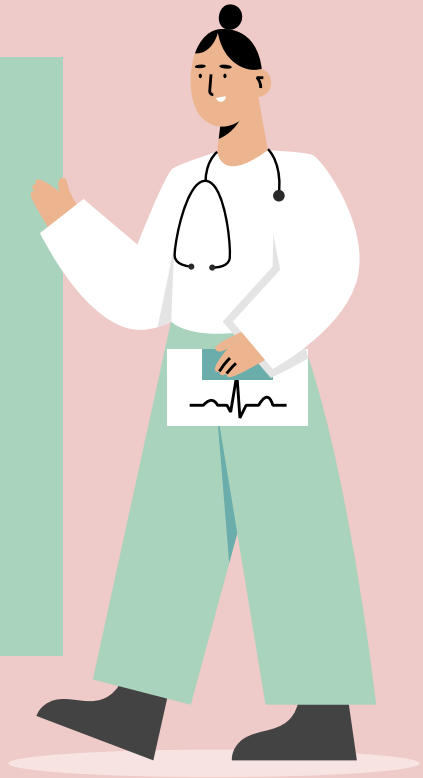
Improving Medical Appointment Attendance

Jocelyn Lau

How can we identify ahead of time patients who might miss their appointments?

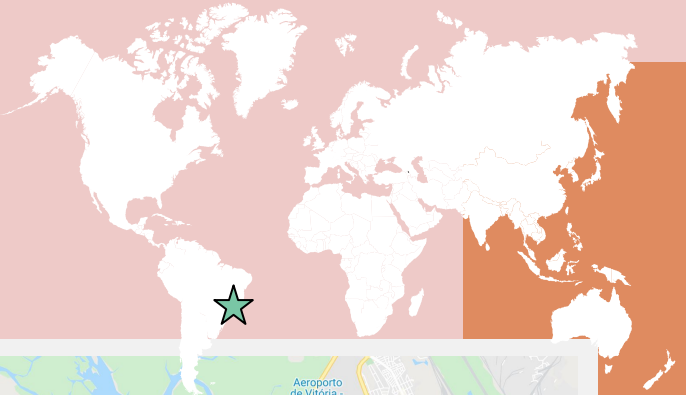


