Disclosures

Conflicts of Interest:

No third-party financial support was received in connection with the work reported in this presentation.

Funding Source:

This research was sponsored by Panalgo.

Using the Health Improvement Distribution Index to Inform Equitable Machine Learning: An Example Analysis among Patients with Type 2 Diabetes Mellitus

Thomas Carpenito PhD, Laura Graf MPH, Joy Gulla MPH, Michael Munsell PhD

Panalgo, Boston, MA

Background

- March 2023, ICER introduces Health Improvement Distribution Index (HIDI) to quantify the impact of a treatment on protected classes, including race
- How to use this information in practice when designing predictive algorithms that may impact care decisions?
- Hispanic, Asian, and Black Americans have a higher relative prevalence of type 2 diabetes mellitus (T2DM) than the overall US population
    - HIDI > 1: Equitable access to diabetes care would produce proportionally greater improvements in these subpopulations

Study Objective

Train a machine learning model that predicts T2DM-related hospitalizations and evaluate its performance among protected classes where equal access to care could lower disparities

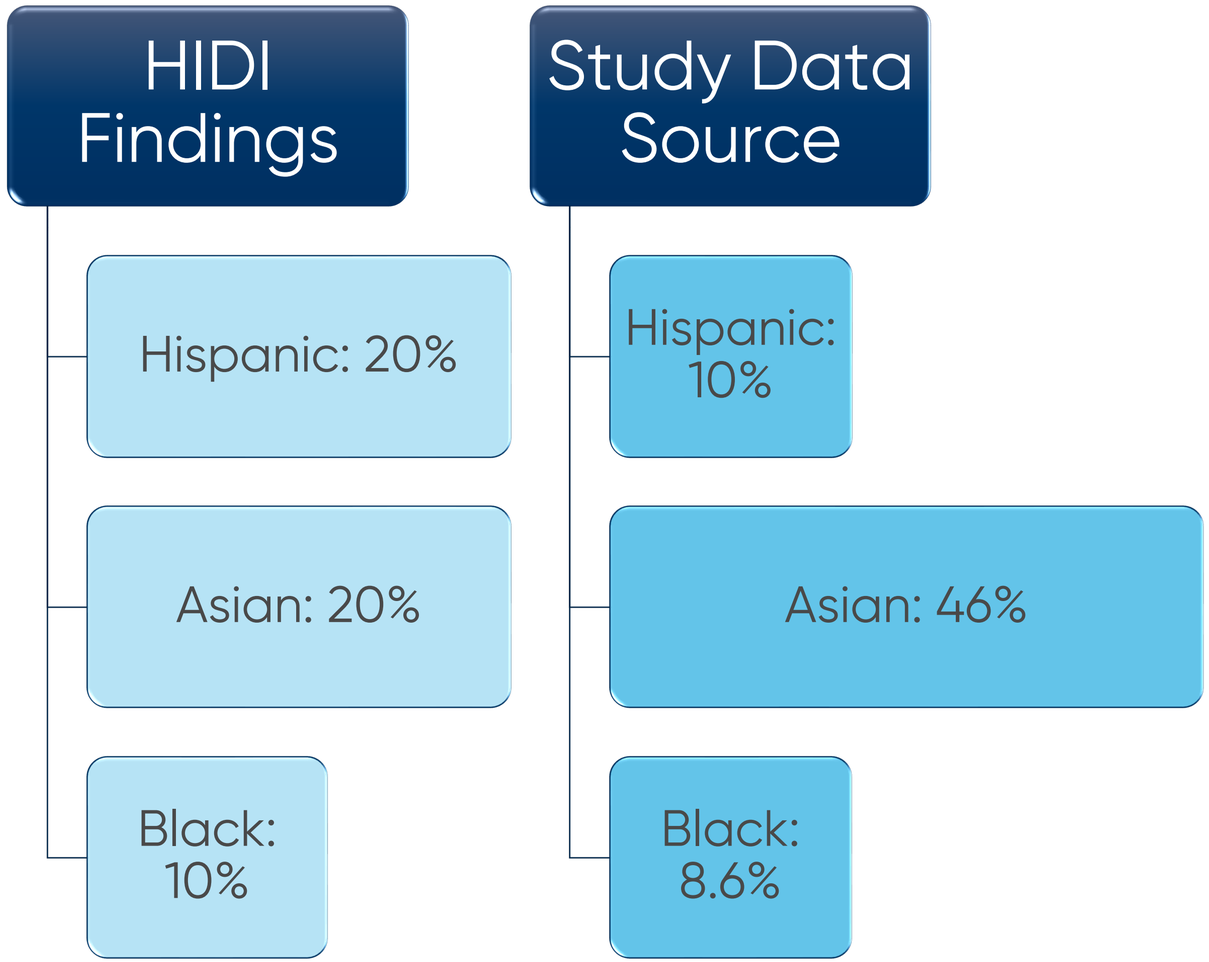
Data Source

Tessa Closed-Claims Database

- Over 170 million covered lives
- De-identified insurance claims composed of commercial, Medicare Advantage, and Medicaid plans
- Data elements include demographics, medical history and diagnoses, in-hospital procedures and medication administrations, prescriptions

