

Bias and Disparities in Clinical AI: Do we throw the baby out with the bathwater?

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Two men walk into your clinic...

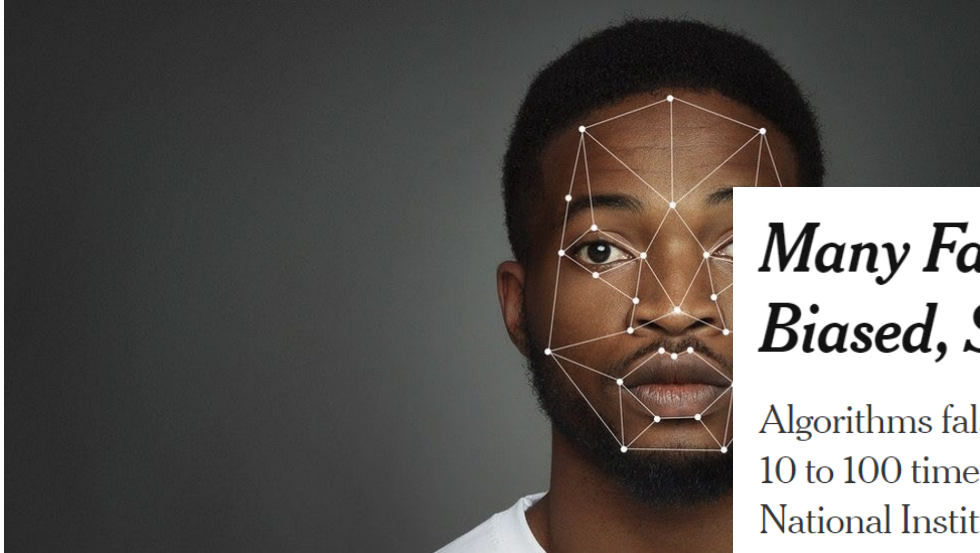
- 60yo White men
- Total cholesterol 220, HDL 40
- BP 150/85, non-smokers
- First man: 9.3% ten-year risk → statin
- Second man: 4.2% ten-year risk → no statin

Who is higher-risk?

Look under the hood

- First man (high-risk)
 - Stable 9-5 job with days off for PCP visits
 - Pre-diabetes diagnosed early → well-controlled
 - Anti-hypertensive started early, takes regularly
- Second man (low-risk)
 - Works construction, cannot take off for PCP visits
 - Undiagnosed diabetes, no antihypertensive prescribed

Bias in AI is an emerging problem...



Many Facial-Recognition Systems Are Biased, Says U.S. Study

Algorithms falsely identified African-American and Asian faces 10 to 100 times more than Caucasian faces, researchers for the National Institute of Standards and Technology found.

