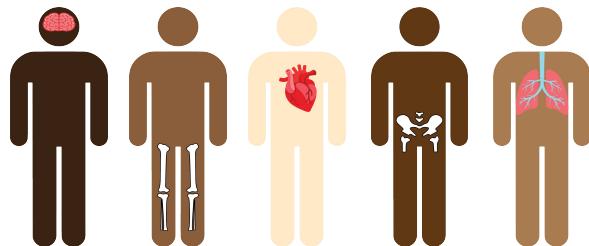


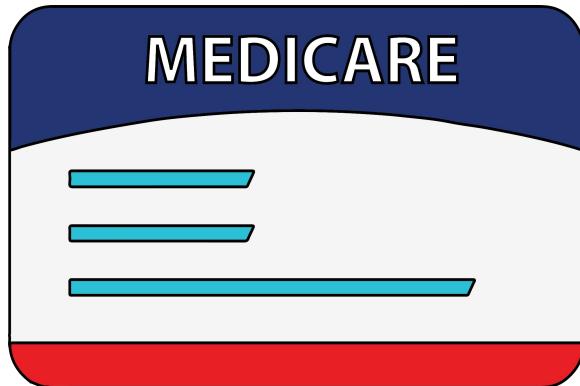
Team 20

Race-based healthcare outcome disparities in hospital readmission rates

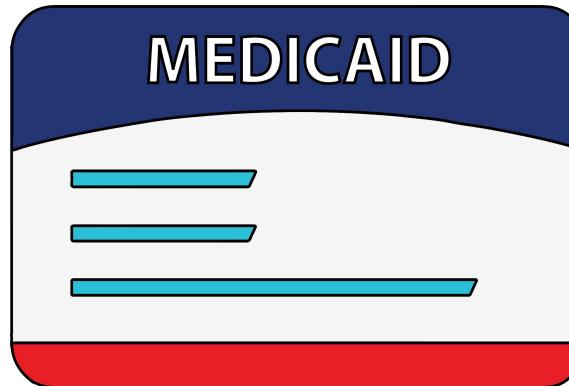
Jess Breda, Athena Casarotto, Mackenzie McPike, Audrey Siqui-Liu



The Centers for Medicare & Medicaid Services (CMS) ensure hospital quality standards through incentive programs.

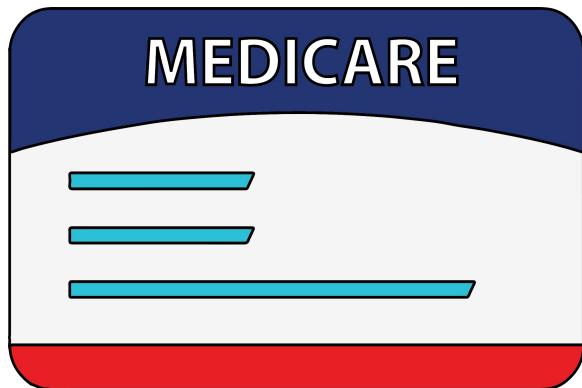


Aged 65+, or have a qualifying disability

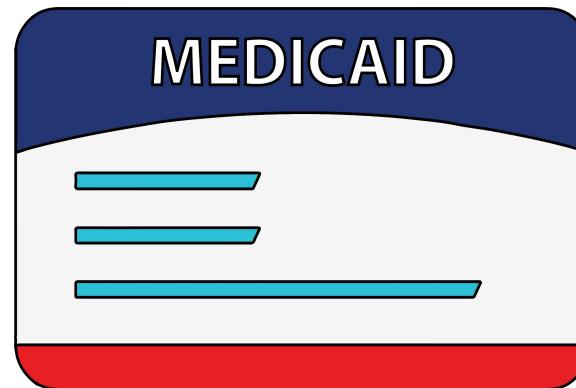


Limited income or resources

The Centers for Medicare & Medicaid Services (CMS) ensure hospital quality standards through incentive programs.



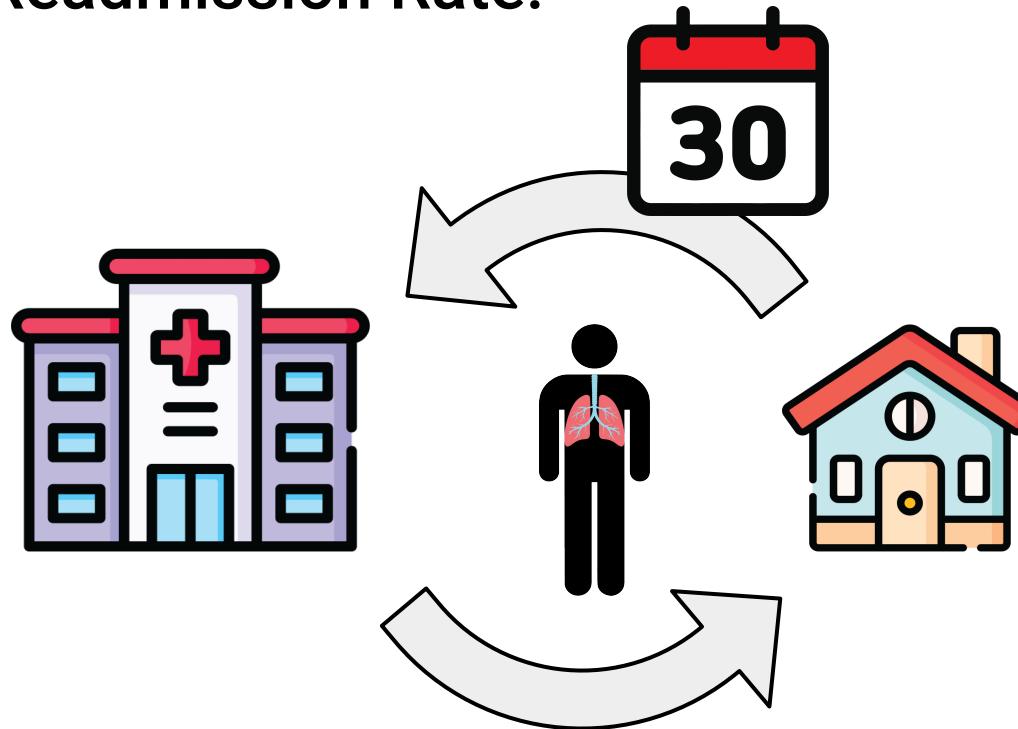
Aged 65+, or have a qualifying disability



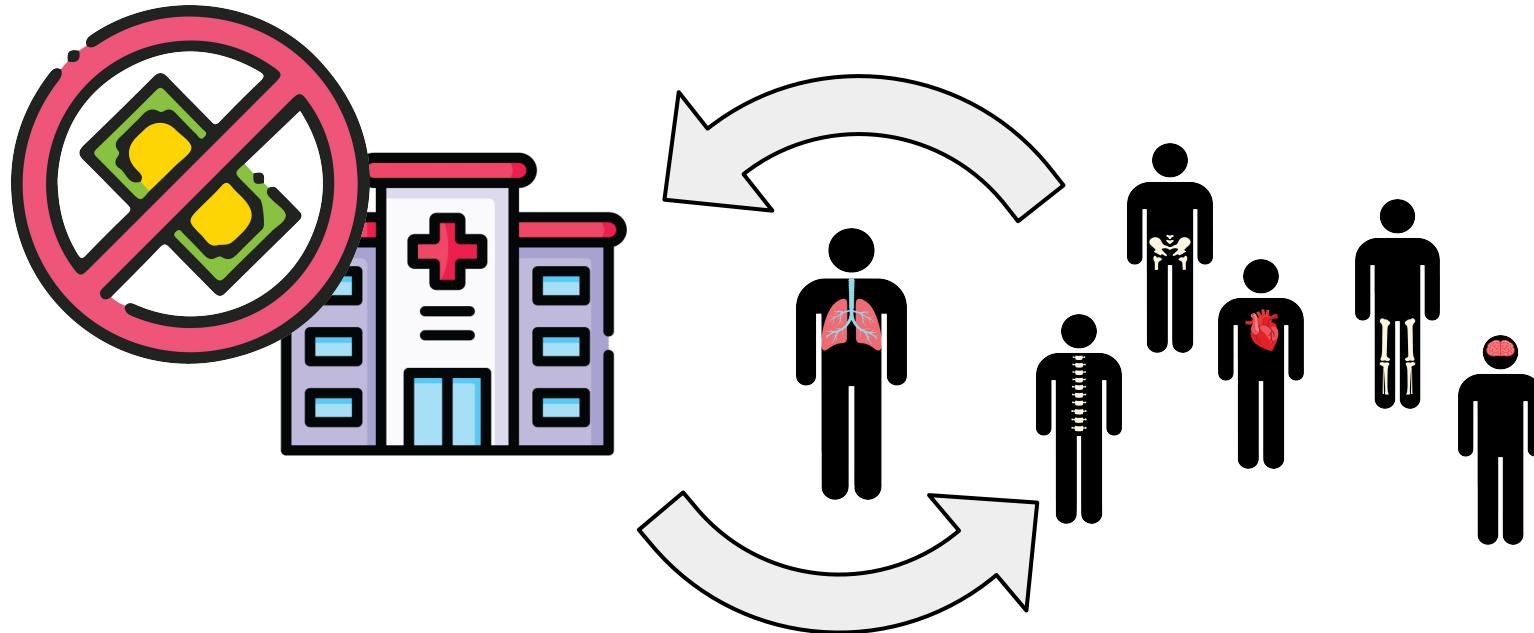
Limited income or resources

“Dual enrollment”

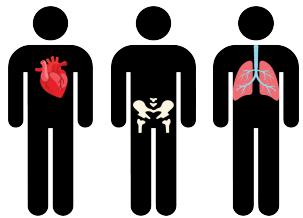
One CMS quality measure that hospitals are evaluated on is 30-day Readmission Rate.



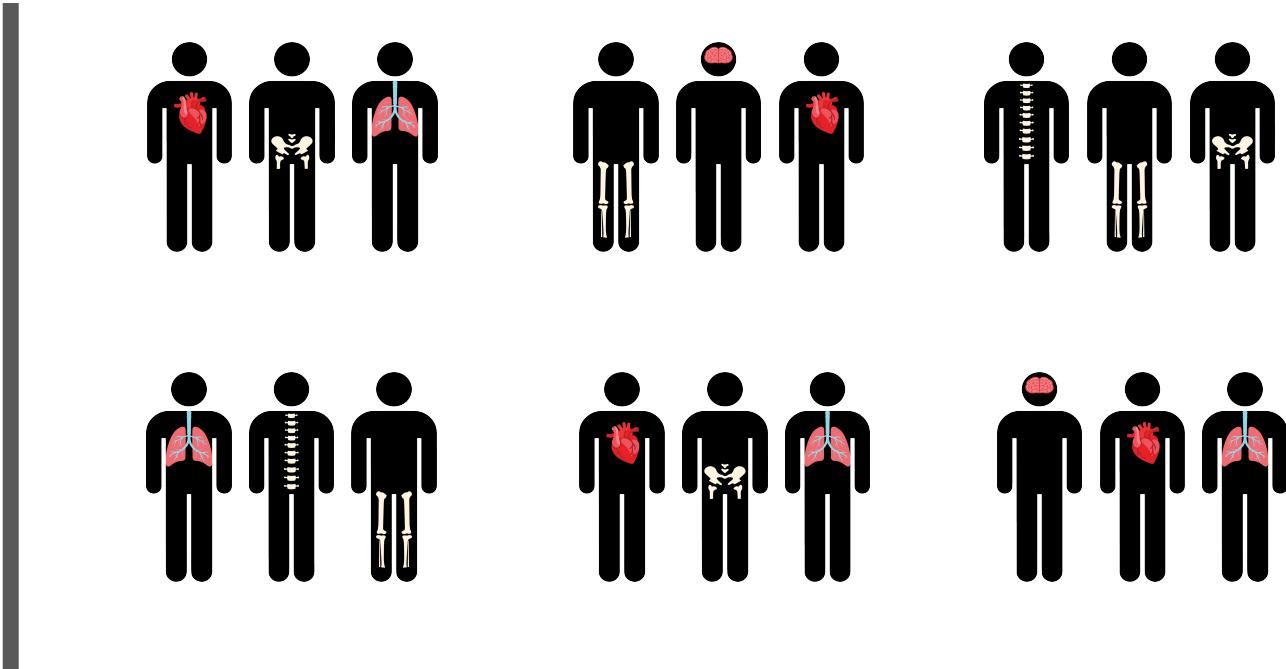
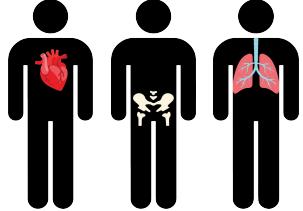
Excess readmissions can mean a reduction of annual Medicare payments by up to 3%.



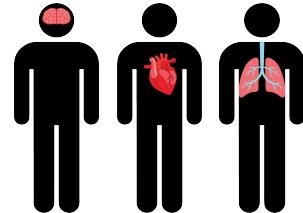
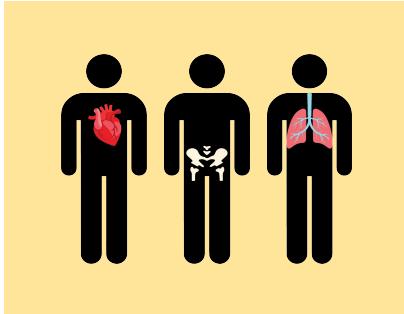
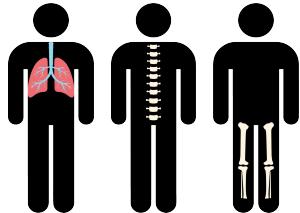
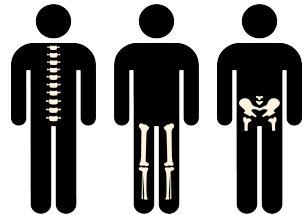
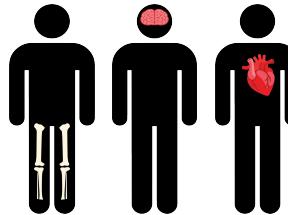
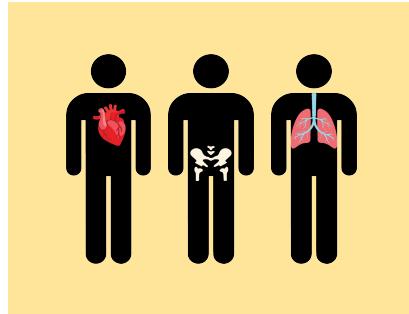
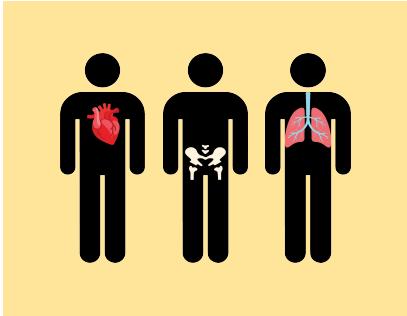
Hospitals are benchmarked against other facilities with similar patient mix and dual-enrollment status.



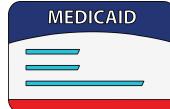
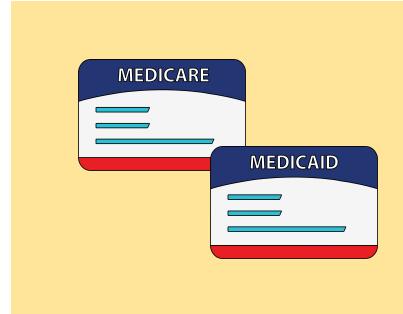
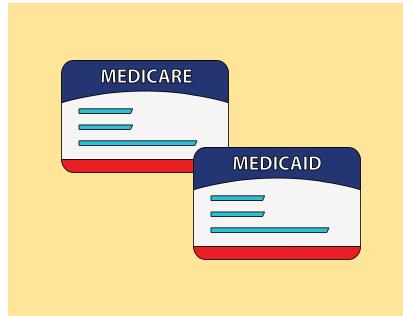
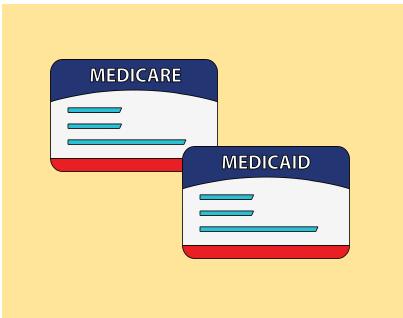
Hospitals are benchmarked against other facilities with similar patient mix and dual-enrollment status.