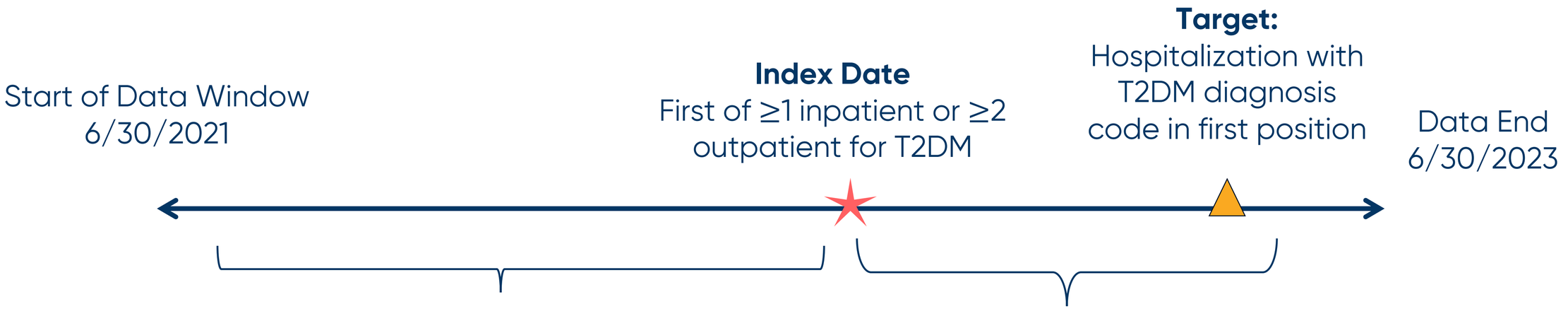
- All analyses were implemented using the **Instant Health Data (IHD)** platform

Data Source: Relative Diabetes Prevalence by Race



Source: https://icer.org/news-insights/press-releases/icer-publishes-evidence-report-on-tirzepatide-for-type-2-diabetes/