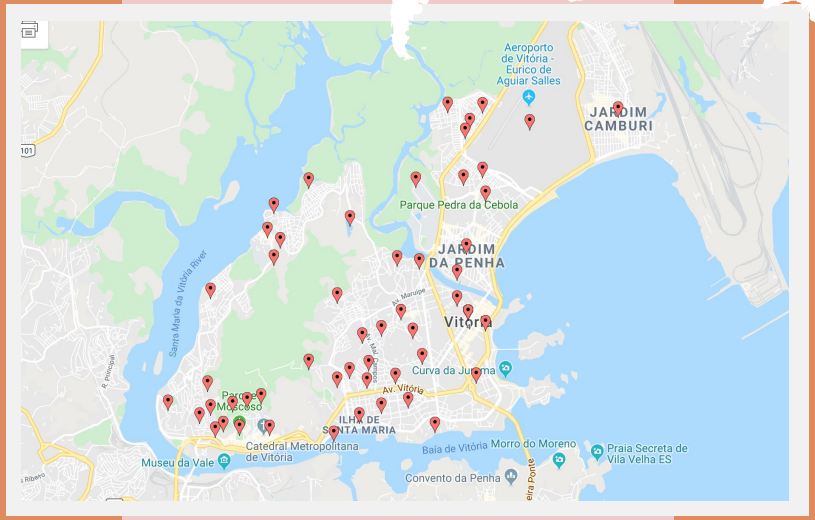
Building a Predictive Model

Medical appointment data from clinics in Vitoria, Brazil

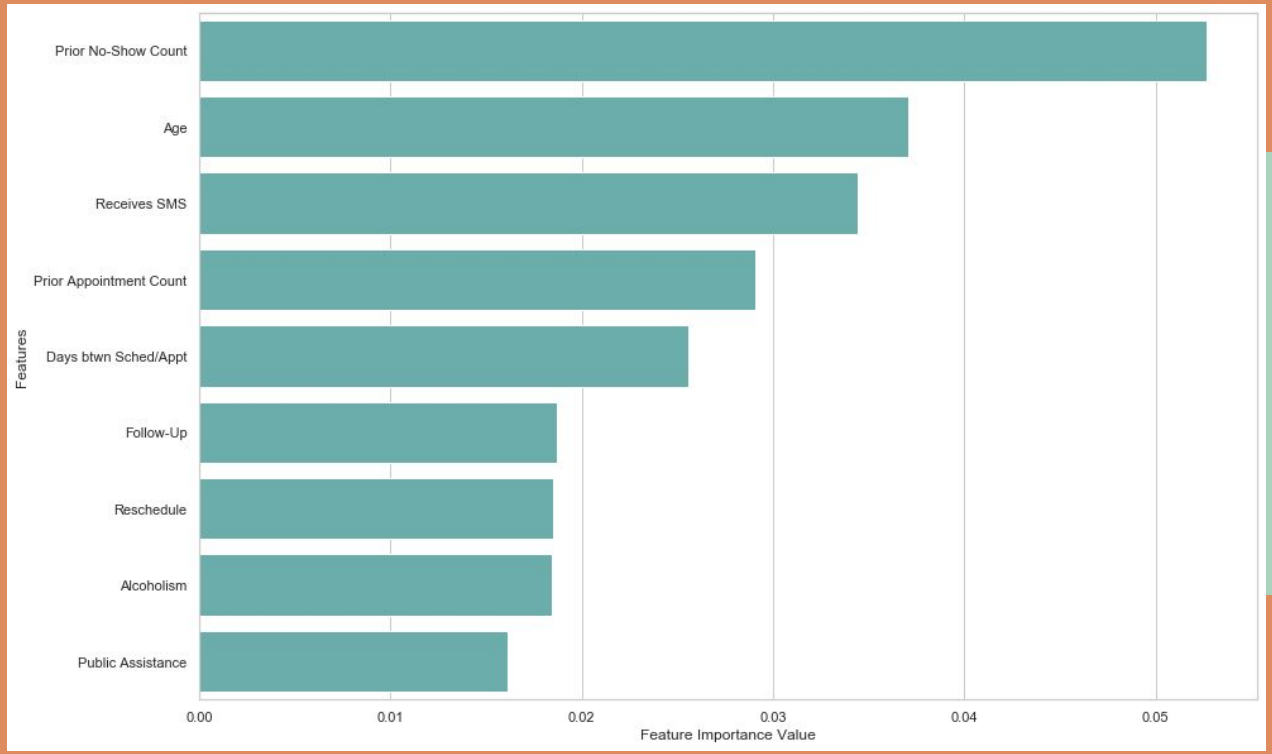
Features:

- Demographics
- Conditions
- Scheduling and appointment dates





sampled neighborhoods in Vitoria, Brazil



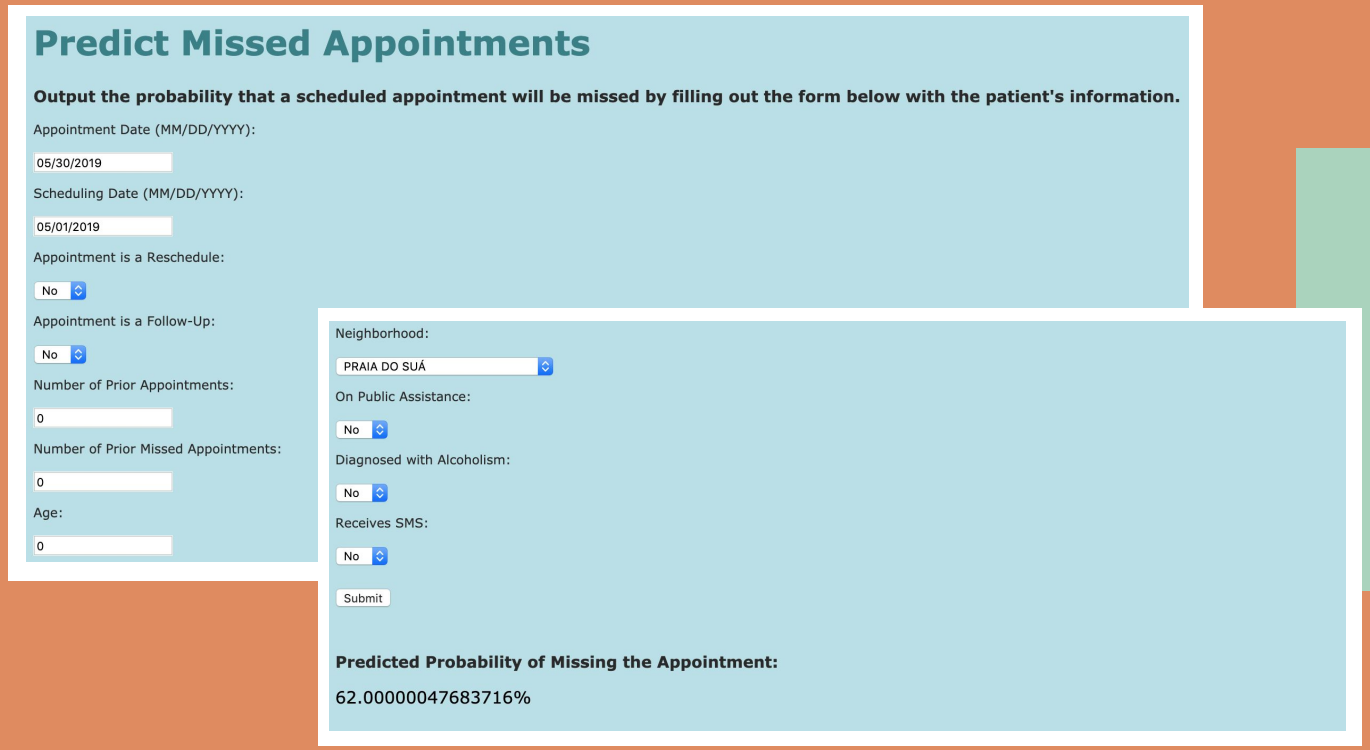
Potential Focus Areas for a Proposed Intervention

Medical Appointment Attendance Management

Welcome to your medical appointment attendance management app!

Are you concerned your patients are missing their scheduled appointments?
Use me to help improve your clinic's attendance rate.

What would you like to do?
1. Predict the probability of a missed appointment
2. Calculate the budget impact of an intervention to improve attendance



Predict Missed Appointments

Appointment Management Cost Impact Calculator

Introduction

Purpose:

To estimate the cost impact of an intervention to improve appointment attendance by converting predicted missed appointments into attended appointments. This calculator takes a group of appointments, estimates the predicted no-show rates, and calculates financial gain or loss based on the cost of the appointment and intervention.

Assumptions:

- The intervention used here assumes 100% effectiveness. The intervention is determined by the user (e.g. a telephone reminder system).

Methods:

- The calculated actual no-show rate is based on historical tre
- The predicted no-show rate is based on the back-end model

Inputs:

- Total Number of Appointments: The number of appointment
- Intervention Cost ($): The per-appointment cost of the prop
- Appointment Cost ($): The dollar value of one appointment
- Threshold: The tolerance level for accurately predicting miss
  lower recall and higher precision. See figure below for the pi

itment).

ed appointment)

l lower precision. A value closer to 1 indicates

Inputs

Total Number of Appointments

1000.0

Intervention Cost ($)

10.0

Appointment Cost ($)

30.0

Threshold

0.5

Submit

Cost Impact Calculator

Threshold

0.5

Submit

Base Case (Do Nothing) Scenario:

Appointment Type	Number of Appointments	Total Gain/Loss ($)[1]
No show	283	-8485.19
Attend	717	21514.81
Total	**1000**	**13029.62**

[1]Number of Appointments x Appointment Cost

Intervention Scenario:

Predicted Appointment Type	Actual Appointment Type	% of Total	Number of Appointments	Intervention Cost ($)[1]	Appointment Gain/Loss ($)[2]	Total Gain/Loss ($)[3]
No show	No show	16.0%	160	-1601.37	4804.11	3202.74
No show	Attend	27.0%	267	-2667.64	8002.92	5335.28
Attend	No show	12.0%	123		-3681.07	-3681.07
Attend	Attend	45.0%	450		13511.89	13511.89
Total		**100.0%**	1000	**-4269.01**	**22637.85**	**18368.84**