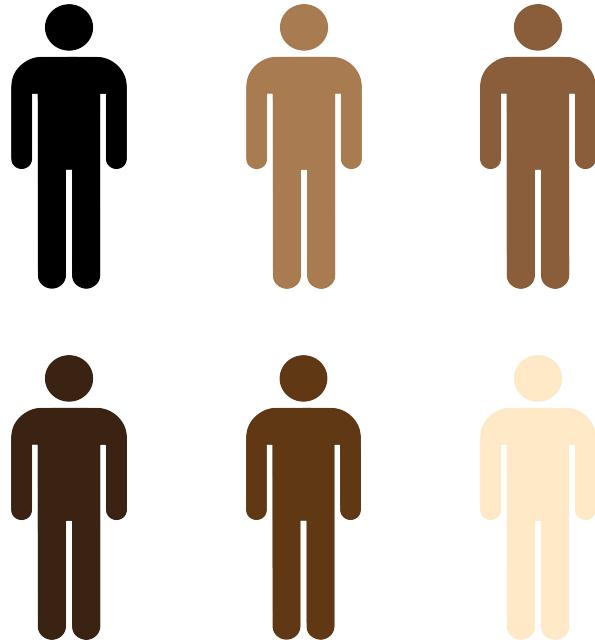
Hospitals are benchmarked against other facilities with similar patient mix and dual-enrollment status.



Hospitals are benchmarked against other facilities with similar patient mix and dual-enrollment status.



CMS does not include patient race or social determinants of health (SDOH) in their risk adjustments.



Social Determinants of Health:



Healthcare



Neighborhood



Economic stability



Social & community context



Education

Census tracts with the highest* readmission rates are...

*census tracts that fall in top 10% of readmission rates nationwide

†census tracts that fall in top 10% for specific social determinant of health (SDOH) risk factor nationwide

Census tracts with the highest* readmission rates are...



9.3% more likely have the most[†] constituents with no vehicles

*census tracts that fall in top 10% of readmission rates nationwide

†census tracts that fall in top 10% for specific social determinant of health (SDOH) risk factor nationwide

Census tracts with the highest* readmission rates are...



9.3% more likely have the most[†] constituents with no vehicles



9.2% more likely include the most[†] minority constituents

*census tracts that fall in top 10% of readmission rates nationwide

†census tracts that fall in top 10% for specific social determinant of health (SDOH) risk factor nationwide

Census tracts with the highest* readmission rates are...



9.3% more likely have the most[†] constituents with no vehicles



9.2% more likely include the most[†] minority constituents



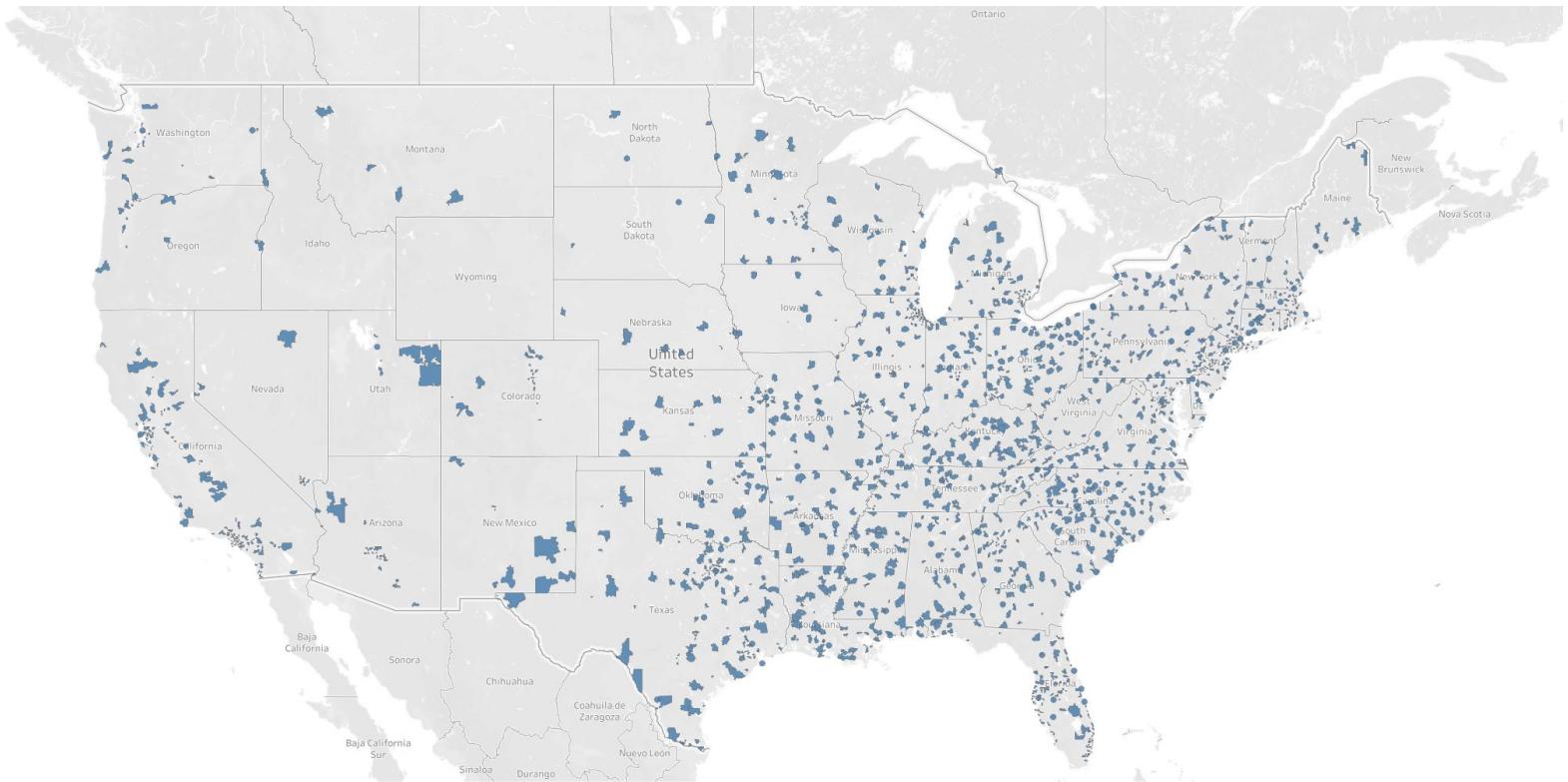
7% more likely carry the highest[†] housing cost burdens

*census tracts that fall in top 10% of readmission rates nationwide

†census tracts that fall in top 10% for specific social determinant of health (SDOH) risk factor nationwide

