


Lab 8: Bias in Algorithms

Gregory Bruich, Ph.D

HARVARD UNIVERSITY

OPPORTUNITY INSIGHTS

Lab 8: Bias in Algorithms

- In the last lab, we developed two methods for prediction that address overfit:
  1. **Cross validation** as a general-purpose tool
  2. **Random forests** as a specific improvement upon decision trees
- In today's lab, we will dive deeper into the issue of **bias in algorithms**, using random forests to predict patient costs and patient health
- We will show that getting the right target—**label choice**—is central
  - A major source of bias in health algorithms
  - And other fields e.g., crime vs. arrests

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Examples of Label Choice Bias in Health Care

Algorithm	Ideal Target
Care Management Prioritization: Identifying patients for additional services	Health needs, benefit from high-risk care management programs
Emergency Severity Index (ESI): emergency triage	Medical condition needing immediate attention
6-Clicks Mobility Score: Decisions about discharge destination	Inability to care for self and live independently at home without help
"No-show" prediction: Clinic scheduling	Voluntary no-show to appointment
Predicting Disease Onset: Targeting preventative care	New disease onset (e.g., heart failure, kidney failure)
Kellgren-Lawrence Grade: Osteoarthritis on knee x-rays	Severity of knee osteoarthritis

Source: Mullainathan and Obermeyer (2021)

Examples of Label Choice Bias in Health Care

Algorithm	Ideal Target	Actual Target
Care Management Prioritization: Identifying patients for additional services	Health needs, benefit from high-risk care management programs	Total costs of care
Emergency Severity Index (ESI): emergency triage	Medical condition needing immediate attention	Nurse-rated acuity, "resources patient is expected to consume"
6-Clicks Mobility Score: Decisions about discharge destination	Inability to care for self and live independently at home without help	Physical measures of mobility and daily activities
"No-show" prediction: Clinic scheduling	Voluntary no-show to appointment	Any no-show to prior appointment
Predicting Disease Onset: Targeting preventative care	New disease onset (e.g., heart failure, kidney failure)	Provider–insurer transaction with ICD code for disease
Kellgren-Lawrence Grade: Osteoarthritis on knee x-rays	Severity of knee osteoarthritis	Severity of osteoarthritis seen by radiologist on knee x-rays

Source: Mullainathan and Obermeyer (2021)