[1]Number of Predicted Appointments x Intervention Cost
[2]Number of Appointments x Appointment Cost
[3]Appointment Gain/Loss - Intervention Cost

Total $ in the Base Case Scenario:	13029.62
Total $ in the Intervention Scenario	18368.84
$ Difference	**5339.219999999999**

Cost Impact Calculator

Cost Impact Calculator

Threshold

0.6

Submit

Base Case (Do Nothing) Scenario:

Appointment Type	Number of Appointments	Total Gain/Loss ($)[1]
No show	283	-8485.19
Attend	717	21514.81
Total	**1000**	**13029.62**

[1]Number of Appointments x Appointment Cost

Intervention Scenario:

Predicted Appointment Type	Actual Appointment Type	% of Total	Number of Appointments	Intervention Cost ($)[1]	Appointment Gain/Loss ($)[2]	Total Gain/Loss ($)[3]
No show	No show	7.000000000000001%	71	-709.91	2129.73	1419.82
No show	Attend	8.0%	84	-836.94	2510.82	1673.88
Attend	No show	21.0%	212		-6355.46	-6355.46
Attend	Attend	63.0%	633		19003.99	19003.99
Total		**100.0%**	1000	**-1546.85**	**17289.08**	**15742.23**

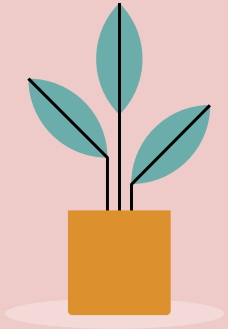
[1]Number of Predicted Appointments x Intervention Cost
[2]Number of Appointments x Appointment Cost
[3]Appointment Gain/Loss - Intervention Cost

Total $ in the Base Case Scenario:	13029.62
Total $ in the Intervention Scenario	15742.23
$ Difference	**2712.6099999999988**