IBM abandons 'biased' facial recognition tech

Buolamwini, 2019; Singer and Metz, NYT 2019; BBC, 2020

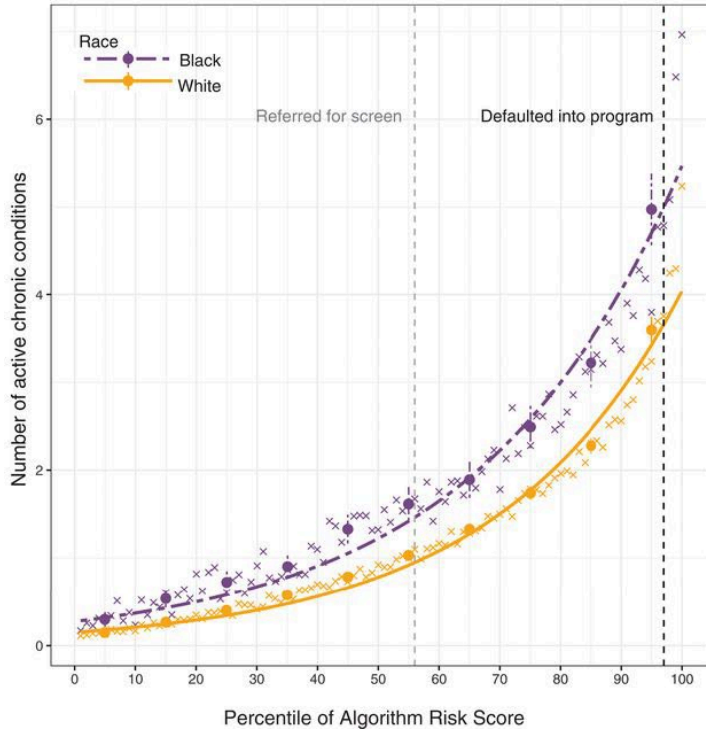
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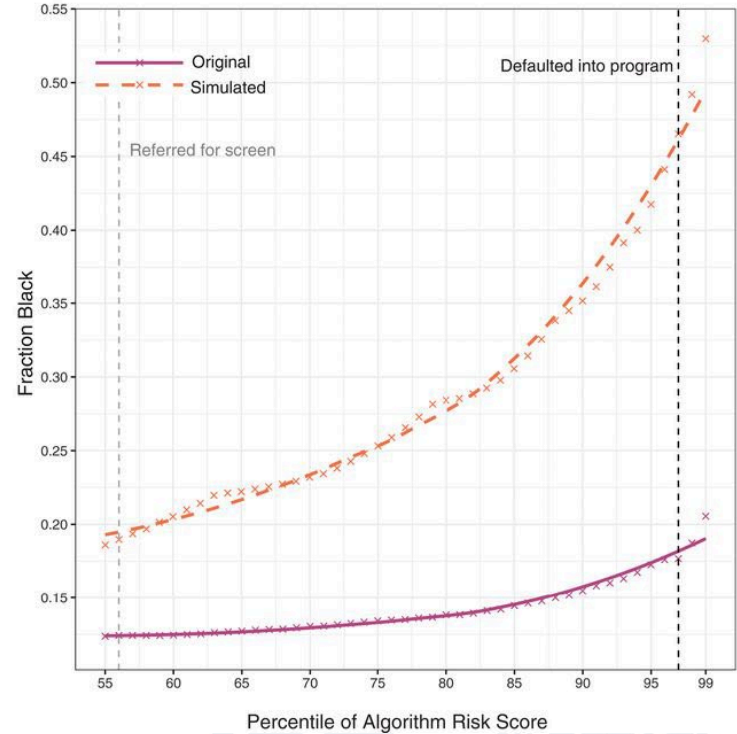
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Healthcare is not immune to AI bias

A



B



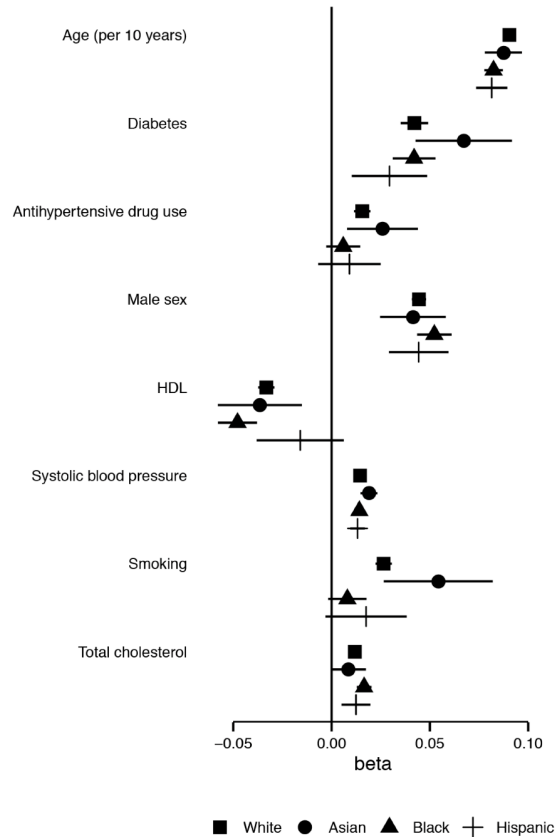
Agenda

- *Why* is AI biased?
- *What* strategies can address this bias?

Why do algorithms automate bias?