Mapping Race and Readmission Rates

Mapping Race and Readmission Rates

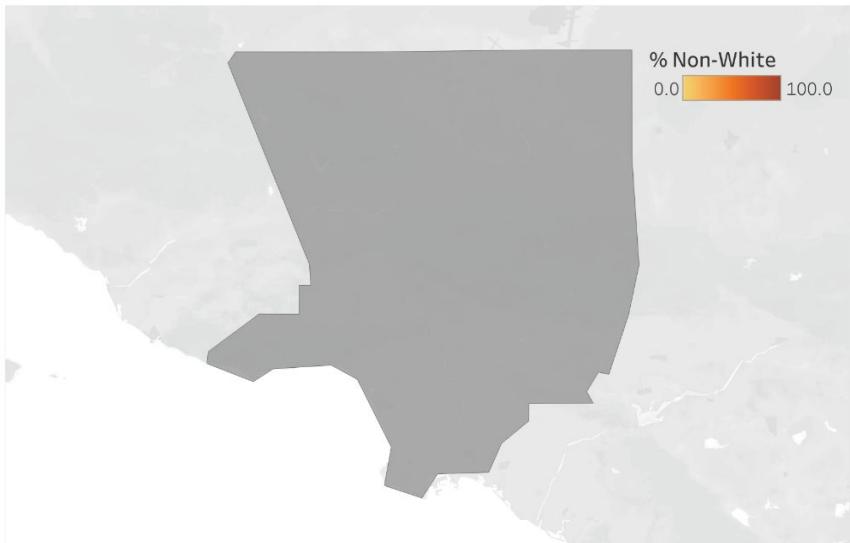


Mapping Race and Readmission Rates: LA County

% Readmissions by Zip Code: LA County

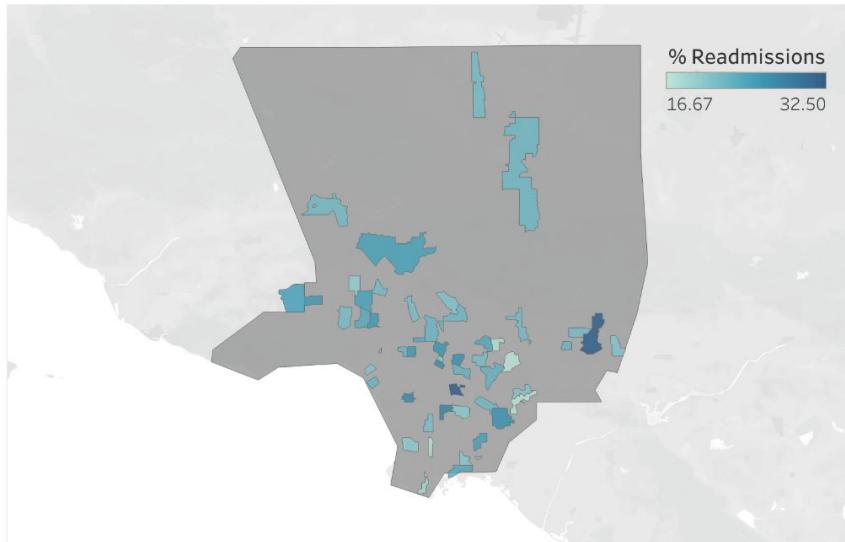


% Non-White by Zip Code: LA County

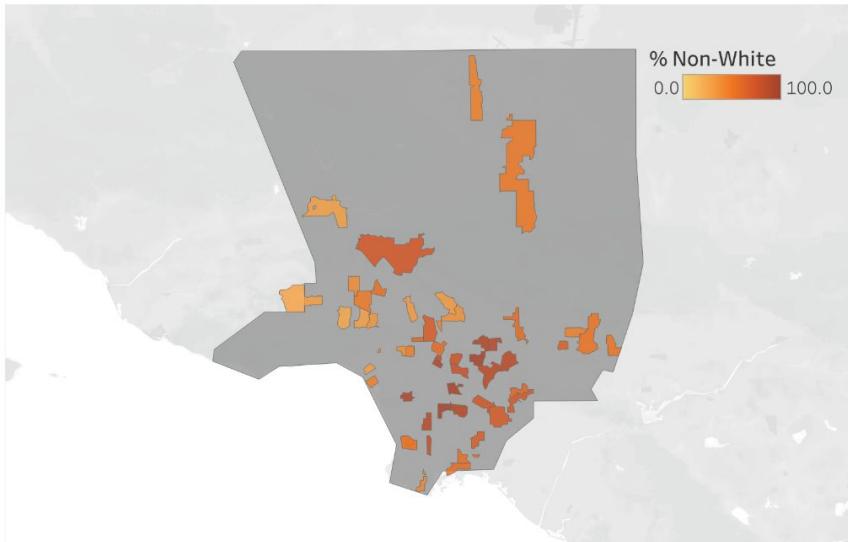


High Readmission Rates in Zip Codes with Majority Non-White Populations

% Readmissions by Zip Code: LA County



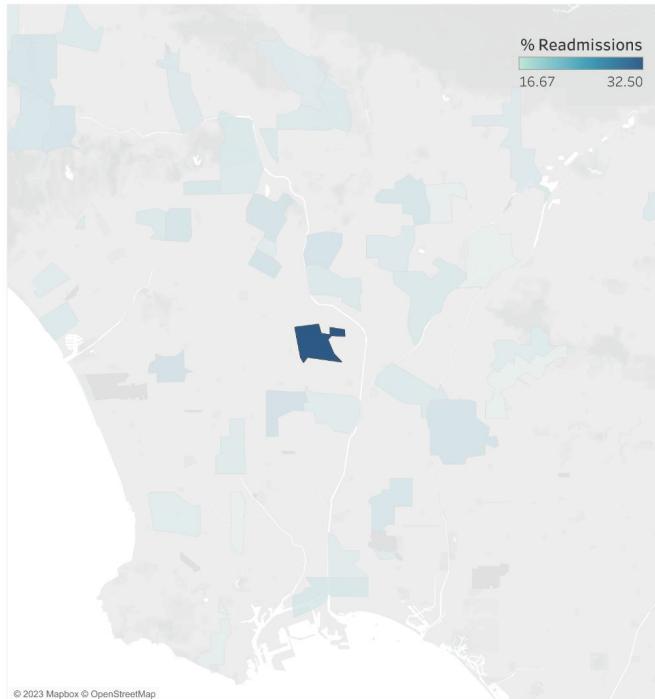
% Non-White by Zip Code: LA County



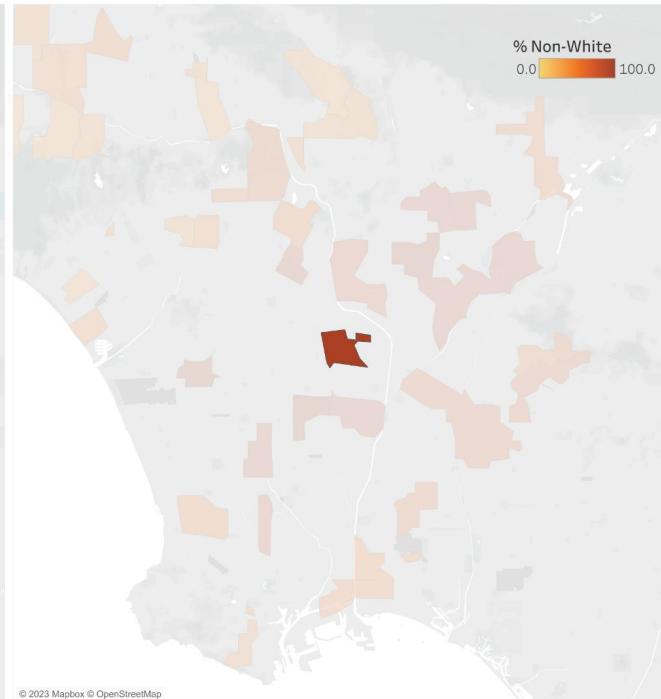
90255

Readmissions: 32%
Non-White: 94%

% Readmissions by Zip Code: LA County



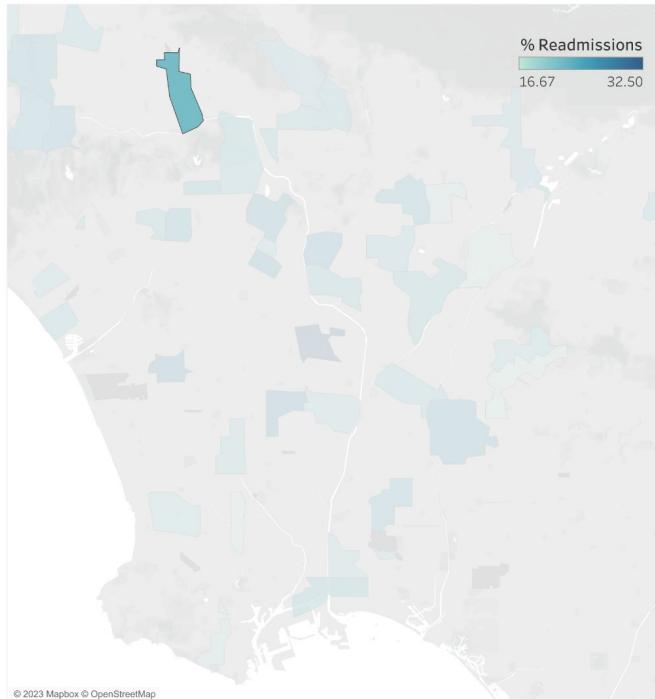
% Non-White by Zip Code: LA County



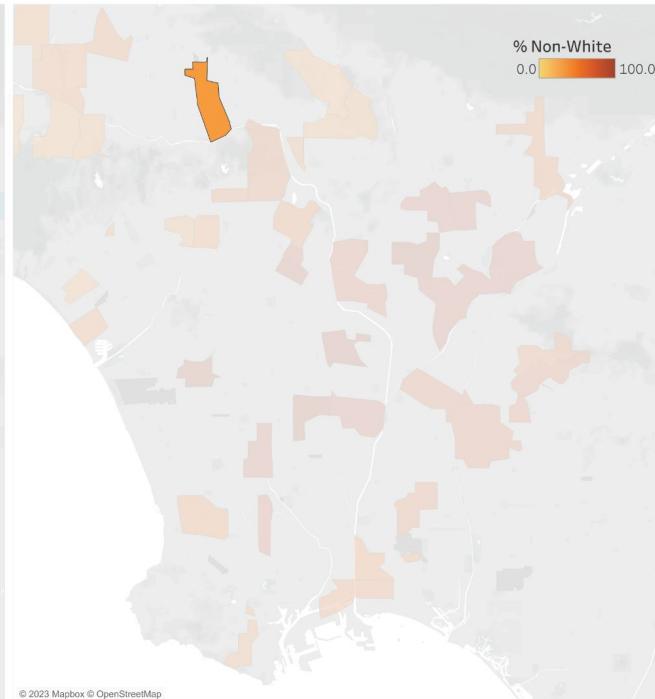
91505

Readmissions: 21%
Non-White: 29%

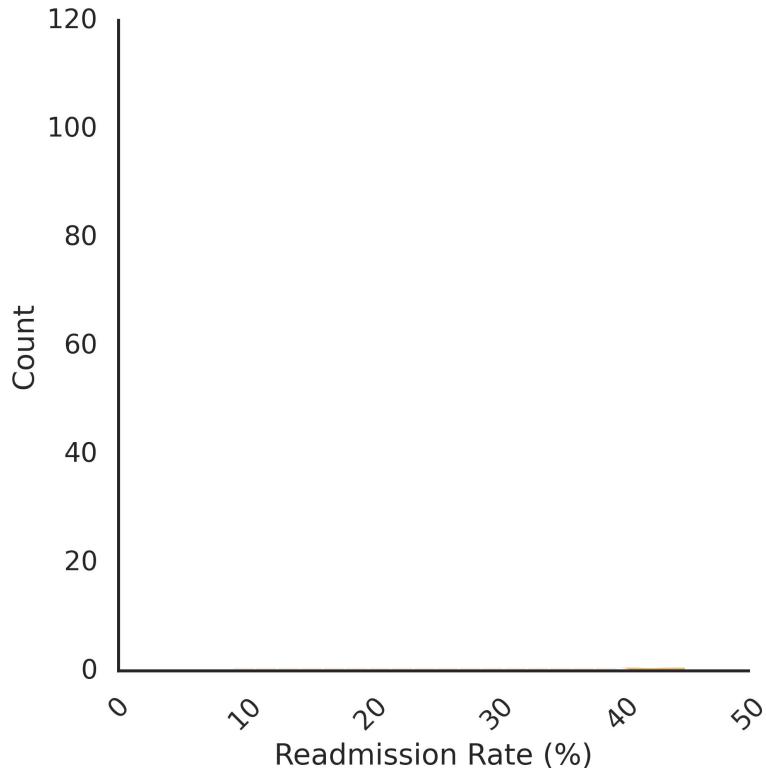
% Readmissions by Zip Code: LA County



% Non-White by Zip Code: LA County

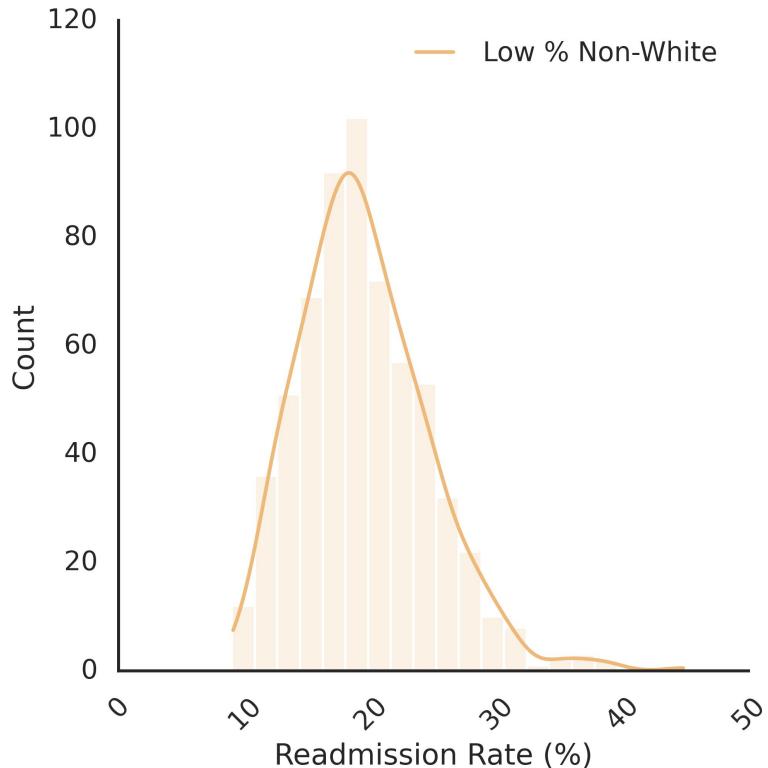


Hospitals with the most* non-white patients had higher readmission rates



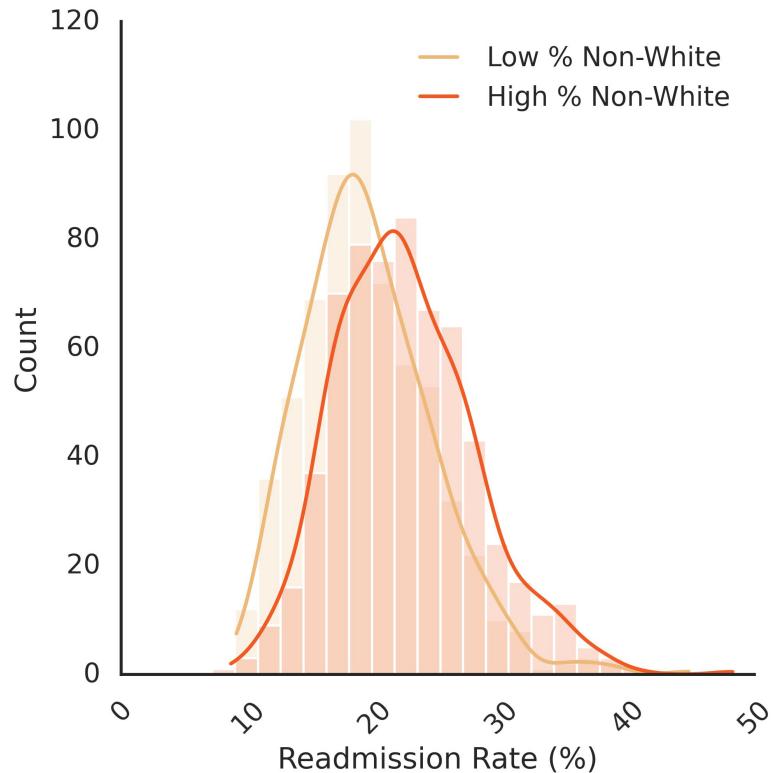
*hospitals that are in the top 10% nationwide for most non-white patients

Hospitals with the most* non-white patients had higher readmission rates



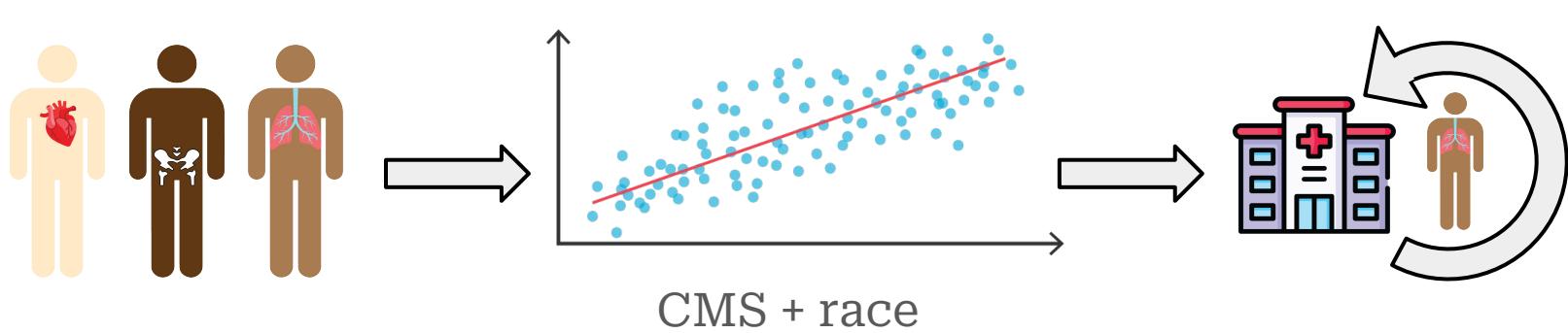
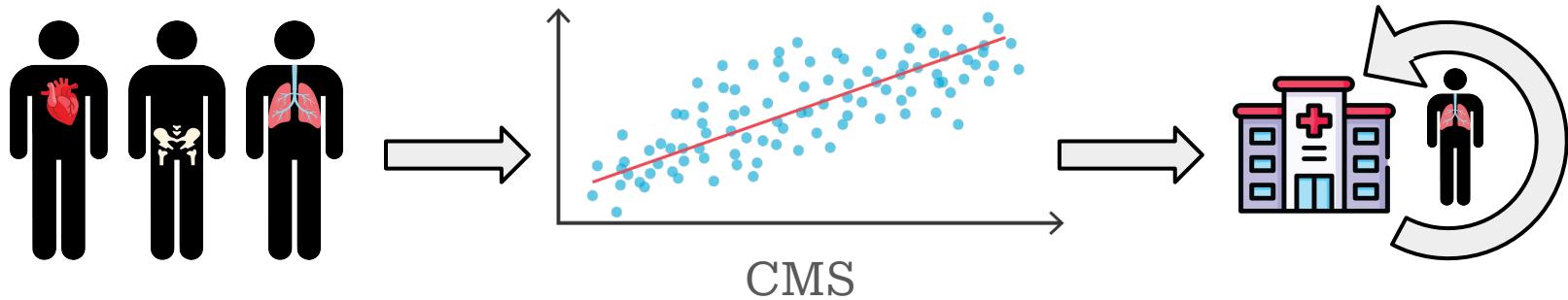
*hospitals that fall in the top 10% nationwide for most non-white patients

Hospitals with the most* non-white patients had higher readmission rates

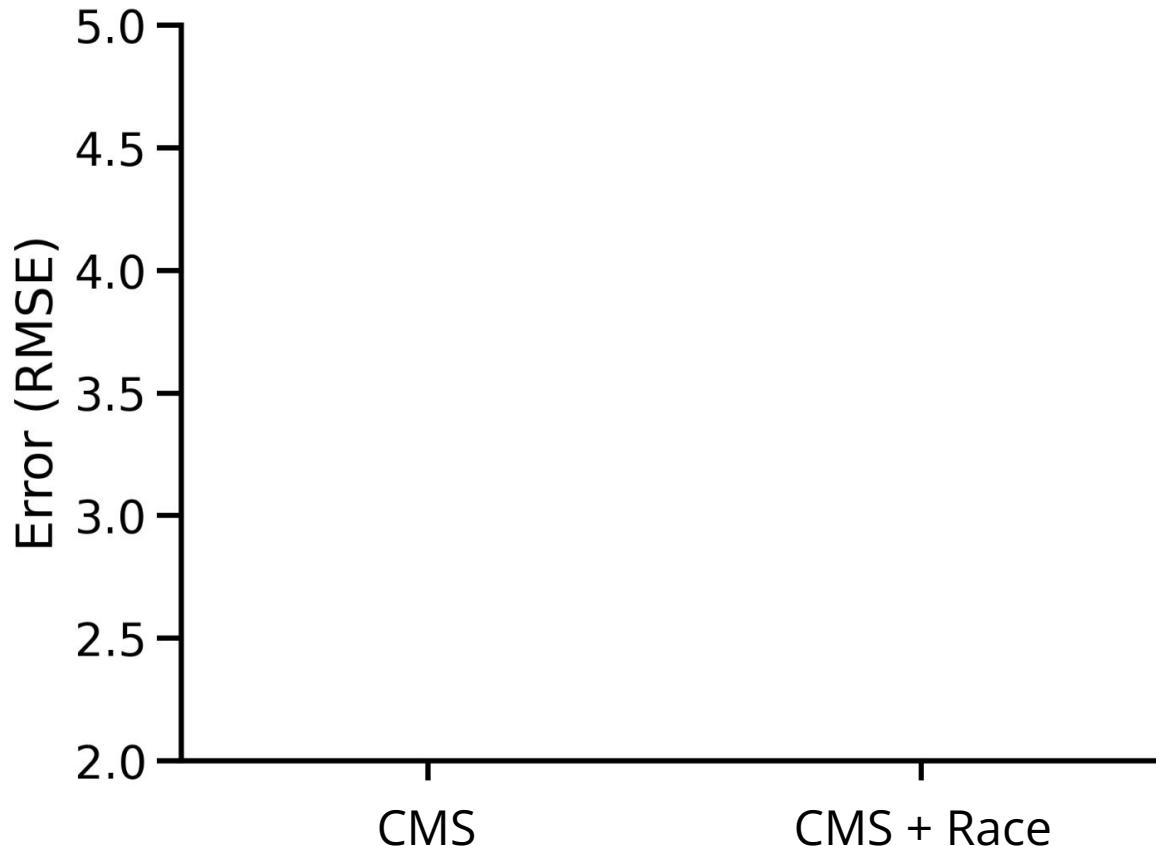


*hospitals that fall in the top 10% nationwide for most non-white patients

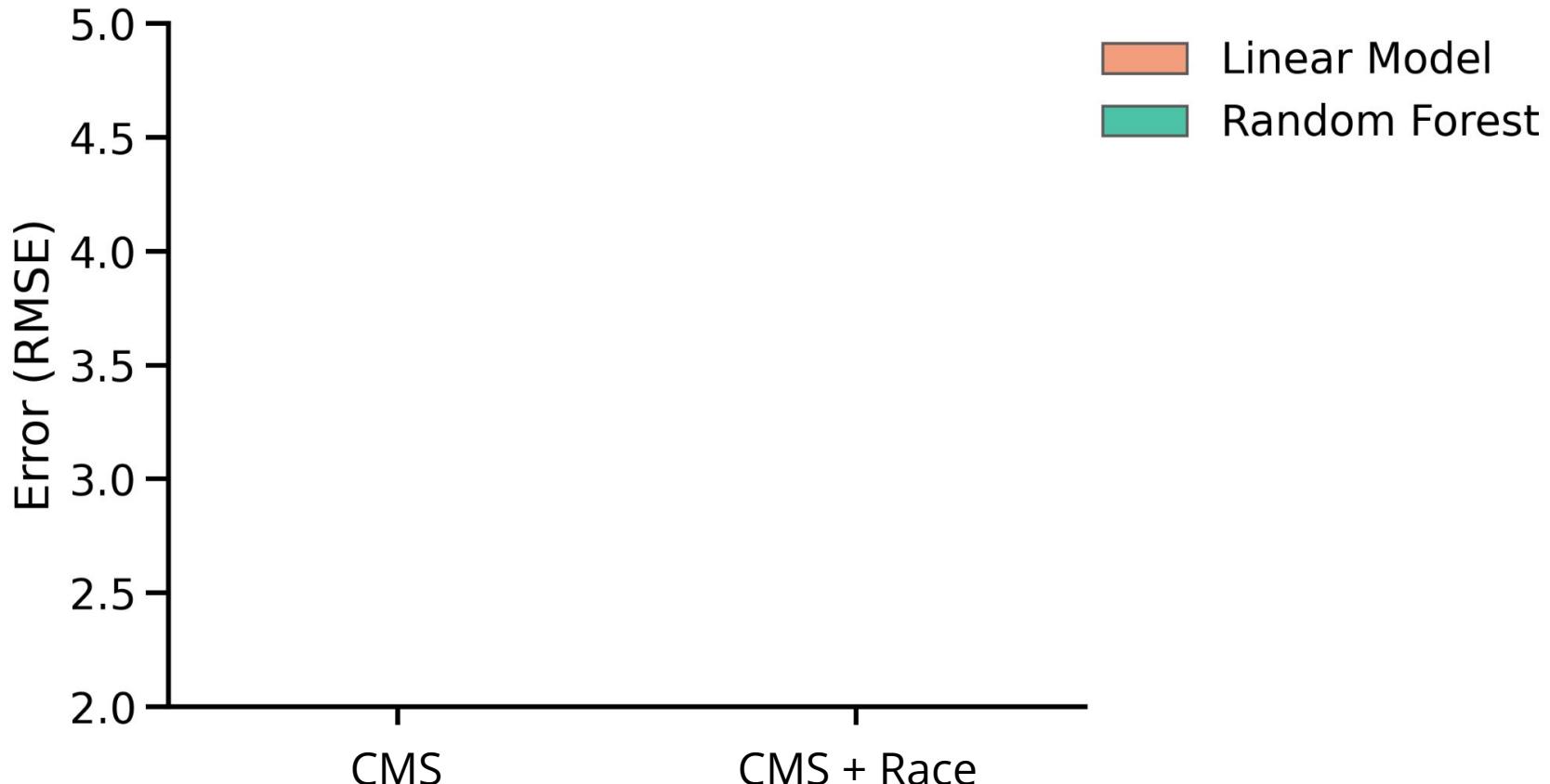
Does a race-aware model predict readmission rates more accurately?



