving fast: FDA, NIST, ONC...**

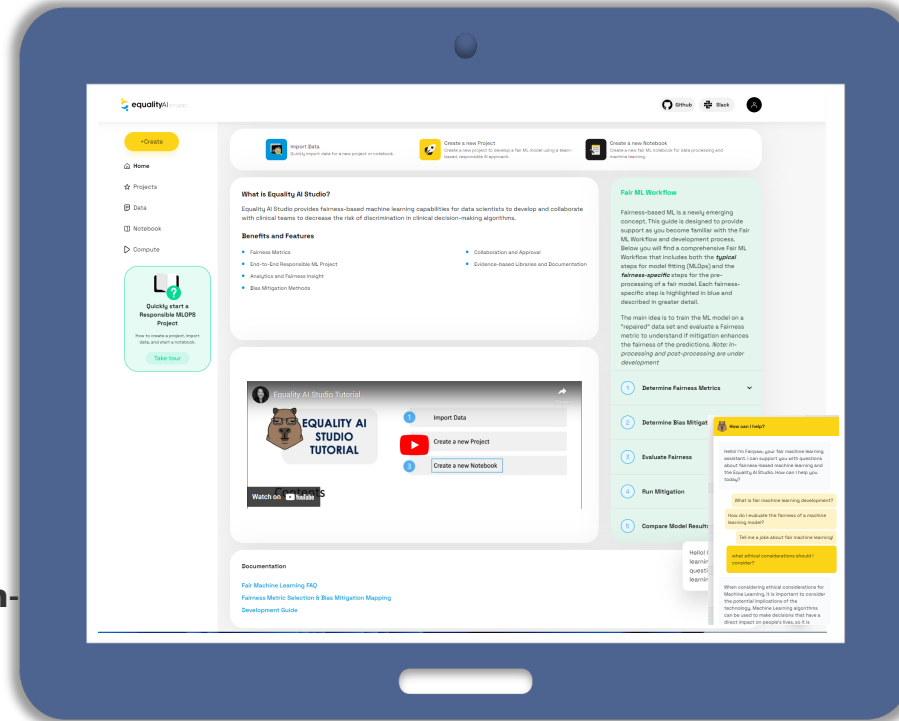


5 **Audit & Decision-Making Log**

- Capture, store, and aggregate decisions
- Share with stakeholders including regulatory agencies (FDA, etc.)

1 **AI/ML Collaboration for ALL**

- A studio for data scientists and stakeholders to collaborate.
- Transparency and validation through diverse teams



2 **Fair ML Evaluation Tools**

- Fairness Metrics
- Bias Mitigation Methods
- Python Notebook Template
- Responsible AI Wiki

3 **Tutorials**

- Tutorials embedded in workflow, always available when needed

4 **Chat Assistant**

- Fairpaw, conversational fair ML assistant.
- Chat-GPT Powered
- Fair Code Co-pilot (TBD)

Quickly start by Creating a [Free Trial](#).

Participate in our [Use Case](#) on [GitHub](#) or [Developer Design Lab](#).



<https://equalityai.com/>

We each have a ROLE to play in ensure the future of AI enabled healthcare is equitable and fair.

Role of Patients/Community/Policy Makers



Provide feedback

Patients can test AI systems and provide feedback on their strengths and weaknesses to improve them



Demand Transparency and Accountability

Patients should demand transparency and ask the following questions:

1. Dataset Representativeness
2. AI Model Performance by Subpopulation
3. Fairness, Accuracy, Outcomes



Advocate for Responsible AI

Patients can advocate for development and use of AI that benefits patients and society in a responsible manner

The community and patients have an important role to play in ensuring AI systems in healthcare are safe, effective and aligned with human values.

Role of Clinicians & Experts



Understand limitations of AI & Human in the Loop

Clinicians should be aware of the limitations of AI systems to provide the best possible care to patients.



Get Involved in AI Development

Clinicians should participate in the AI Lifecycle to increase the relevance and accuracy of the models.



Provide oversight

Clinicians should provide oversight of AI systems through AI Governance to ensure they are operating as intended and providing safe and effective recommendations.



Speak up about concerns

If clinicians have concerns about an AI system, they should voice those concerns to colleagues, administrators, regulators etc.

While AI promises many benefits, clinicians play a critical role in ensuring these systems are used responsibly and safely.

Role of AI Developers & Researchers



Design systems with Subpopulations in Mind

AI developers should develop expertise in Responsible AI methods: Fairness, bias mitigation



Test thoroughly

Extensive testing of AI systems using techniques like cross-validation helps identify bugs, edge cases, and training gaps to build more robust models.



Listen to stakeholders

Getting regular feedback from users, domain experts, and other stakeholders helps AI developers build systems that address real needs.



Transparency Through Documentation

Clear documentation of development workflows, system design, testing, and maintenance helps ensure transparency and enable collaboration.

Responsible AI requires AI developers to take great care through the full development lifecycle to build systems that are ethical, safe, and serve all stakeholders.

Role of Healthcare Leaders



AI Strategy Alignment

Align AI strategy for total value and commit to health equity



AI Governance

Oversee AI systems through policies and procedures



AI Audit

Evaluate AI systems for biases and harms with Sub-population analysis for bias, performance, and compliance with AI governance process

Healthcare leaders should champion responsible AI safety that improves health outcomes for all.

EQUALITY AI MANIFESTO & PROMISE

Data scientists are the newest members of the healthcare team. As such, the Hippocratic Oath applies...First do no harm. Therefore, we pledge to adhere to the following ethical code and swear to fulfill, to the best of our ability and judgement, this covenant:

- We respect that algorithms have power; over life and death; treatment and non-treatment; distribution of scarce resources. This awesome responsibility must be faced with great humbleness and awareness of our privilege.
- We respect healthcare data privacy and security. We won't lose sight that each data point is a unique human experience digitally recorded.
- We respect the hard-won scientific gains of those in whose steps we walk and gladly share such knowledge.
- We will not be ashamed to say, "I don't know...yet", and will call on our colleagues when the skills of others are needed.
- We value a culture that combines an agile mindset and processes with authenticity, personal wellness, and team fulfillment.

May we always act to preserve the finest traditions of the healthcare calling. We bring modern technology methods to solve healthcare's most challenging problems: inequity, bias, and unfairness. We believe in AI for good, AI that is fair, and AI for equity.

Questions?

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