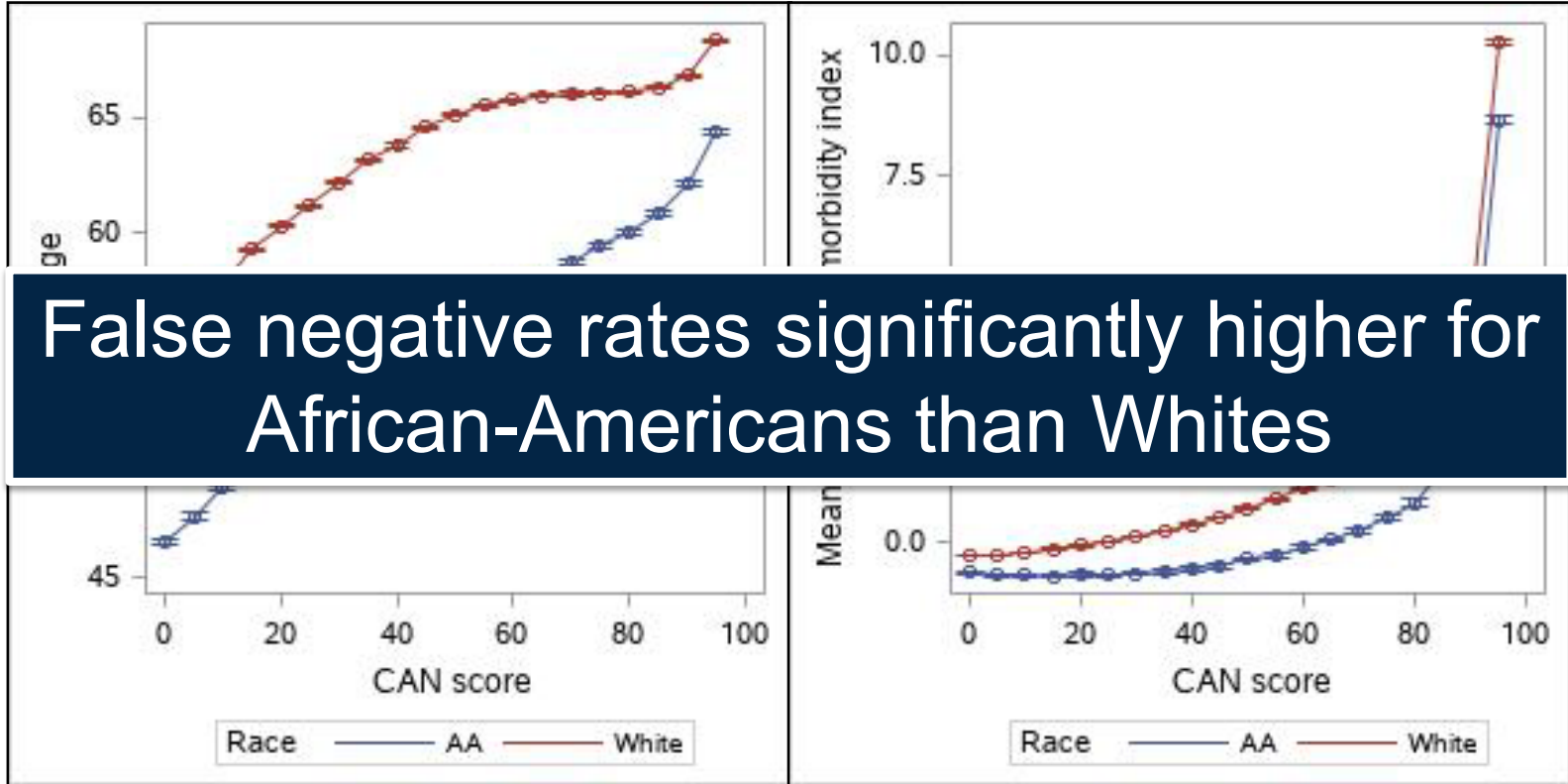
- ◆ **Statistical bias:** Algorithm result \neq Underlying true value
 - ◆ Suboptimal sampling
 - ◆ Picking bad outcome labels
 - ◆ Heterogeneity of effects