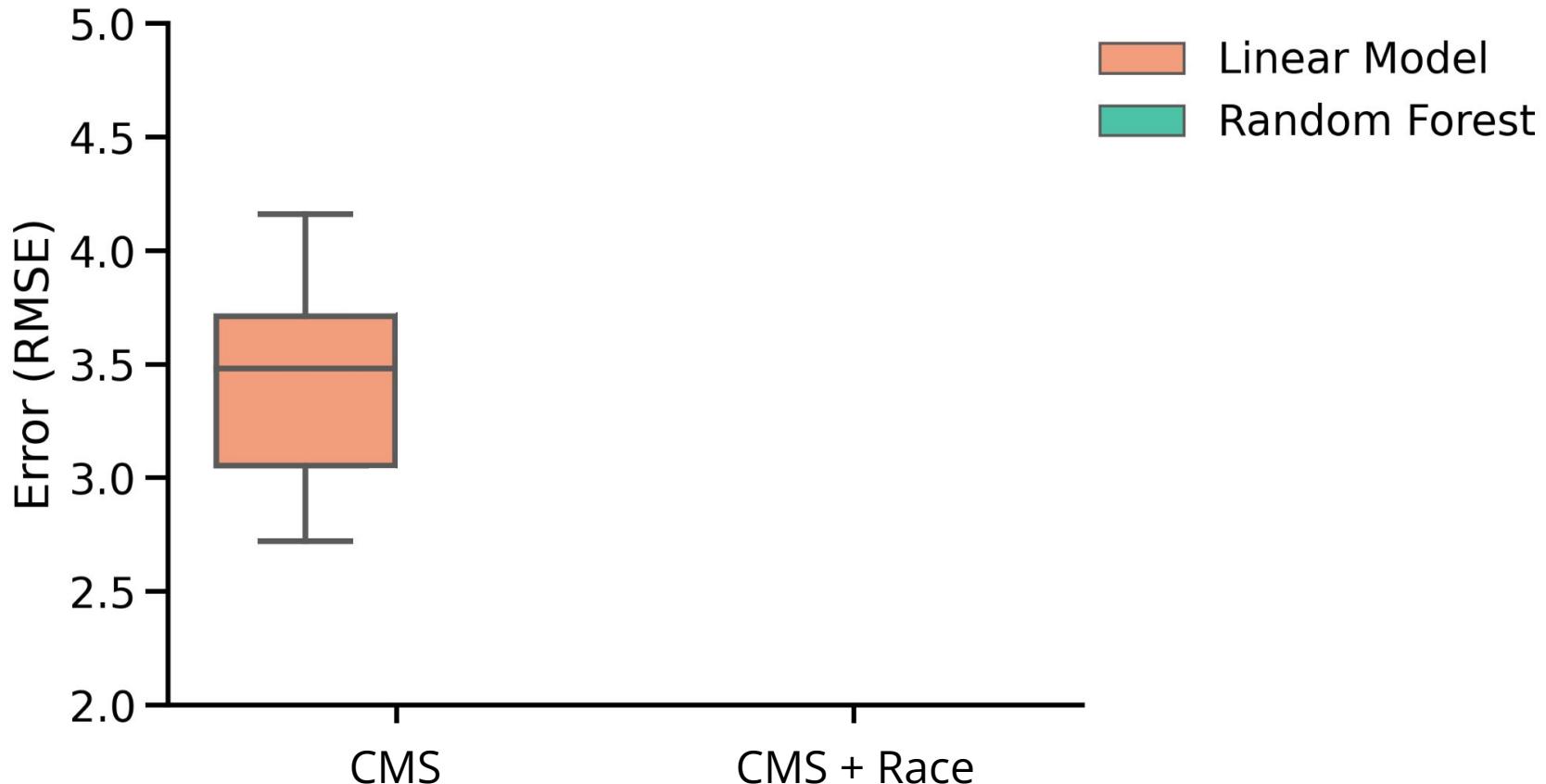
Including race does not improve predictive performance across models



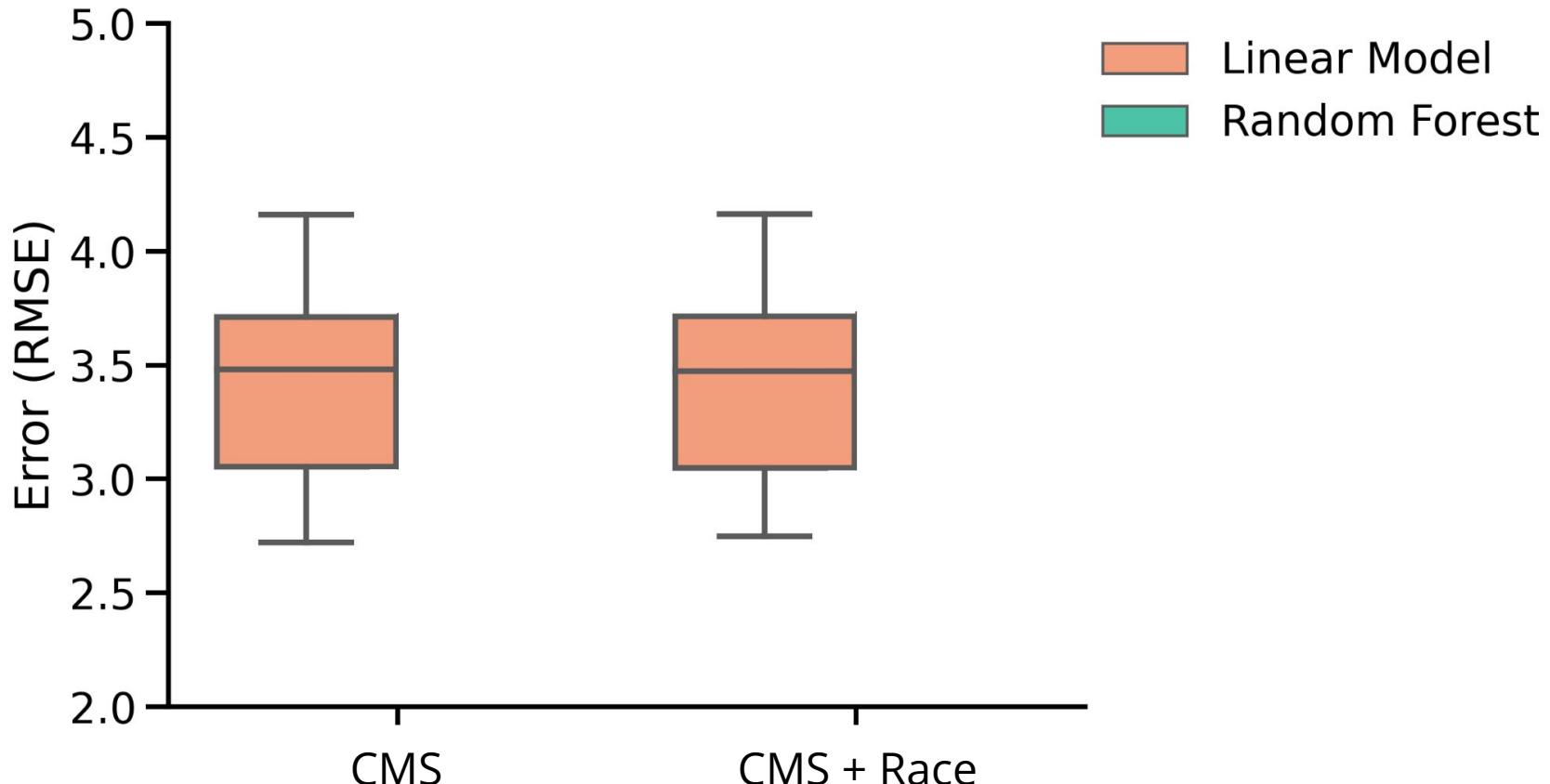
Including race does not improve predictive performance across models



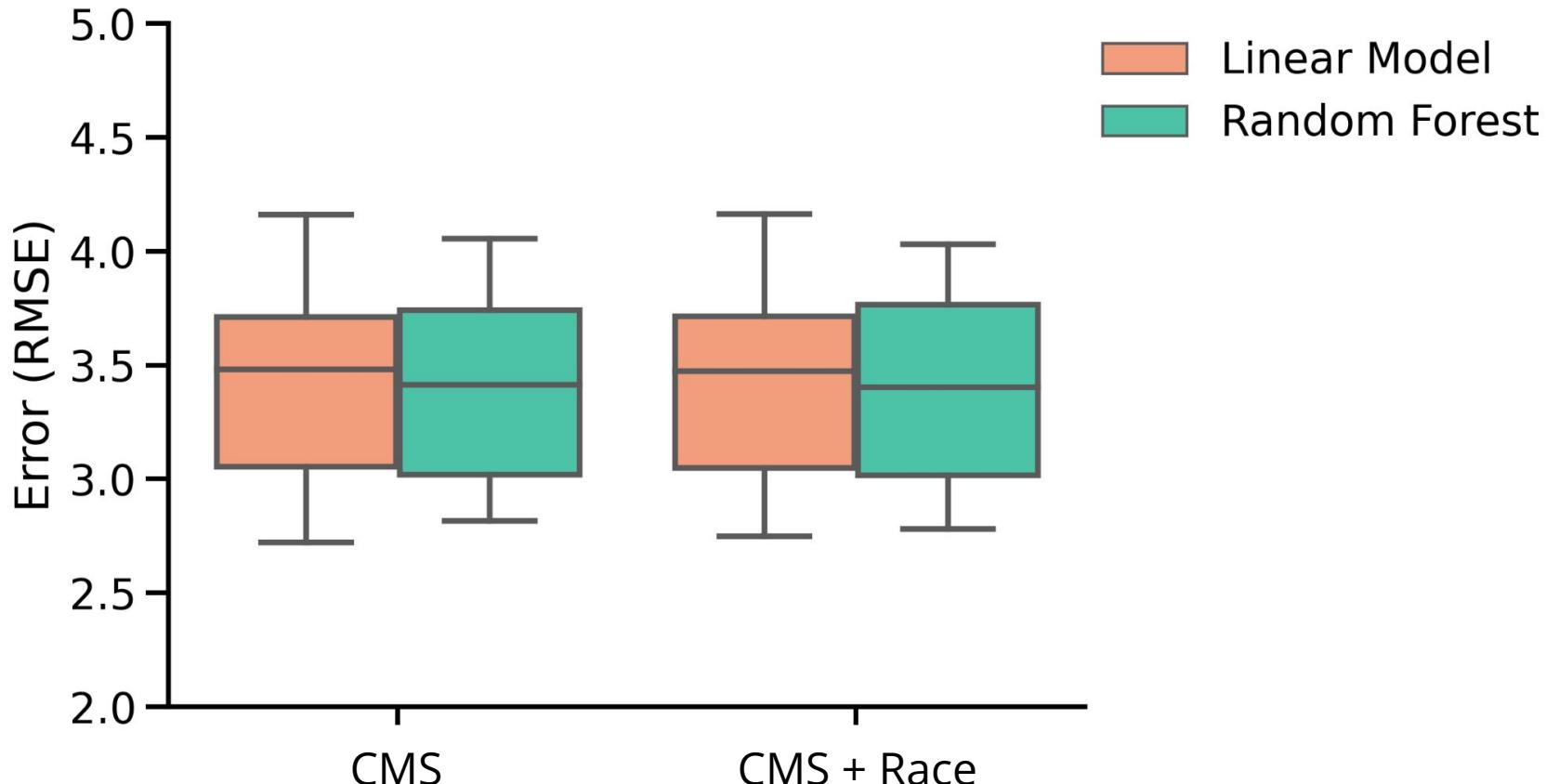
Including race does not improve predictive performance across models