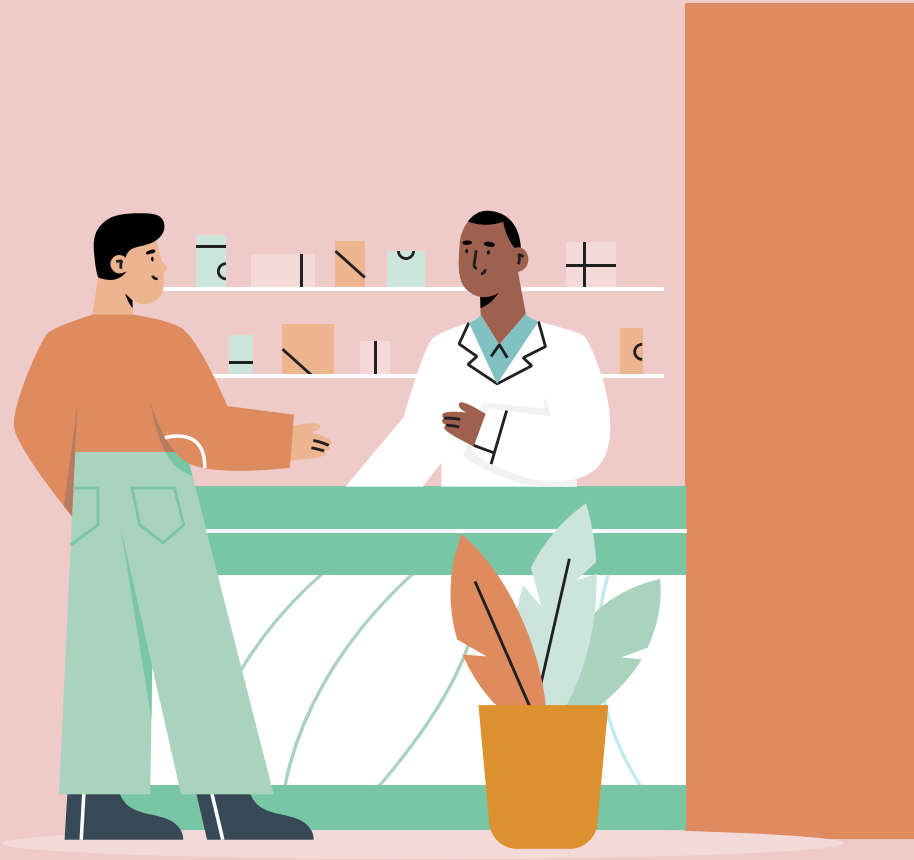
Moving Forward

- Determine a targeted approach based on considerations like intervention cost
- Design an intervention that accounts for:
  - History of missed appointments
  - Age
  - Timing of appointment