Reason #1: Under-sampling

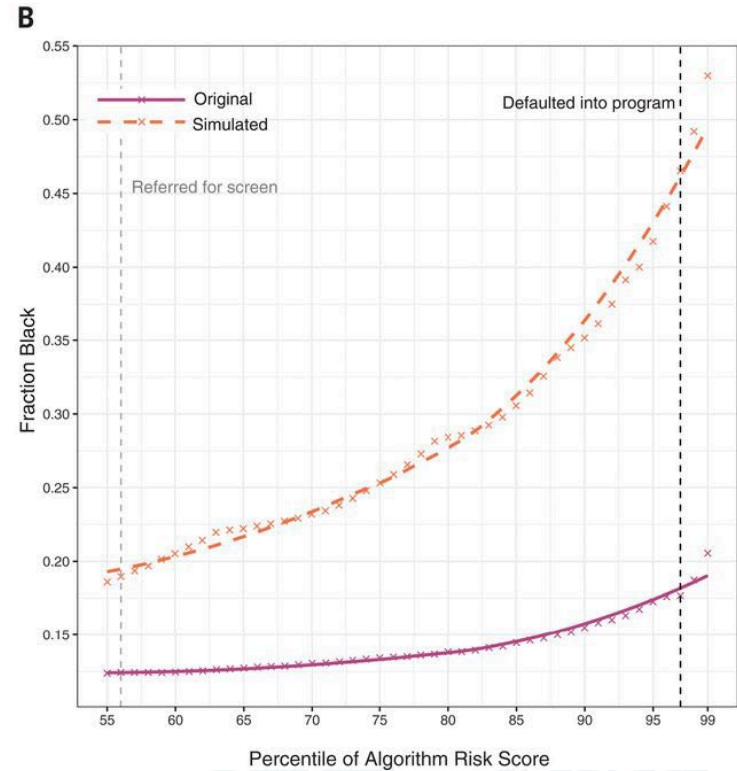
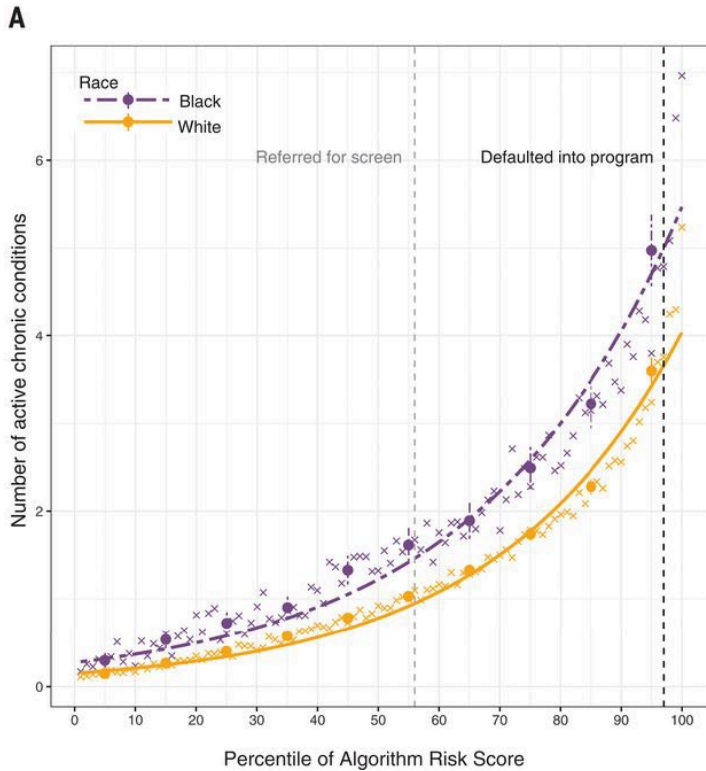


Predicted risk of a cardiovascular event from Framingham Risk Score was nearly 20% lower for African-Americans than for Caucasians with similar clinical characteristics

Reason #2: Heterogeneity of Effects



Reason #3: Picking bad outcomes



Why do algorithms automate bias?

- ◆ **Statistical bias:** Algorithm result \neq Underlying true value
 - ◆ Suboptimal sampling
 - ◆ Outcome labels problem
 - ◆ Heterogeneity of effects
 - ◆ Measurement error in predictors
- ◆ **Social bias:** Inequity in healthcare delivery
 - ◆ Implicit and explicit bias in clinical delivery and historical data

Fundamental problem:

Biased data generation *process*

Biased data generation → Biased algorithms

Likelihood of genetic testing among African-American women with breast cancer

Analysis	Odds Ratio (95% CI)
Overall	0.40 (0.34-0.48)
Adjusted for mutation risk	0.66 (0.53-0.81)
Adjusted for physician recommendation	0.76 (0.57-1.02)

The presence of a laboratory test order, regardless of any other information about the test result, has a significant association with the odds of survival

Agenda

- *Why* is AI biased?
- *What* strategies can address this bias?

How do we address bias?

- ◆ **Identifying bias and potentially flawed decision-making in real time**
 - ◆ Using ML to detect bias in physician documentation
 - ◆ Flagging potentially biased decisions (e.g. opioids at the end of day)
- ◆ **Using (relatively) unbiased data sources**
 - ◆ Data prior to a clinician decision
 - ◆ Continuously recorded data
- ◆ **Tracking algorithm outputs continuously to monitor bias**
- ◆ **Creating simulated datasets to “pressure-test” bias**

Can AI mitigate disparities?

	Pre-intervention, %	Post-intervention, %	Absolute Percentage-point Difference
Non-Hispanic White	3.9 (58/1494)	14.2 (201/1417)	10.3
Non-Hispanic Black	3.6 (17/467)	16.9 (69/408)	13.3
Other*	1.2 (2/164)	19.5 (34/408)	18.3

In a trial of a machine learning-based nudge to perform end-of-life conversations, there was a significantly higher impact for non-White minorities

If we can get this right...



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