Including race does not improve predictive performance across models

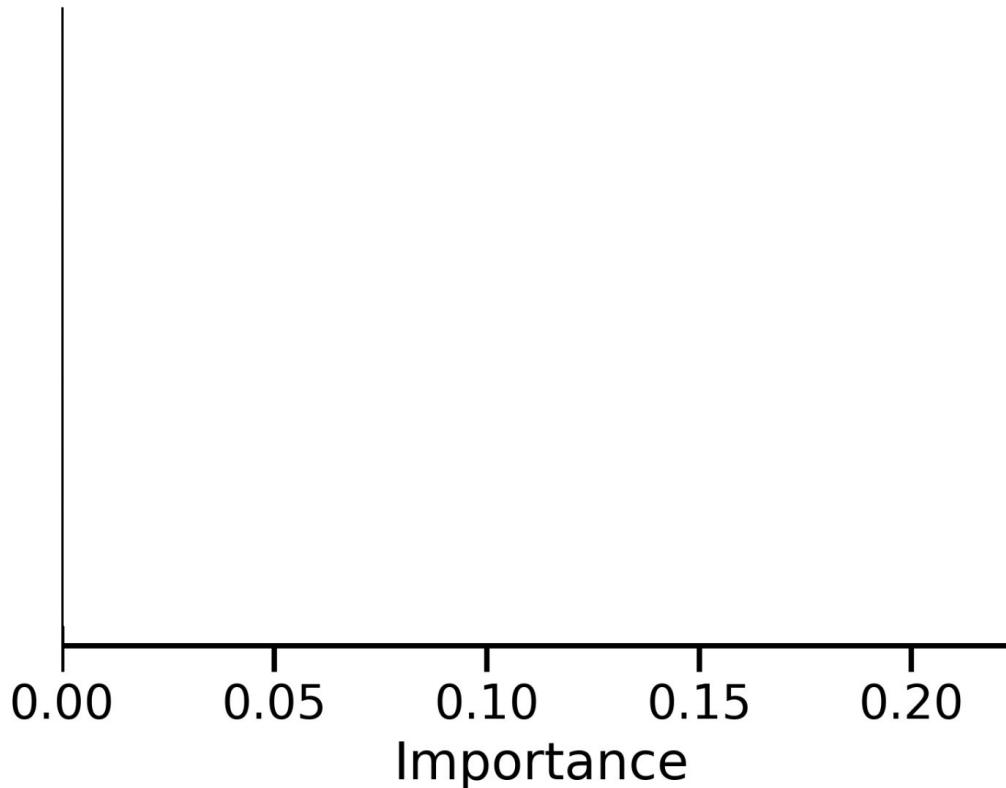


Including race does not improve predictive performance across models

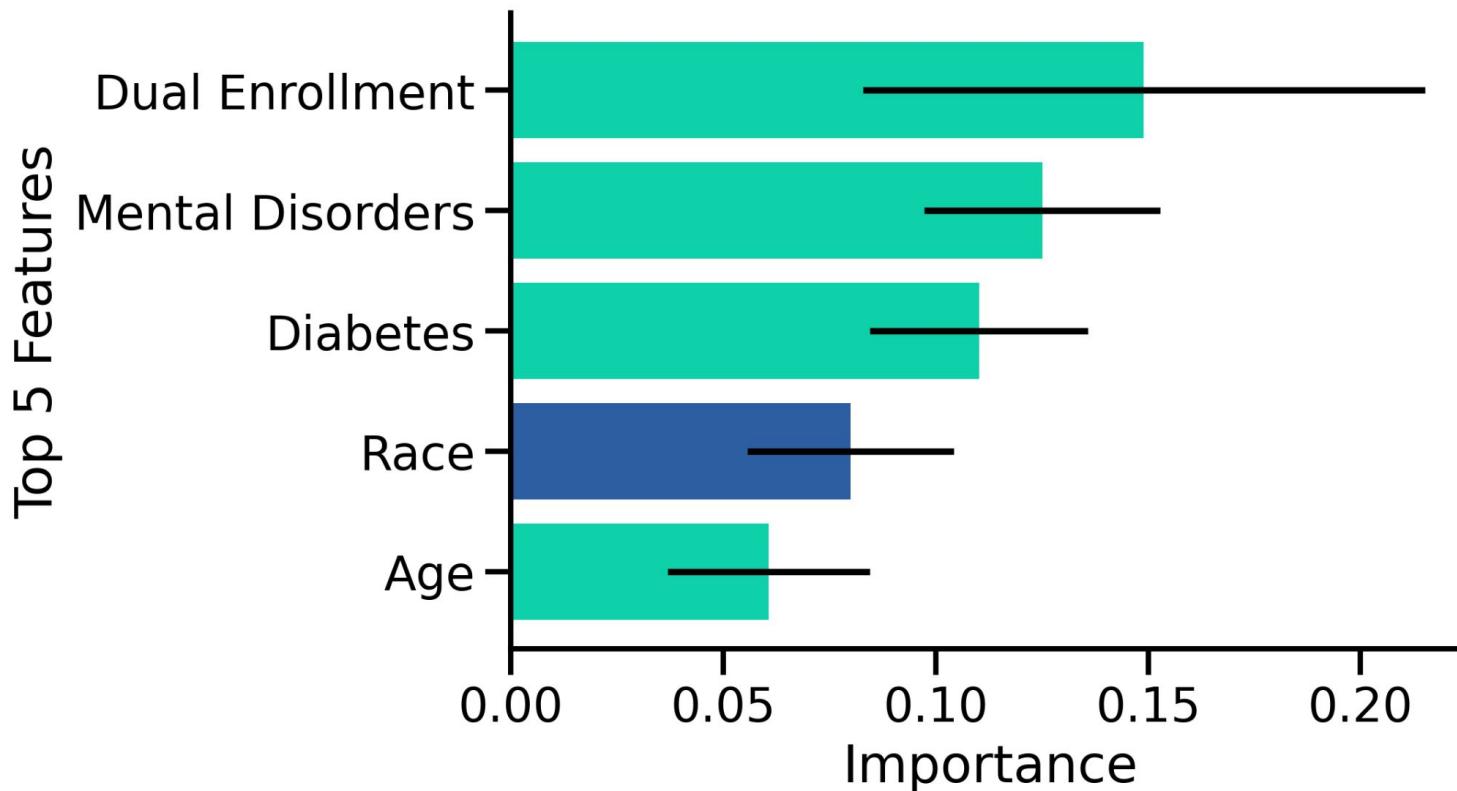


**Race is 4th most important feature in predicting
readmission rates**

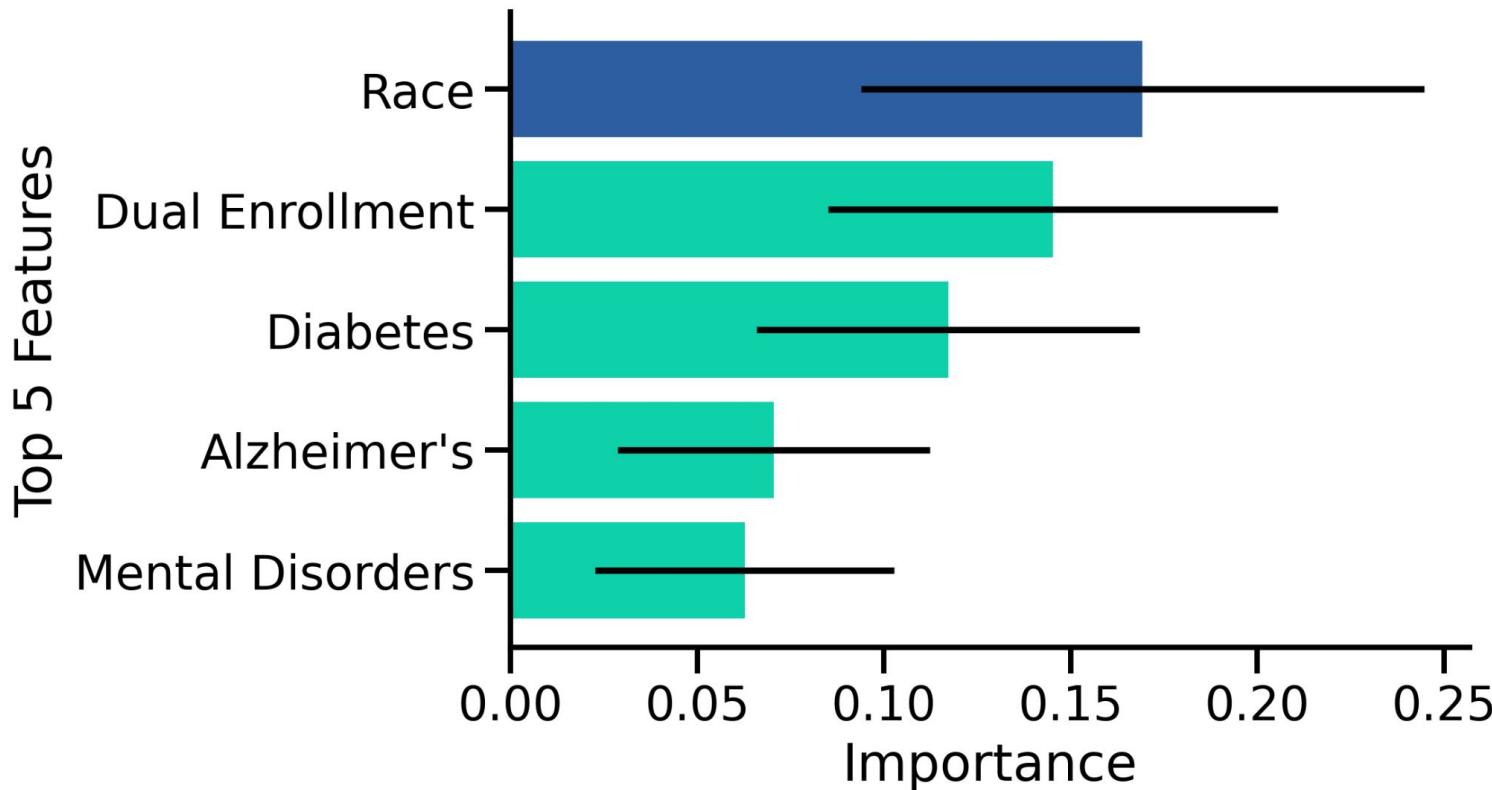
Top 5 Features



Race is 4th most important feature in predicting readmission rates

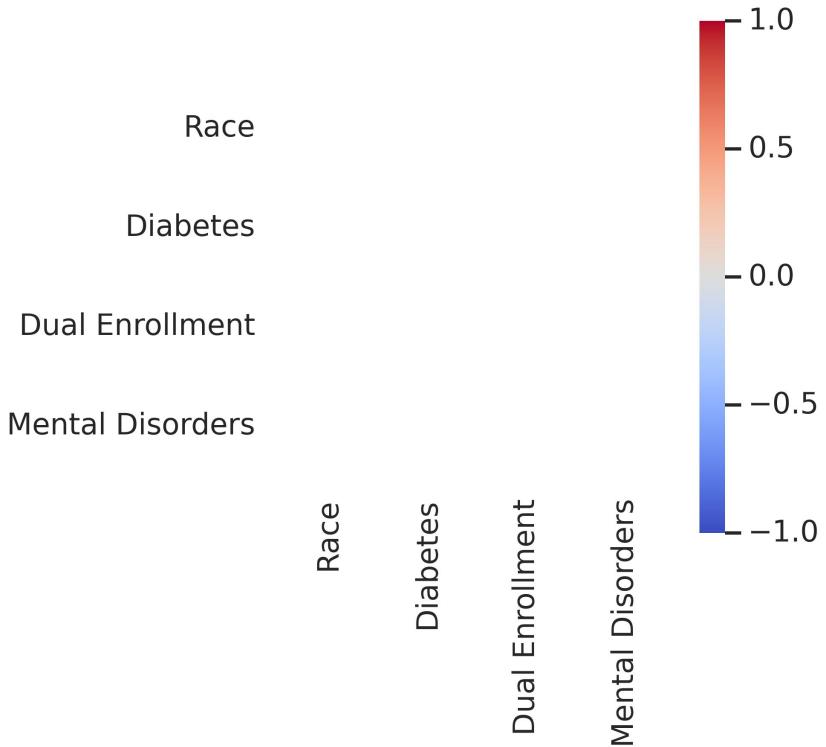


When looking at hospitals with highest* readmission rates,
race is the *most* important feature

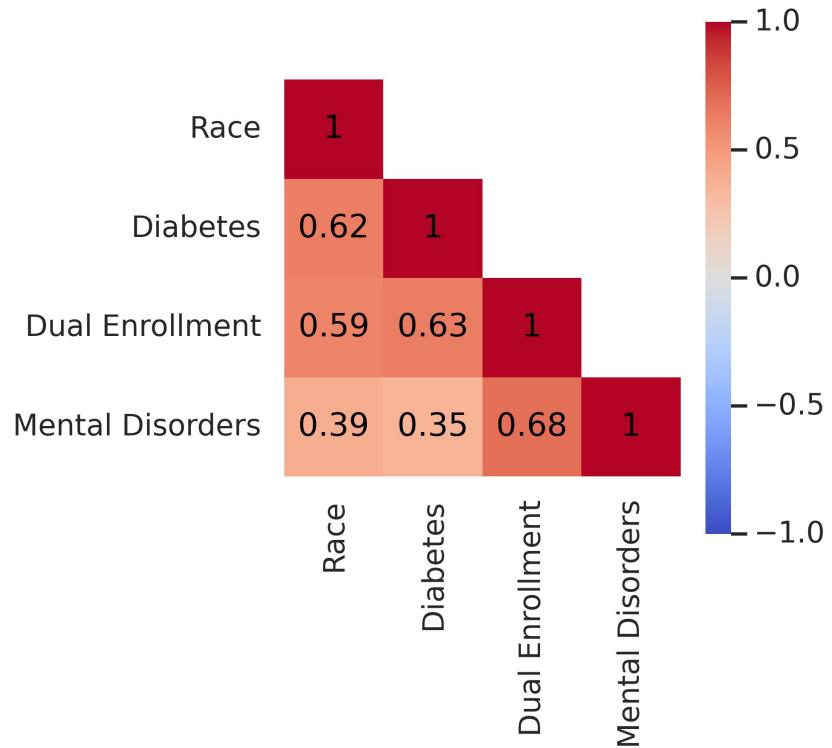


*hospitals with highest 10% of readmission rates for each condition (heart failure, pneumonia, copd)

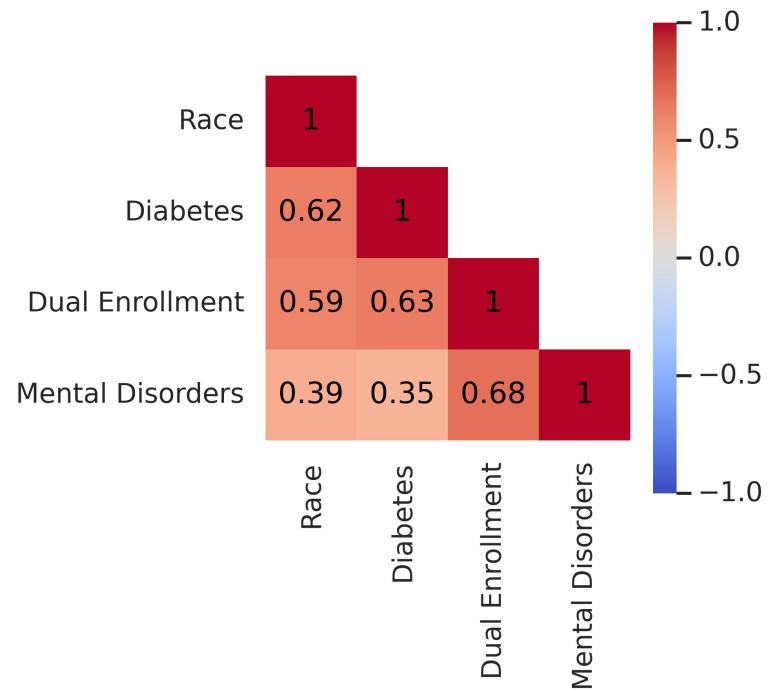
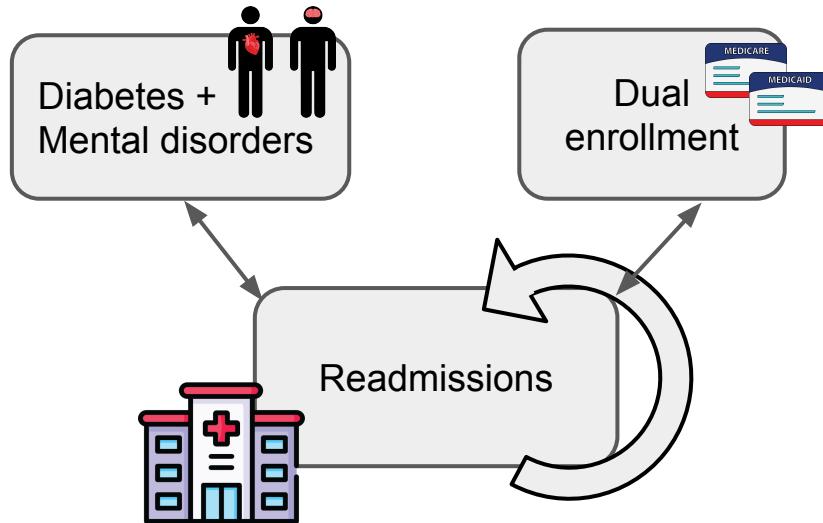
Race is highly correlated with existing CMS features



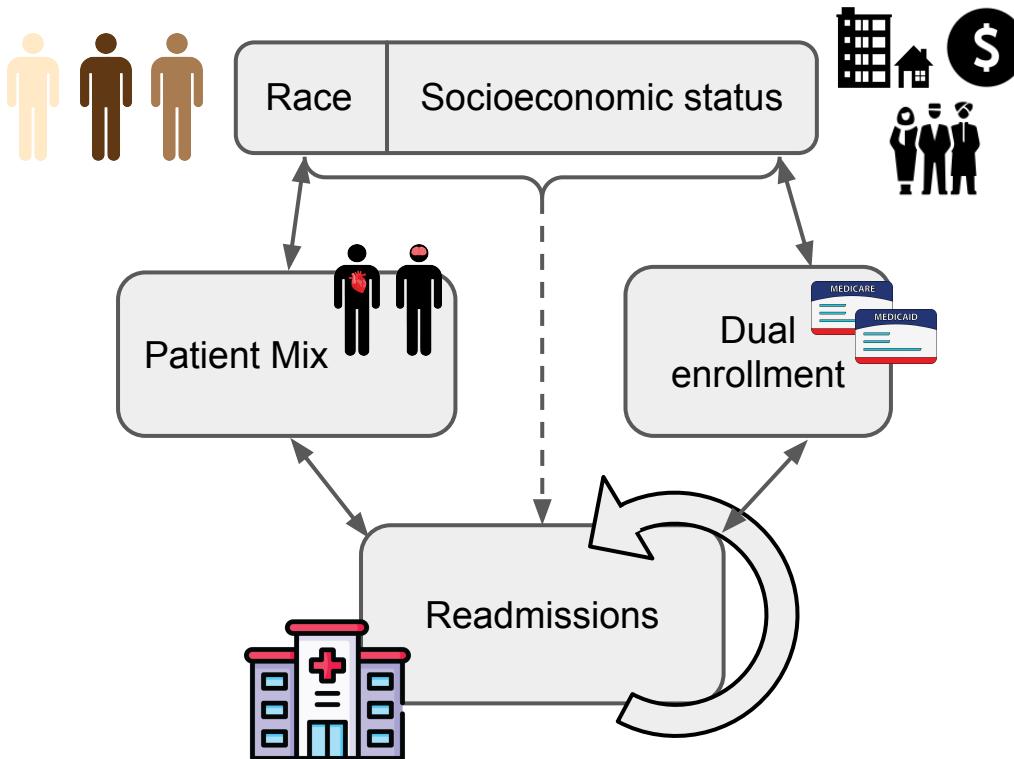
Race is highly correlated with existing CMS features



Patient Mix and Dual Enrollment are correlated with readmissions

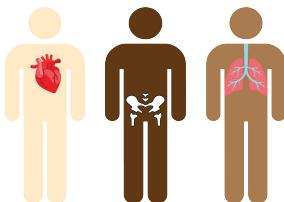
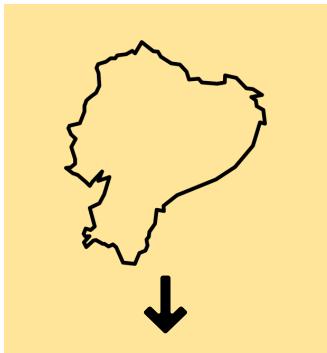


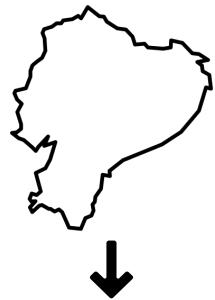
Existing CMS features mediate the relationship between race and readmissions



Challenges & Next Steps

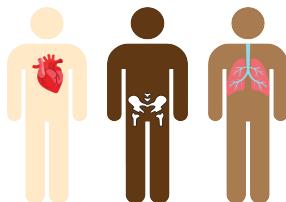
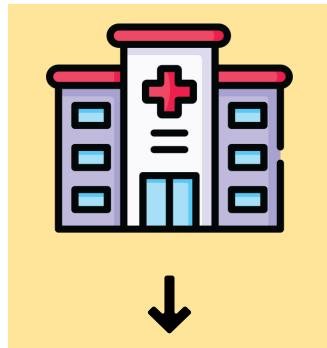
- Aggregated social variables at the census tract level

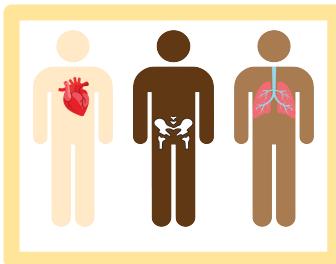
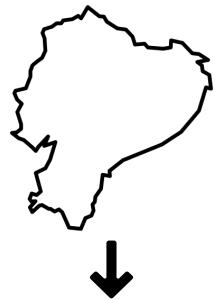




Challenges & Next Steps

- Aggregated social variables at the census tract level
- **Aggregated patient data at the hospital level**





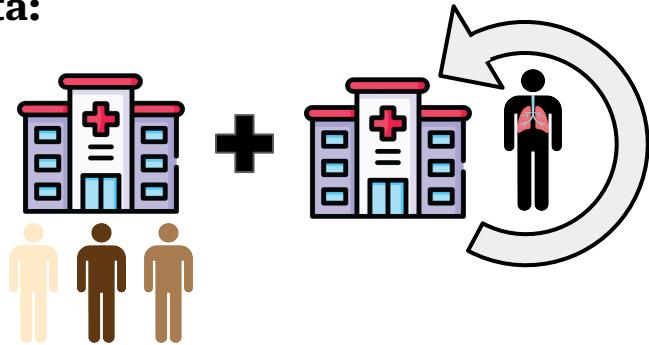
Challenges & Next Steps

- Aggregated social variables at the census tract level
- Aggregated patient data at the hospital level
 - **Individualized patient data for future models**