Study Design

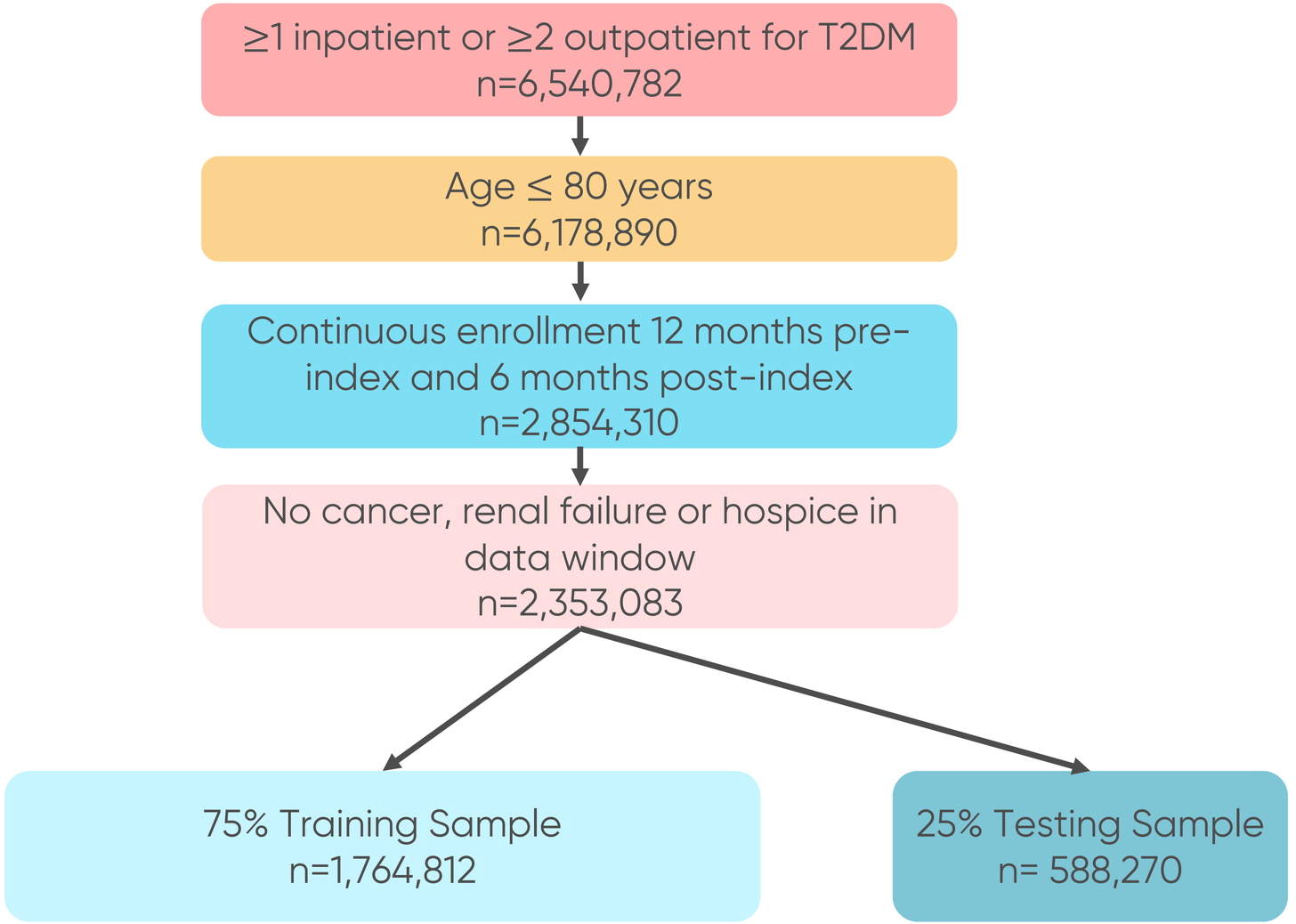


- 12-month baseline (continuous enrollment)
- Age ≤ 80 years
- Age, sex, baseline resource use, diagnoses and procedures

- 6-month follow up (continuous enrollment)

- Patients were excluded if a diagnosis of cancer, renal failure or an encounter for hospice was observed at any point during the study window
- Maternity, elective surgery, and rehabilitation visits excluded from target variable

Study Design



Study Design

Training Sample
Demographic (race not included), baseline diagnoses and procedures included as training features

→ **XGBoost**
T2DM-related hospitalization 6 months post-index

Training Sample
Prevalence of Diabetes Inpatient Hospitalization in Follow up

→ Prediction Threshold >5.48%

Test Sample
Apply trained model

→ False Negative Rate Stratified by Race

→ Compare to HIDI to see if results exacerbate existing disease specific health disparities

Race After Inclusion Criteria Applied

N	2,353,083
Age at Index, Mean (SD)	55.37 (13.29)
Female Sex, N (%)	1,288,312 (54.75%)
Race, N (%)	
Asian	141,352 (6.01%)
Black	302,736 (12.87%)
Caucasian	725,005 (30.81%)
Hispanic	341,363 (14.51%)
Other Race	104,819 (4.45%)
Unknown	737,808 (31.35%)