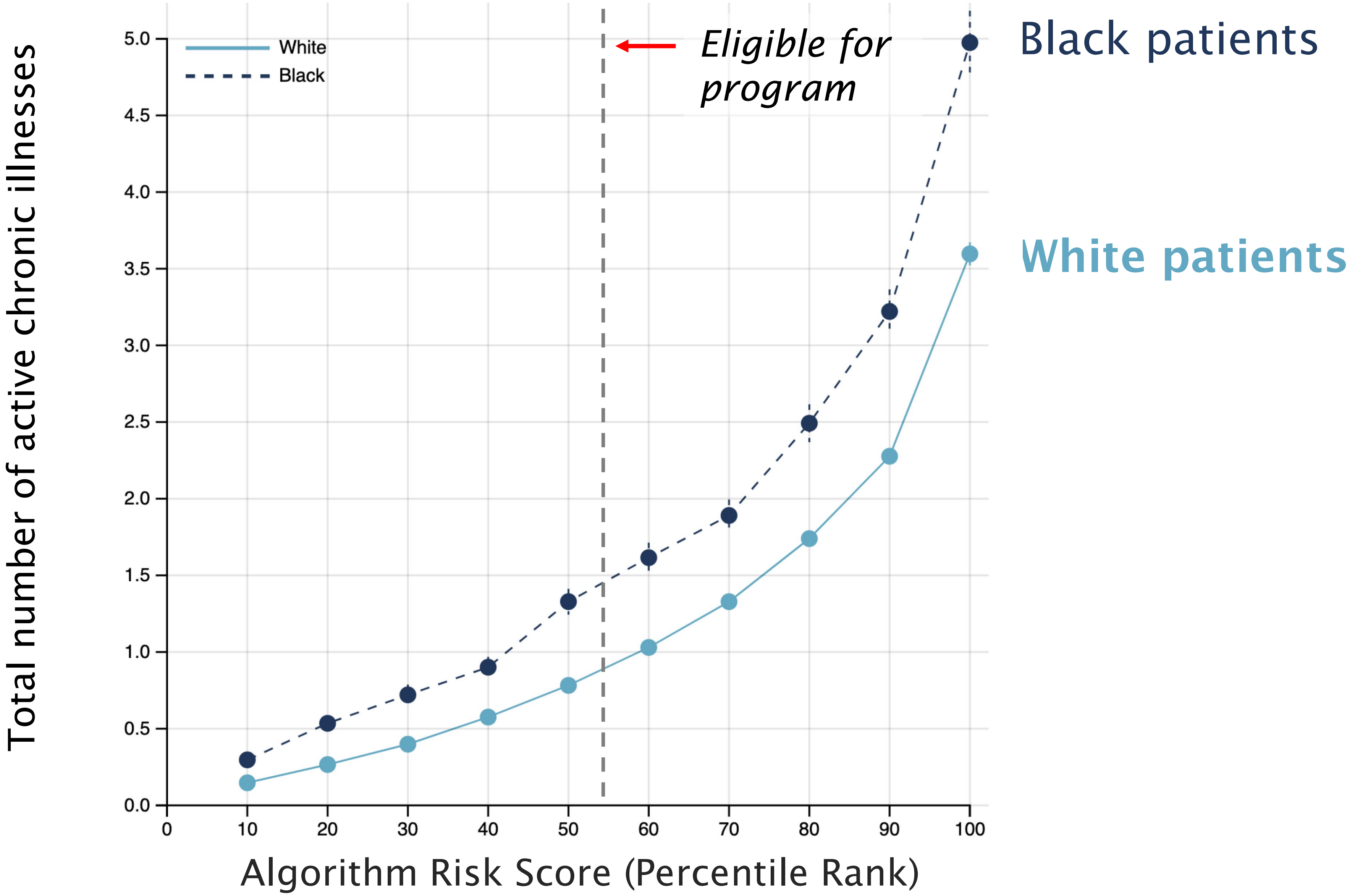
Examples of Label Choice Bias in Health Care

Algorithm	Ideal Target	Actual Target	Risk of Bias
Care Management Prioritization: Identifying patients for additional services	Health needs, benefit from high-risk care management programs	Total costs of care	**High.** Less money is spent on Black patients who have the same level of need
Emergency Severity Index (ESI): emergency triage	Medical condition needing immediate attention	Nurse-rated acuity, "resources patient is expected to consume"	**High.** Resource consumption varies by race and insurance for any given acuity
6-Clicks Mobility Score: Decisions about discharge destination	Inability to care for self and live independently at home without help	Physical measures of mobility and daily activities	**High.** Similar physical mobility scores have larger impact on those lacking income
"No-show" prediction: Clinic scheduling	Voluntary no-show to appointment	Any no-show to prior appointment	**High.** No shows relate to access: barriers are unequally distributed
Predicting Disease Onset: Targeting preventative care	New disease onset (e.g., heart failure, kidney failure)	Provider–insurer transaction with ICD code for disease	**High.** Probability of being coded varies by physician quality, hospital billing, insurance, etc.
Kellgren-Lawrence Grade: Osteoarthritis on knee x-rays	Severity of knee osteoarthritis	Severity of osteoarthritis seen by radiologist on knee x-rays	**High.** Radiologists miss causes of knee pain affecting underserved groups

Source: Mullainathan and Obermeyer (2021)

Health vs. Risk Score from Commercial Algorithm Currently Used in Healthcare

Patients with the Same Risk Score should have Same Health Needs



Source: Obermeyer, Powers, Vogeli, and Mullainathan (2019)