Concluding Recommendations

- Our EDA and other studies^{1,2} show that non-white patients have higher readmission rates

Our Data:

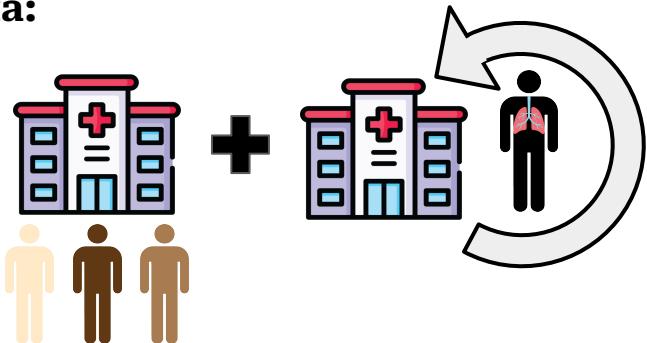


1. [Sociodemographic Characteristics in AMI readmissions | JAMA | 2023](#)
2. [Racial Disparities in 7-Day Readmissions from an Adult Hospital Medicine Service](#)

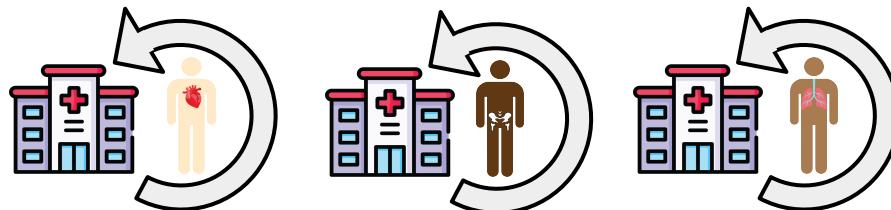
Concluding Recommendations

- Our EDA and other studies^{1,2} show that non-white patients have higher readmission rates

Our Data:



Ideal Data:

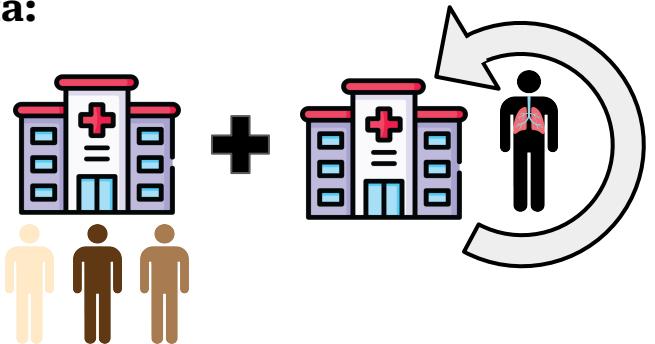


1. [Sociodemographic Characteristics in AMI readmissions | JAMA | 2023](#)
2. [Racial Disparities in 7-Day Readmissions from an Adult Hospital Medicine Service](#)

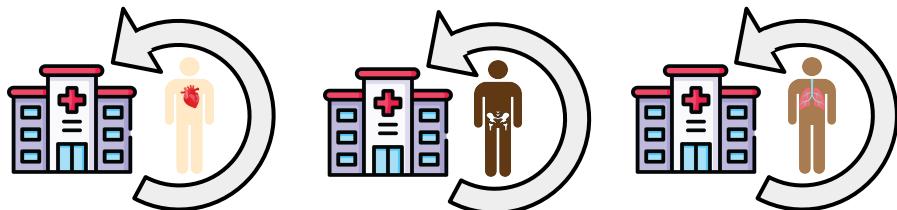
Concluding Recommendations

- Our EDA and other studies^{1,2} show that non-white patients have higher readmission rates
- These disparities may be hidden by aggregated readmission data

Our Data:



Ideal Data:



1. [Sociodemographic Characteristics in AMI readmissions | JAMA | 2023](#)
2. [Racial Disparities in 7-Day Readmissions from an Adult Hospital Medicine Service](#)

Concluding Recommendations

- Our EDA and other studies^{1,2} show that non-white patients have higher readmission rates
- These disparities may be hidden by aggregated readmission data

Non-white patients have



61%

**greater odds of being
readmitted**
than white patients¹

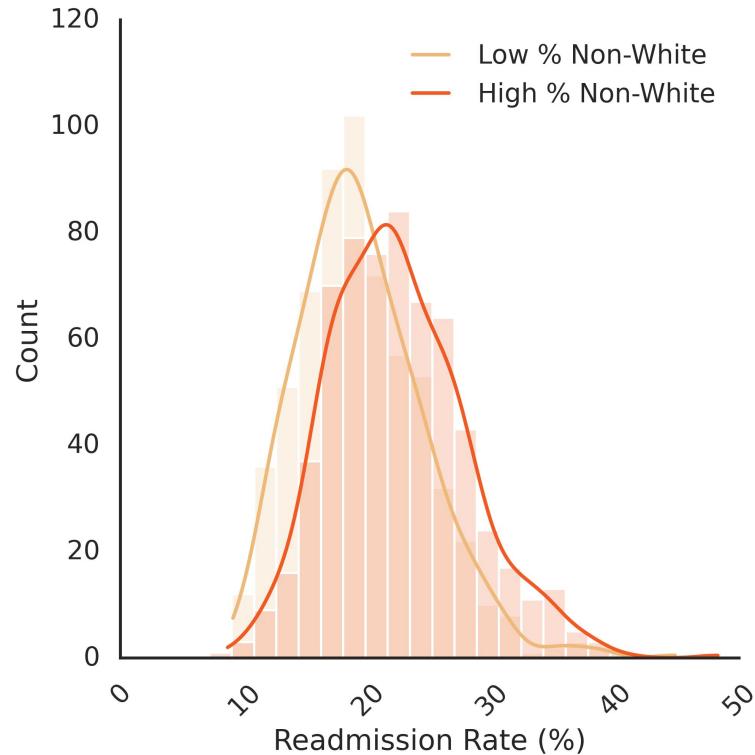
1. [Sociodemographic Characteristics in AMI readmissions | JAMA | 2023](#)
2. [Racial Disparities in 7-Day Readmissions from an Adult Hospital Medicine Service](#)

Concluding Recommendations

- Our EDA and other studies^{1,2} show that non-white patients have higher readmission rates
- These disparities may be hidden by aggregated readmission data

For future analysis:

→ **Split publicly-available readmission outcome datasets by patient race within each hospital**



1. [Sociodemographic Characteristics in AMI readmissions | JAMA | 2023](#)
2. [Racial Disparities in 7-Day Readmissions from an Adult Hospital Medicine Service](#)

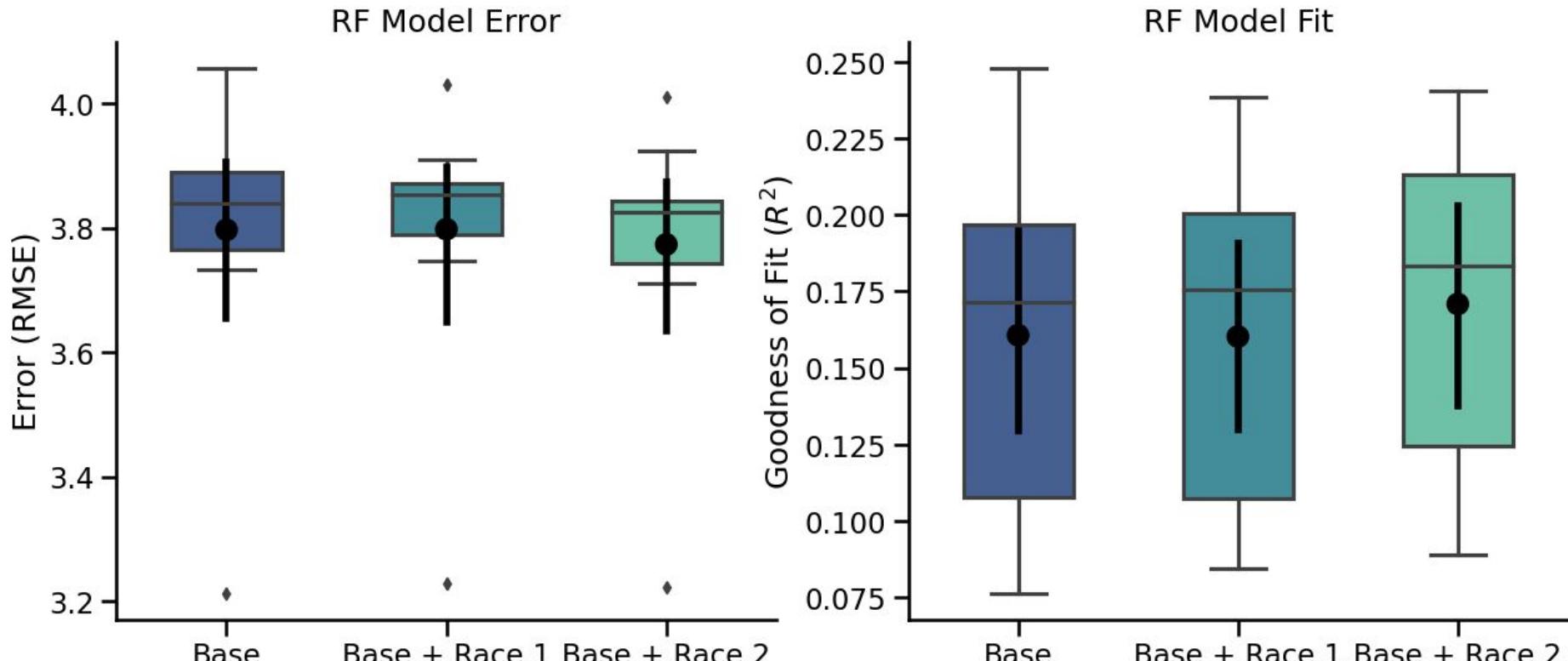
Model Methods

Linear model:

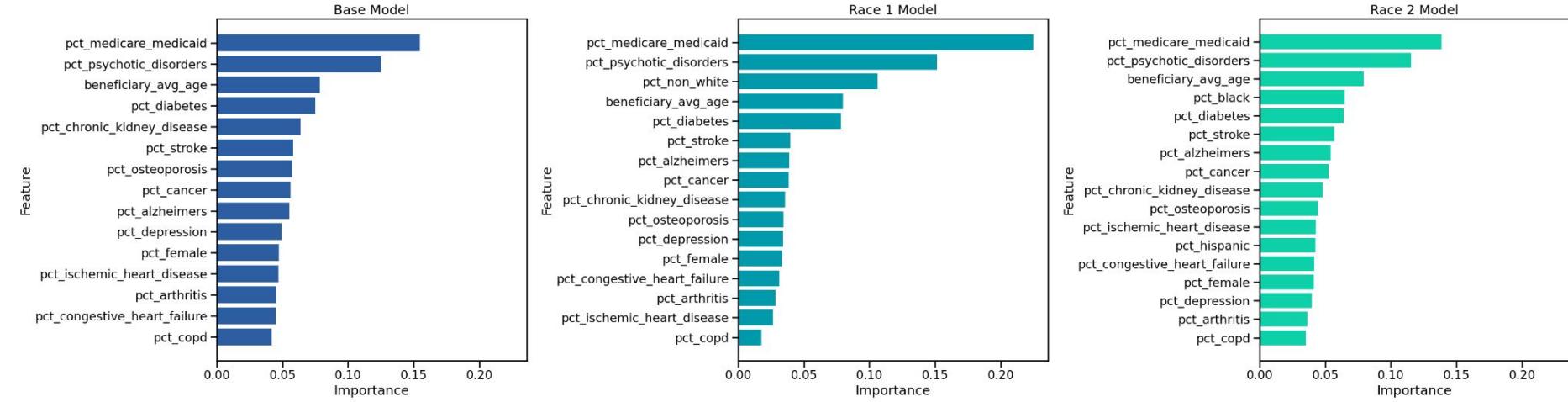
- **Prediction:** Adjusted R² & Root Mean Squared Error (RMSE) were computed using 10-fold cross validation for each condition (hf, pn, copd)
- **Functions used:** statsmodels.ols, sklearn.Kfold

Random Forest:

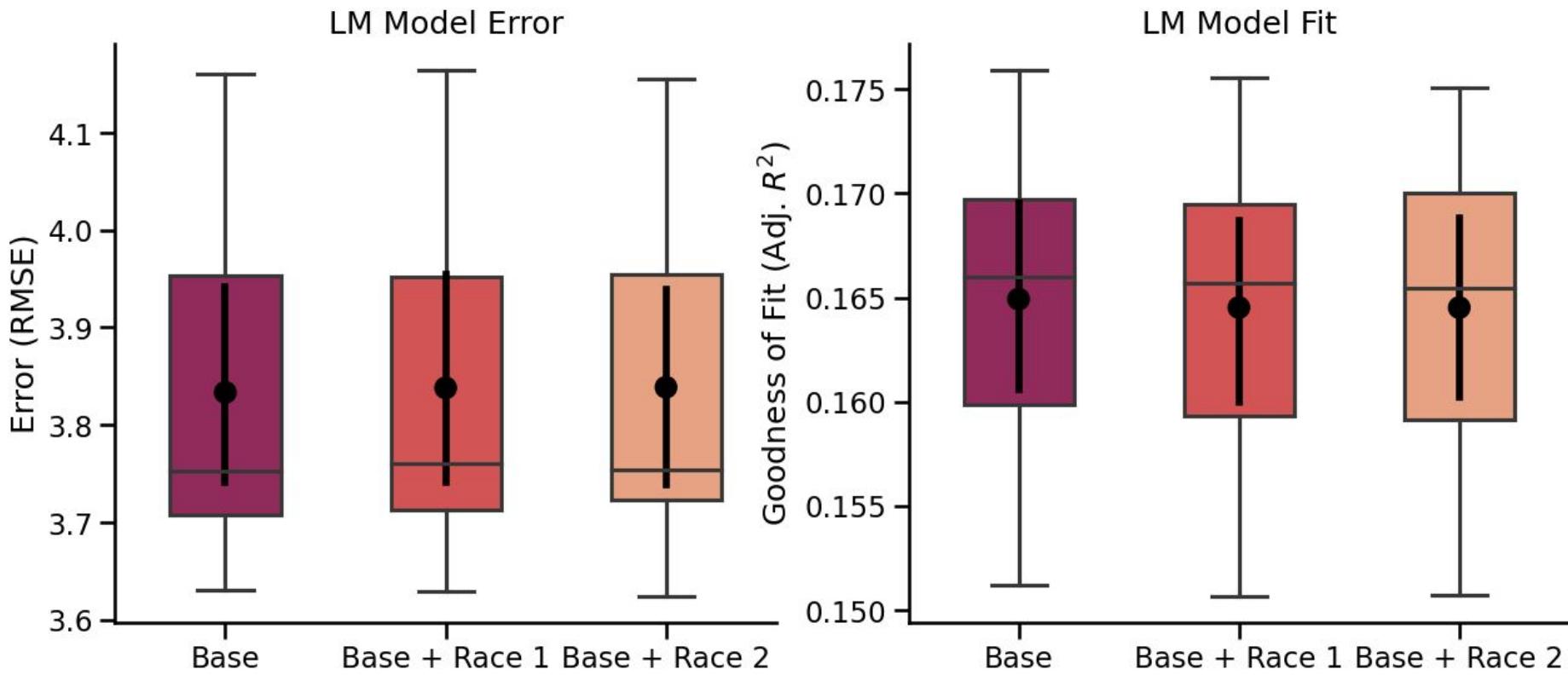
- **Hyperparameter tuning:** number of estimators, tree depth, maximum features, and minimum samples to split and leaf were selected using a grid search with 5-fold cross validation for each condition
- **Prediction:** R² and & RMSE were computed using 10-fold cross validation for each condition
- **Feature analysis:** feature importances were computed for each condition for the model with race included
- **Functions used:** sklearn: RandomForestRegressor, Kfold, GridSearchCV