Thank You



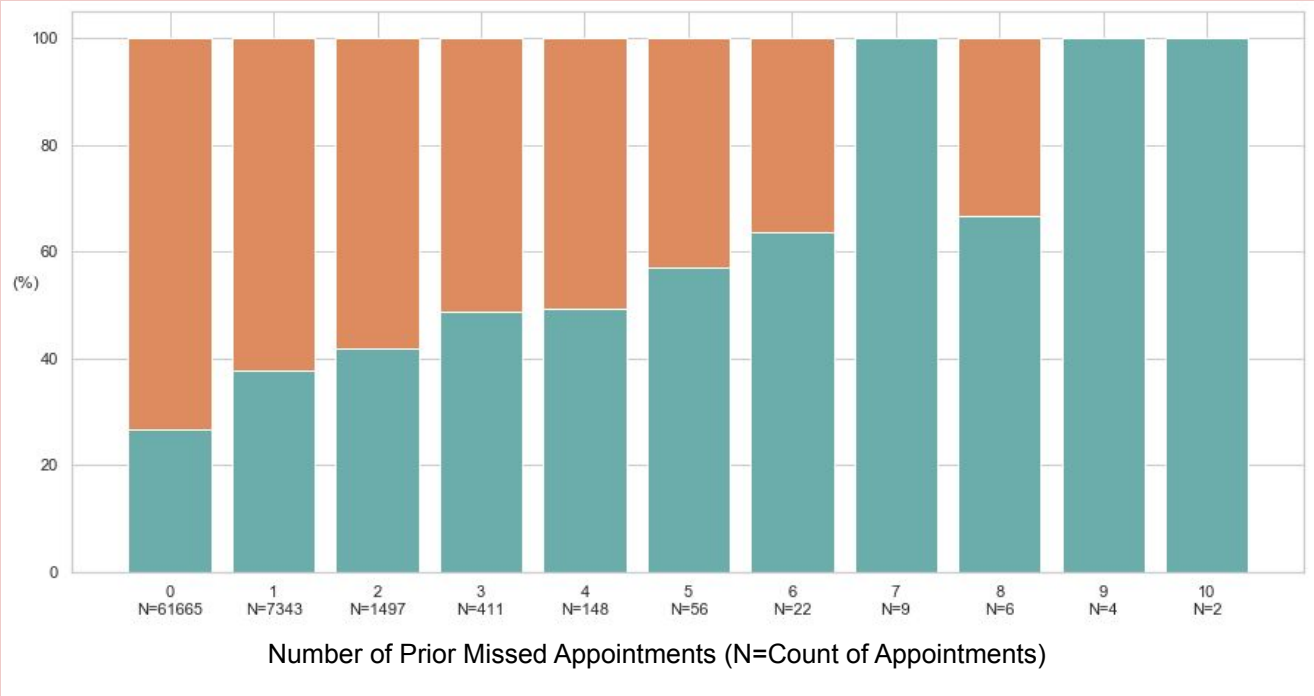
Appendix



Missed Medical Appointments are a Problem

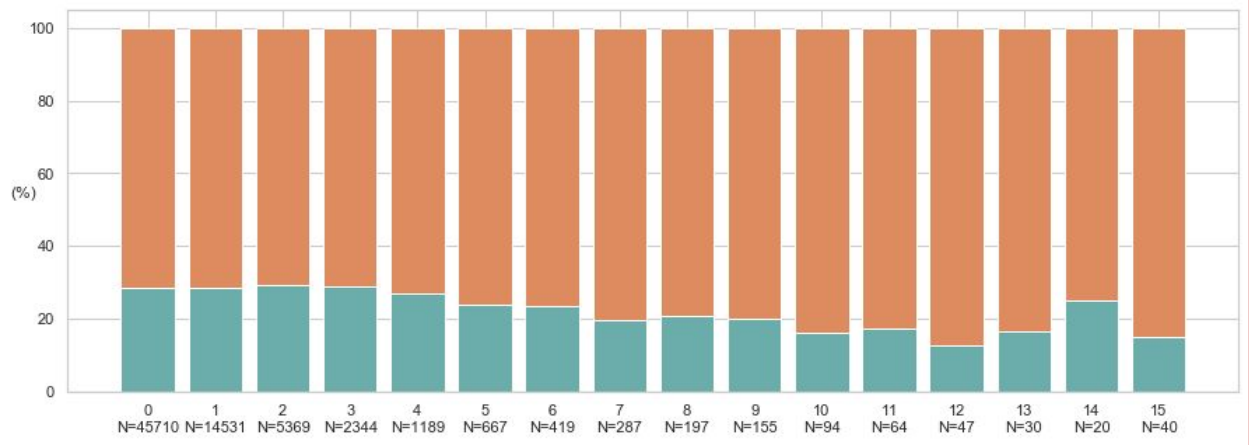
- Patient may not be getting care they need
- Patient may get worse if they don’t keep up with regular appointments
- Missed appointments are lost revenue for the clinic