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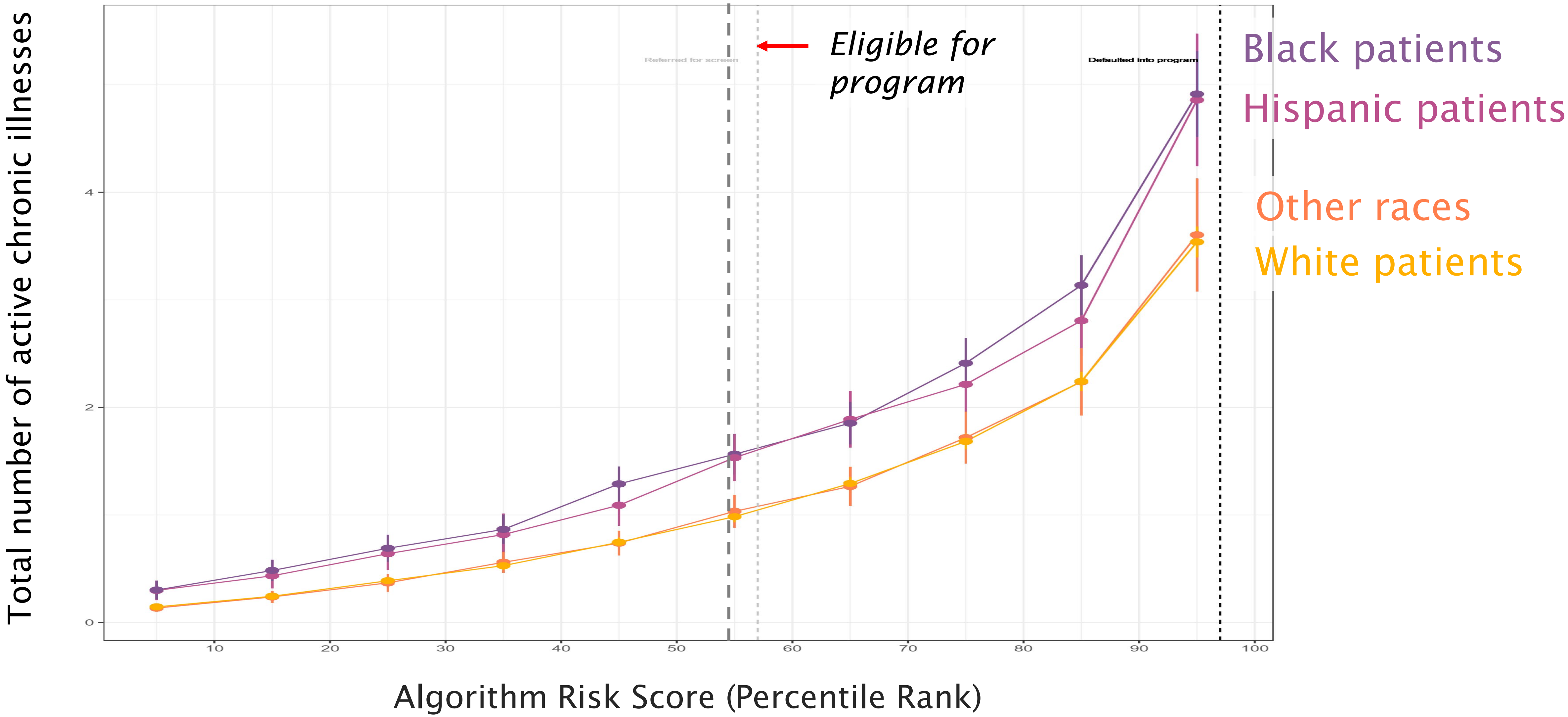
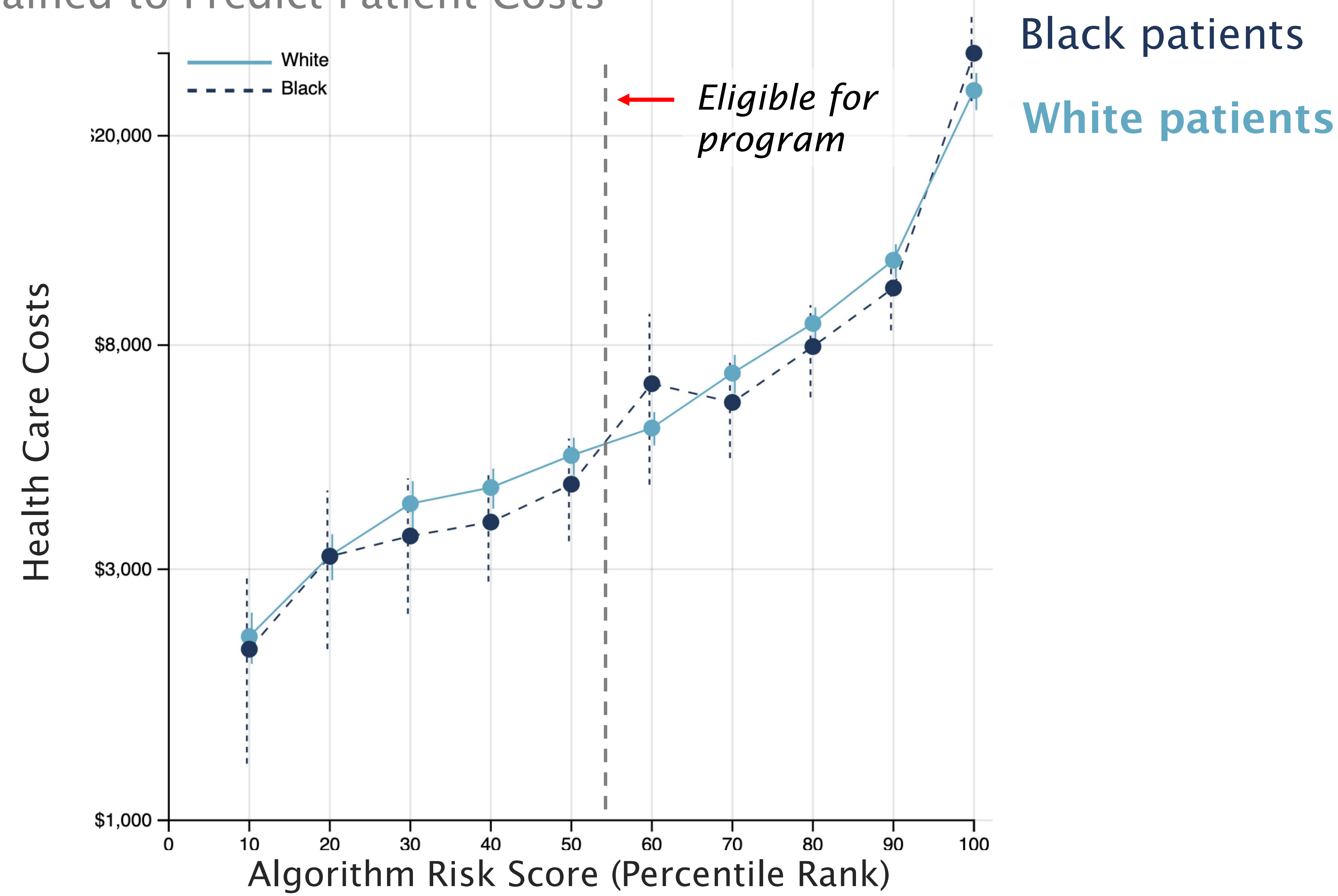


Source: Obermeyer, Powers, Vogeli, and Mullainathan (2019)

Comparing the Actual Target for Black versus White Patients

Algorithm was Trained to Predict Patient Costs



Source: Obermeyer, Powers, Vogeli, and Mullainathan (2019)

What is the source of bias in algorithms? Labels versus predictors

- Principle: patients with the same risk score should have same health needs
- In this lab, we will use binned scatter plots to compare the bias of four models:
  - **Random forest model 1:** trained to predict **patient costs** and does **not** use patient race as a predictor
  - **Random forest model 2:** trained to predict **patient costs** and **uses patient race** as a predictor variable
  - **Random forest model 3:** trained to predict **patient health** and does **not** use patient race as a predictor
  - **Random forest model 4:** trained to predict **patient health** and **uses patient race** as a predictor variable