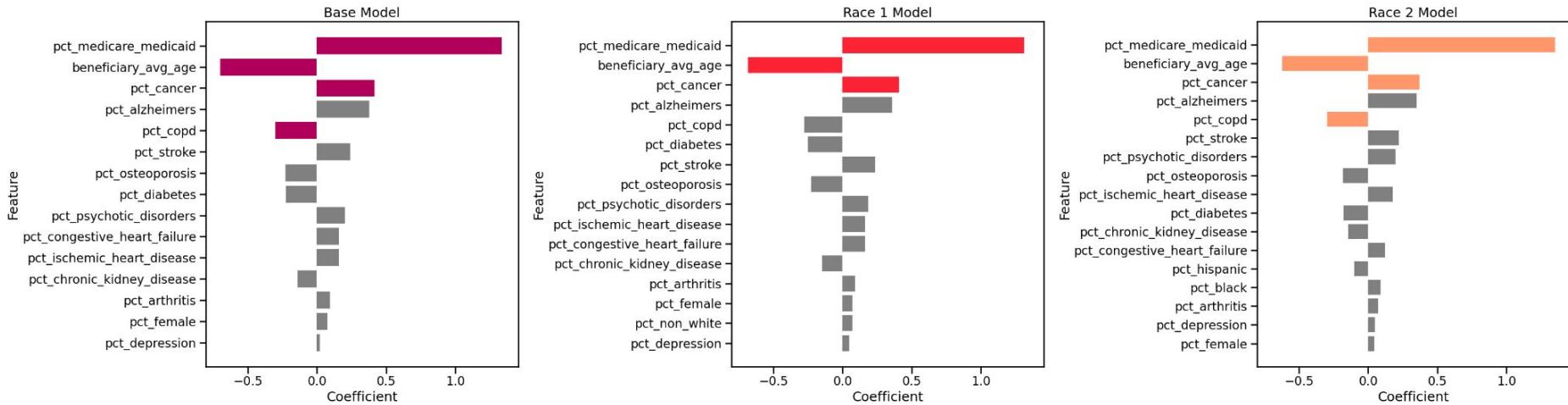
COPD RF model comparison



COPD RF importances

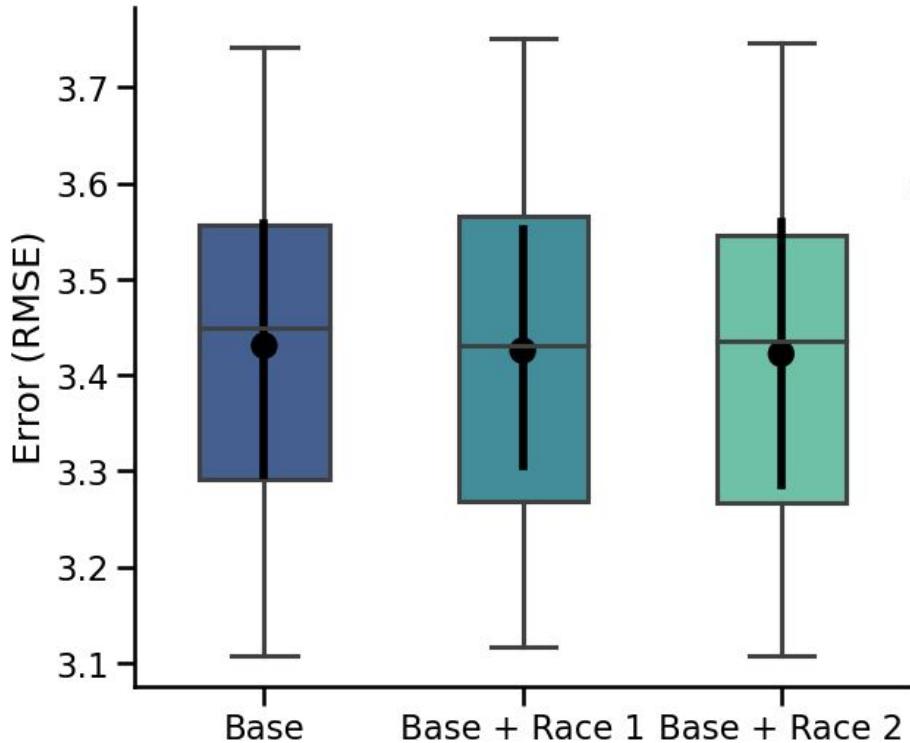


COPD LM model comparison

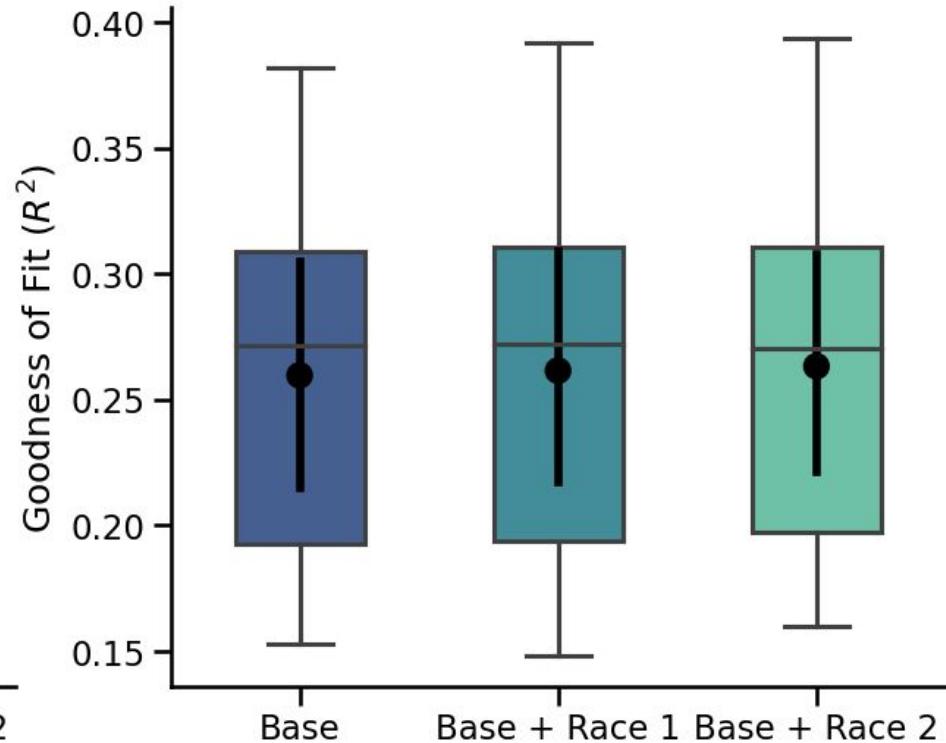


COPD LM model weights

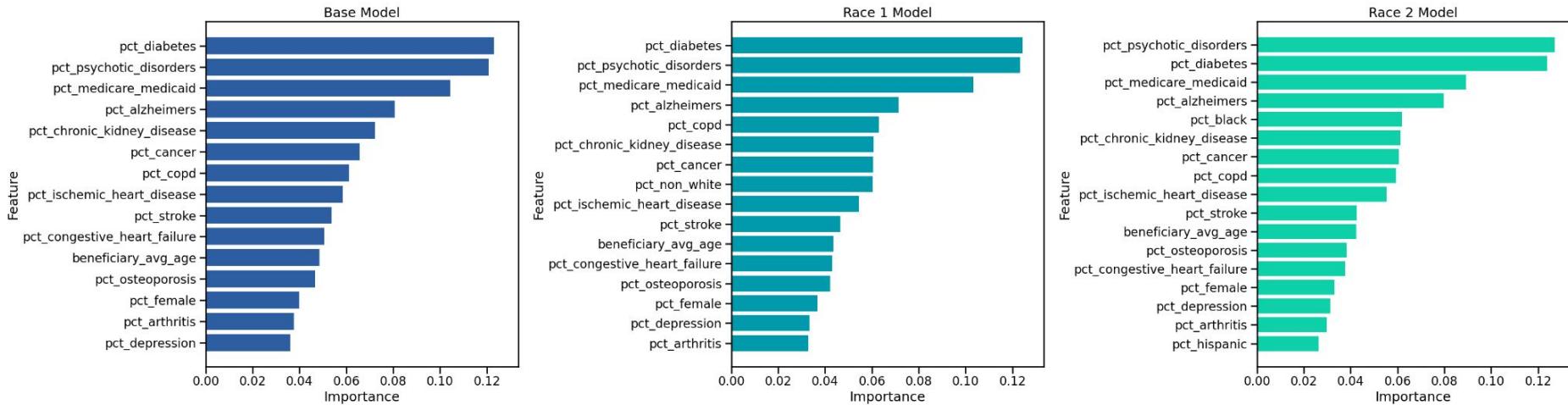
RF Model Error



RF Model Fit

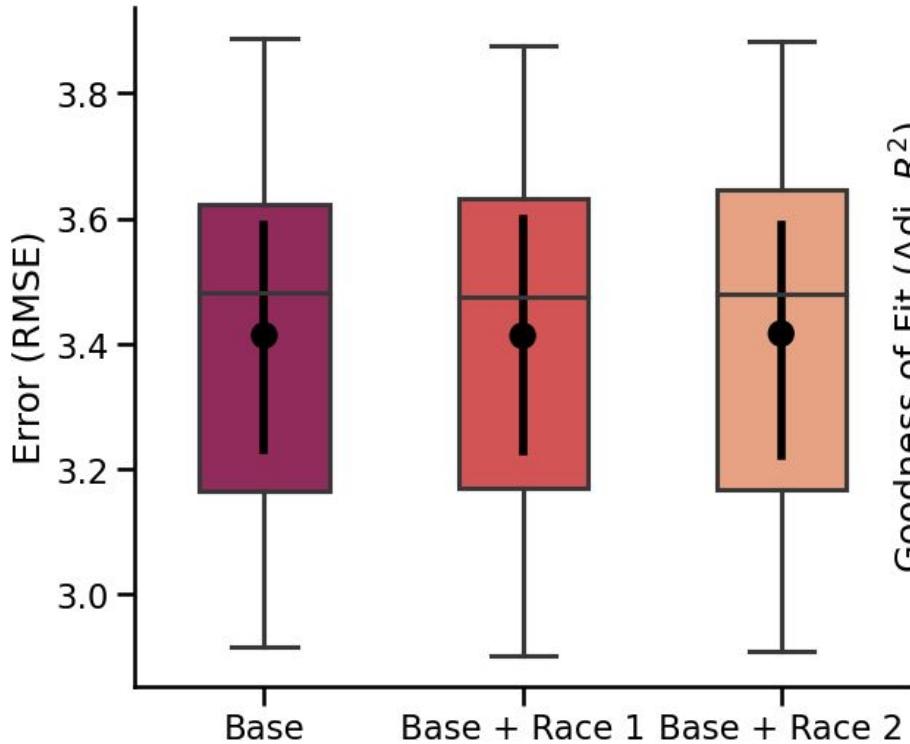


HF RF model comparison

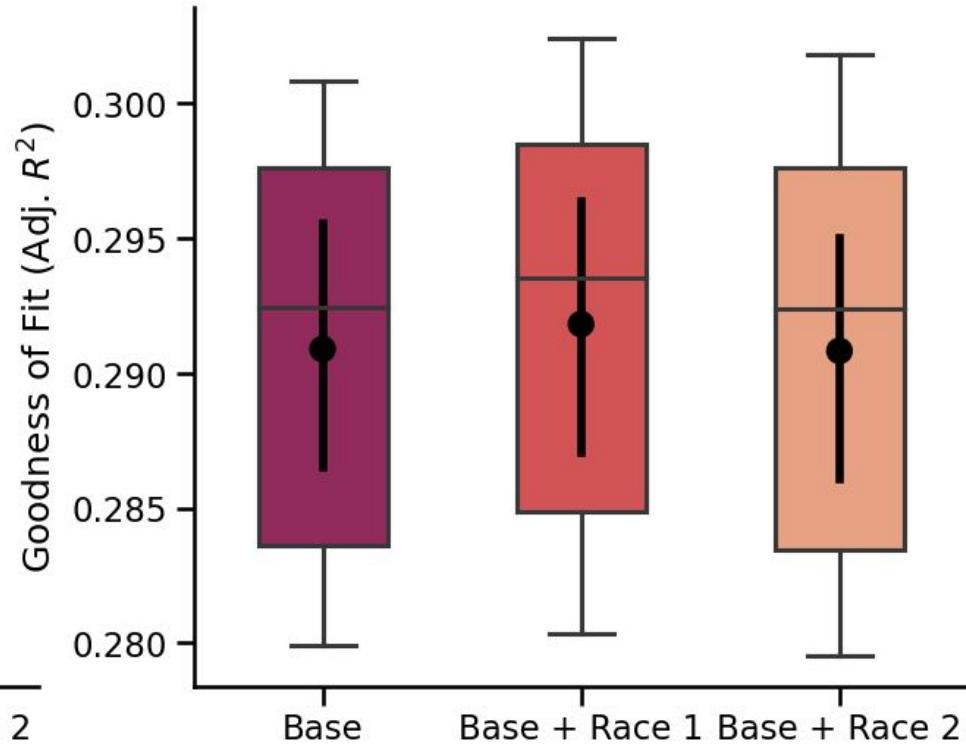


HF RF importances

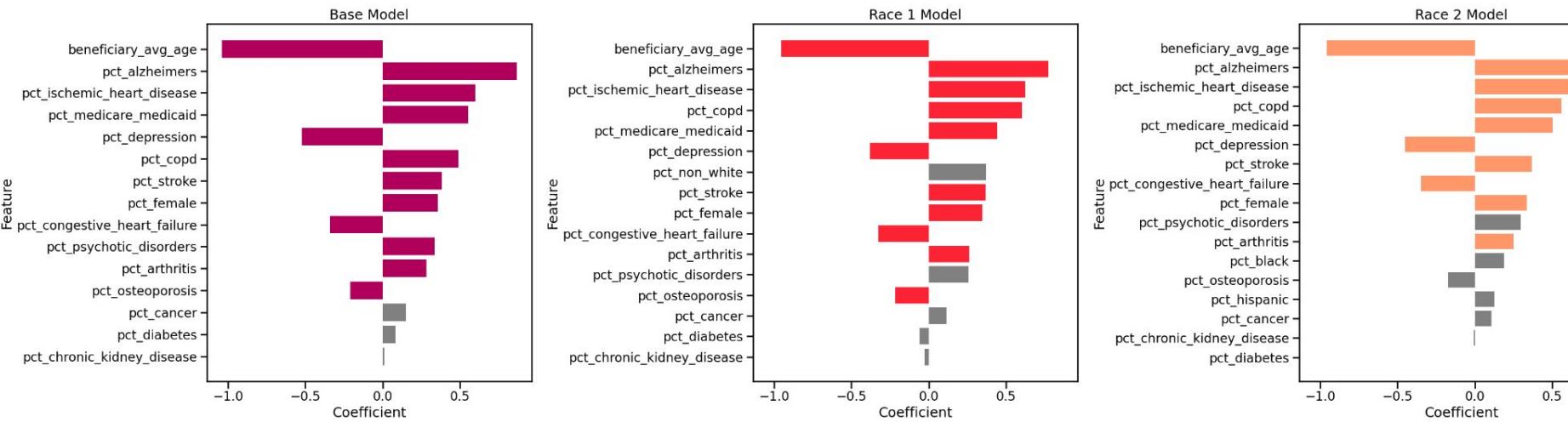
LM Model Error



LM Model Fit

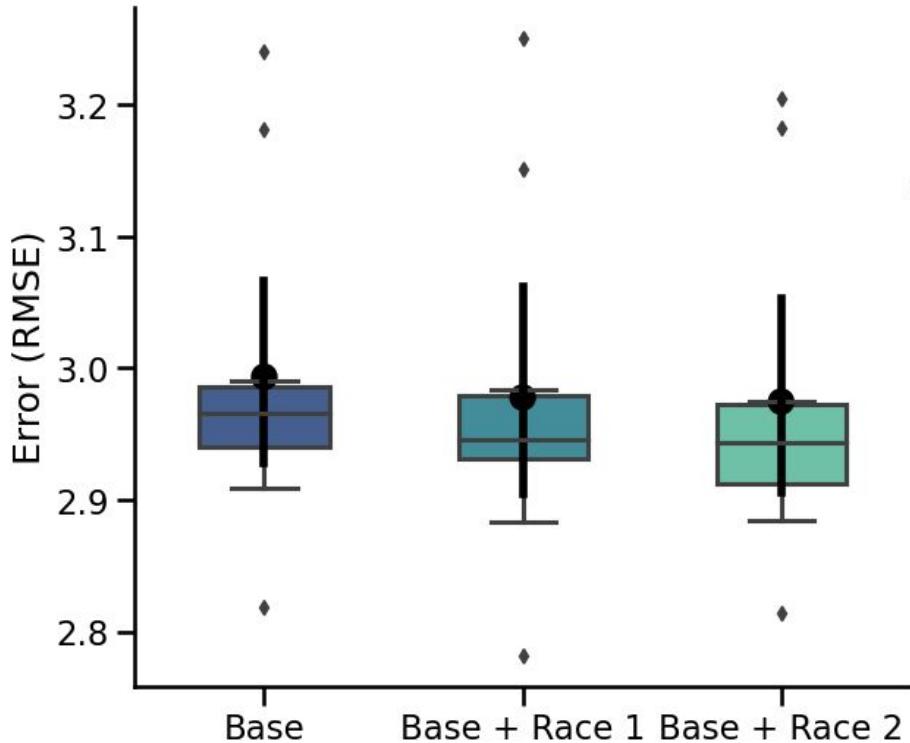


HF LM model comparison

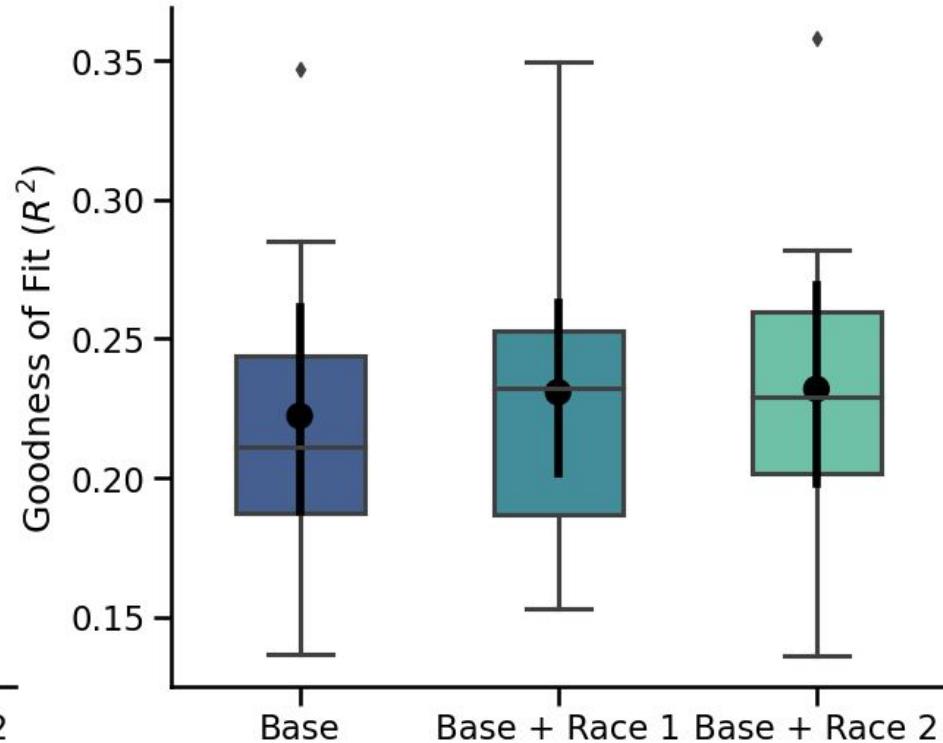


HF LM model weights

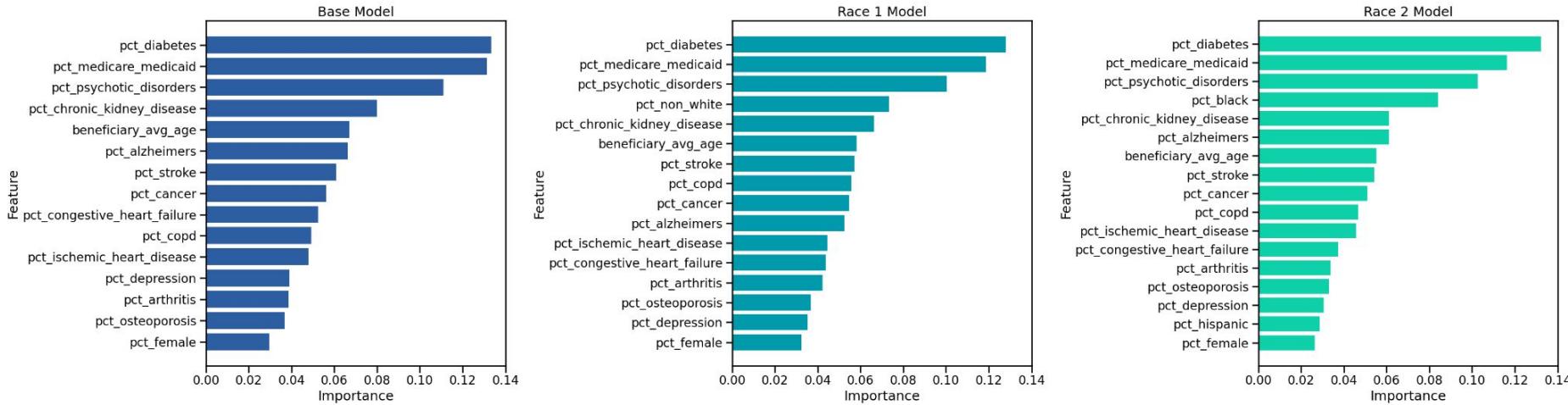