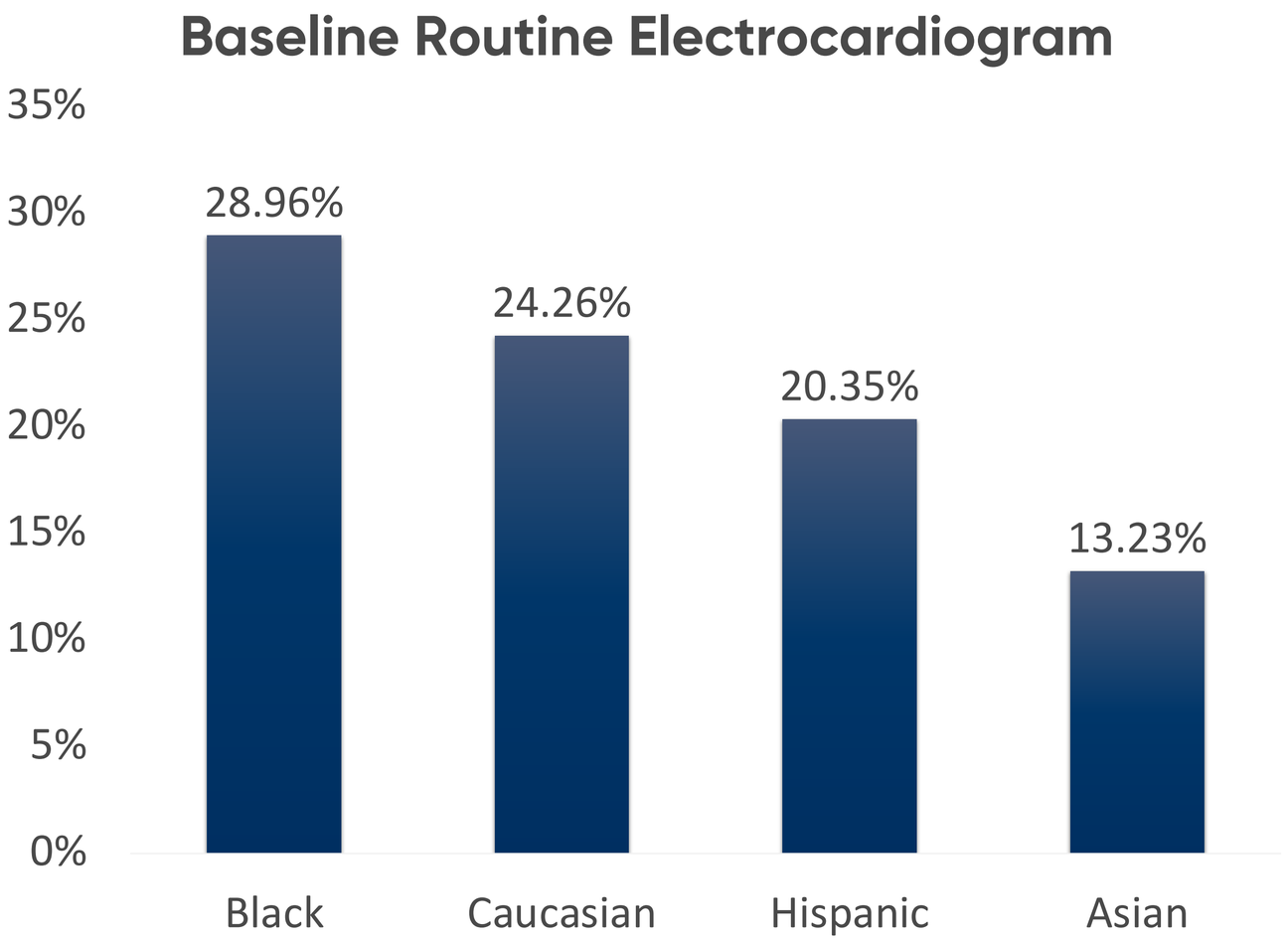
Results: XGBoost Model Discrimination

False Negative by Race

- False negatives (i.e., missing a true hospitalization) presents the most consequential scenario if using algorithm for intervention
- If high false negative rate for protected class with higher disease burden, could exacerbate health inequality

Race	False Negative Rate	HIDI
Overall	33.05%	1
Caucasian	28.88%	1
Black	25.70%	1.1
Hispanic	36.25%	1.2
Asian	49.75%	1.2

Missing Top Features



- Baseline hospitalization (top feature) was less common among Asian and Hispanic patients
- Led to fewer procedures that are helpful in identifying risk and average lower risk scores

How to address?

- With lower average predictions and higher false positives, one simple way is to use race-specific optimal risk thresholds
- Recommended if deploying care management strategies (Hane 2022)

Race	Optimal Youden Index	False Negative Rate	HIDI
Overall	37% (at 0.05)	33.05%	1
Caucasian	38% (at 0.06)	35%	1
Black	38% (at 0.06)	31%	1.1
Hispanic	37% (at 0.04)	29%	1.2
Asian	37% (at 0.03)	30%	1.2

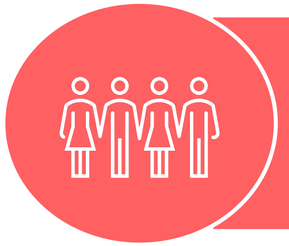
Limitations

- Single model and use case; other models and objectives will have different biases
- Findings may not be generalizable across all conditions
- Many patients with unknown race and potential for inaccurate race data in administrative claims data
- Presented simple case for illustrative purposes; other solutions for addressing biases exist and can be explored (e.g., linking EMR data for additional clinical information)

Conclusion & Next Steps

While Asian and Hispanic patients have a relatively high prevalence of the T2DM, they had lower representation in administrative claims after inclusion criteria

Patients at risk of a future T2DM-related hospitalization had differing baseline healthcare utilization by race, leading to a variation in the rate of false negatives by race



Benchmarks such as the HIDI can be used by researchers to better understand the potential for risk algorithms to exacerbate existing health inequalities for protected classes

Thank You!

Contact:
mmunsell@panalgo.com