RF Model Error



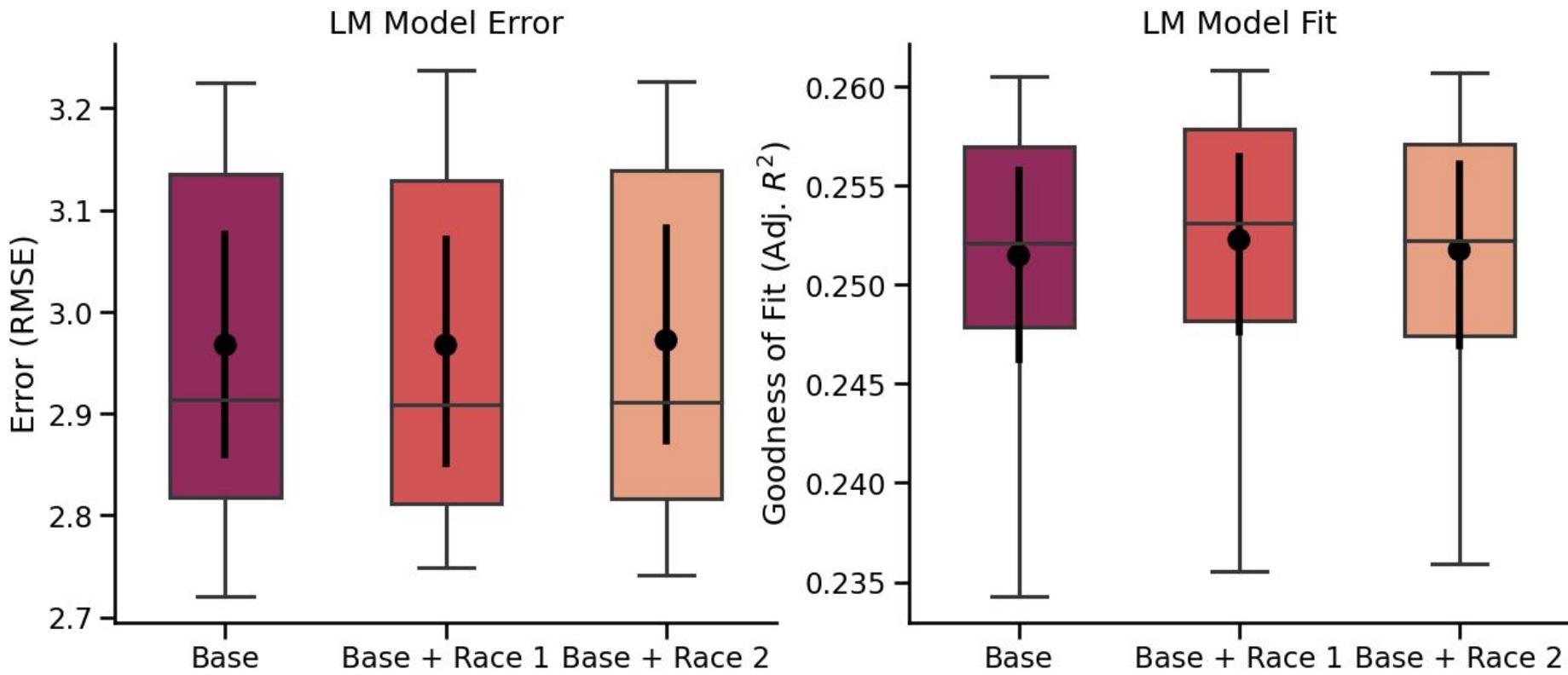
RF Model Fit



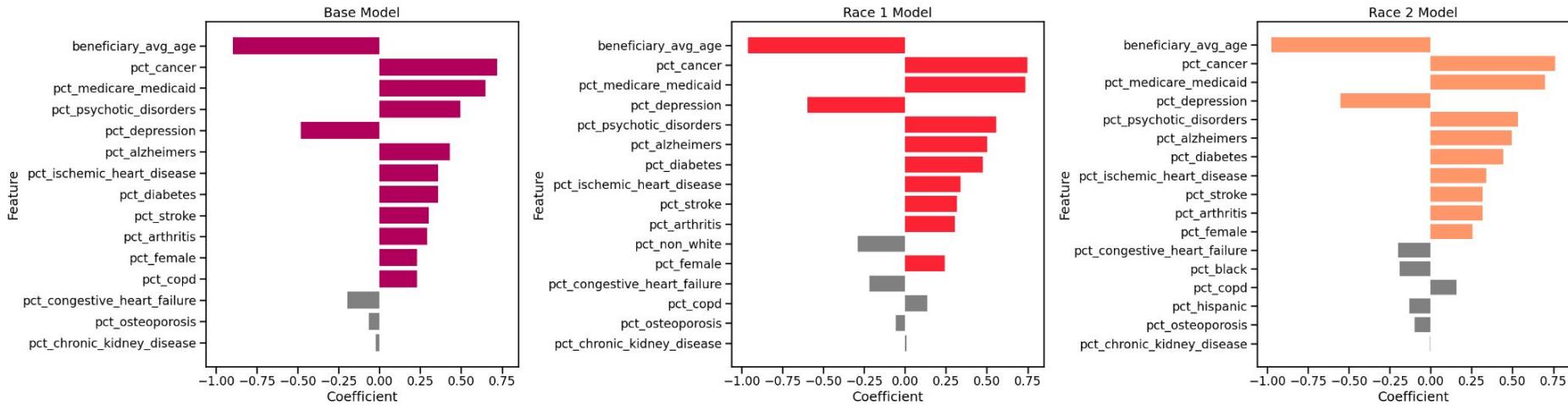
PN RF model comparison



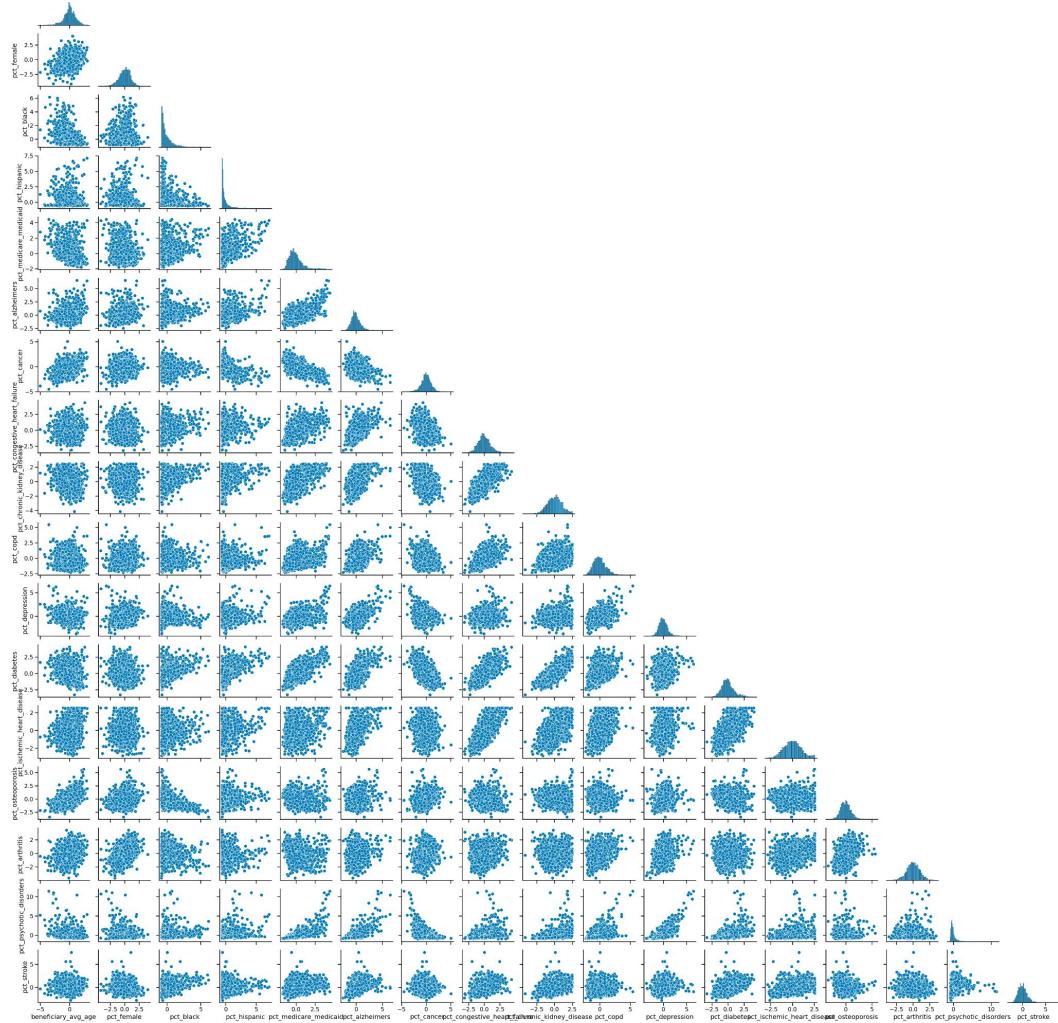
PN RF importances



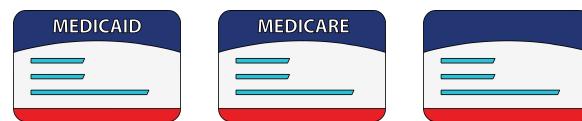
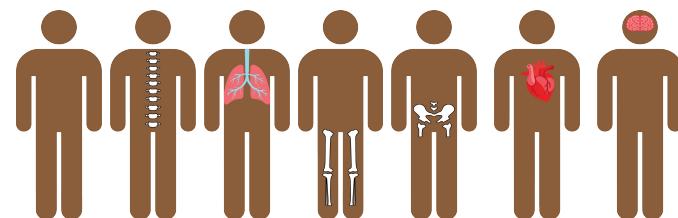
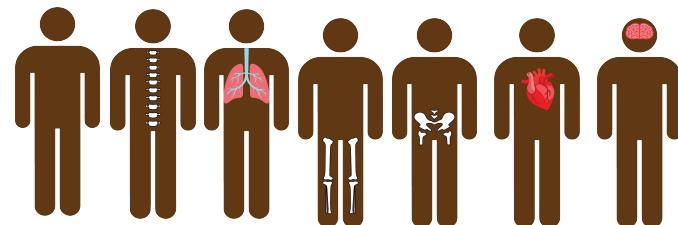
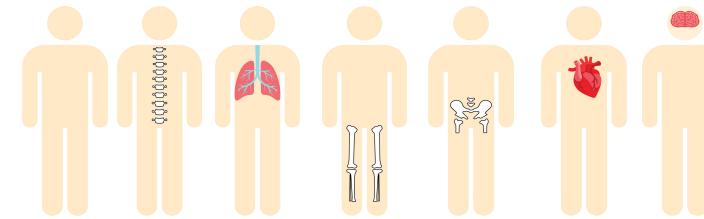
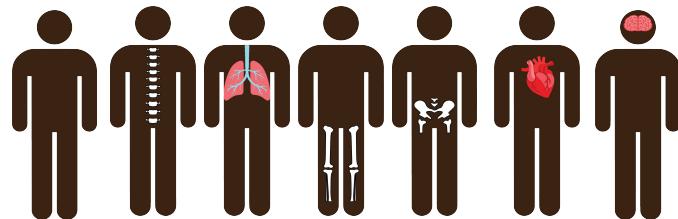
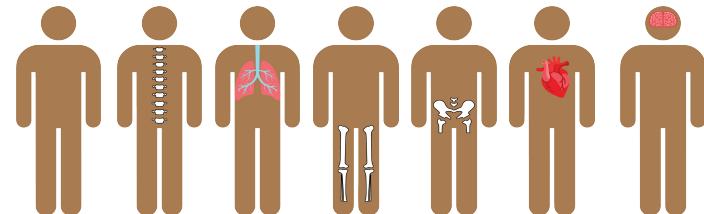
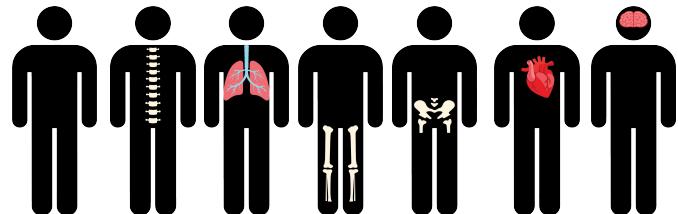
PN LM model comparison



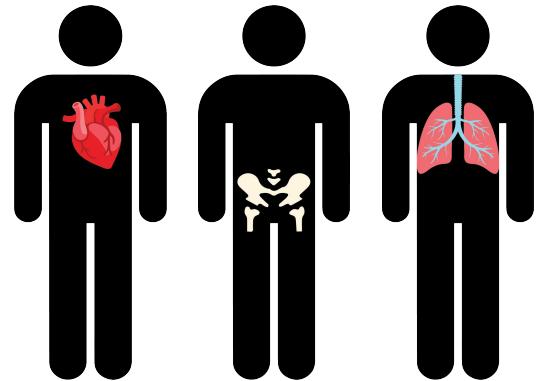
Example data distribution (non-transformed)



Icons



CMS Model:
Patient Mix, Dual Enrollment



Our Model:
CMS Model + Race