Missed Appointment Rate by Number of Prior Missed Appointments

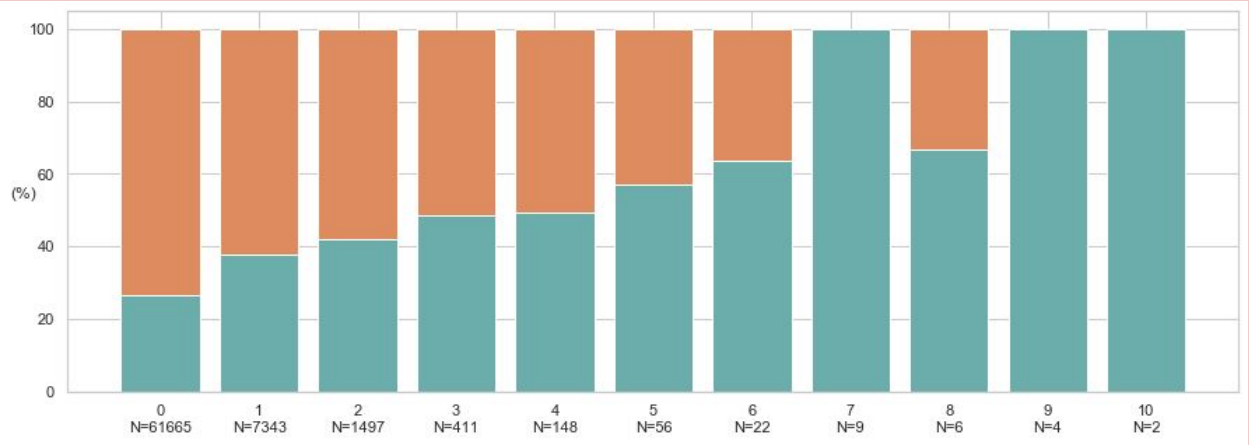


28.3% of All Scheduled Appointments were Missed

Missed Appointment Rate by Number of Prior Scheduled Appointments



Missed Appointment Rate by Number of Prior Missed Appointments

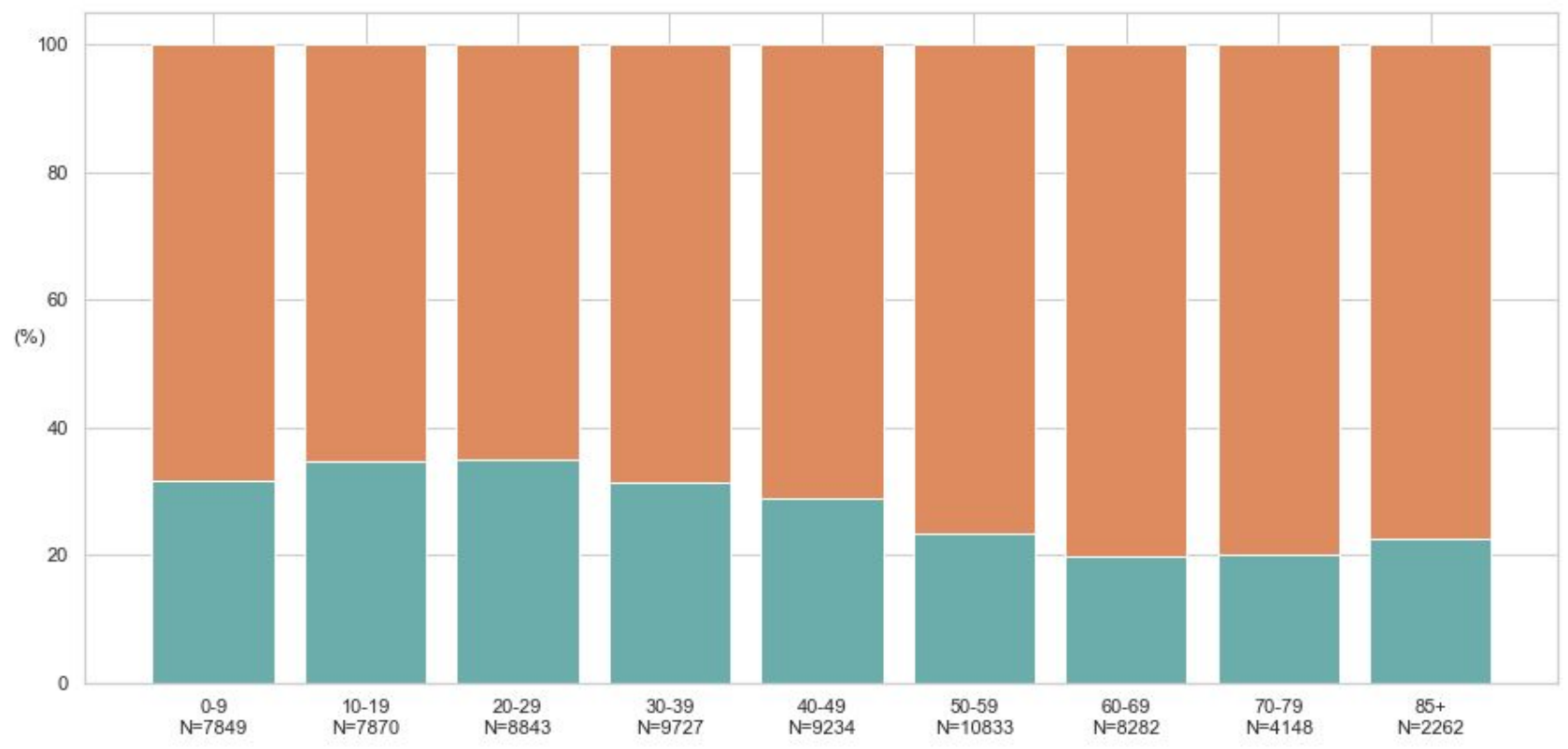


28.3% of All Scheduled Appointments were Missed

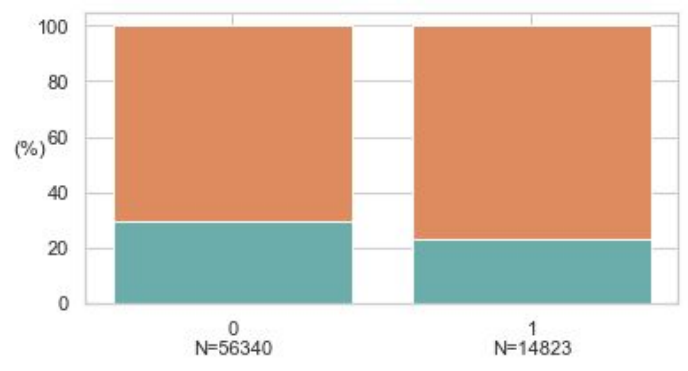
Attended

Missed

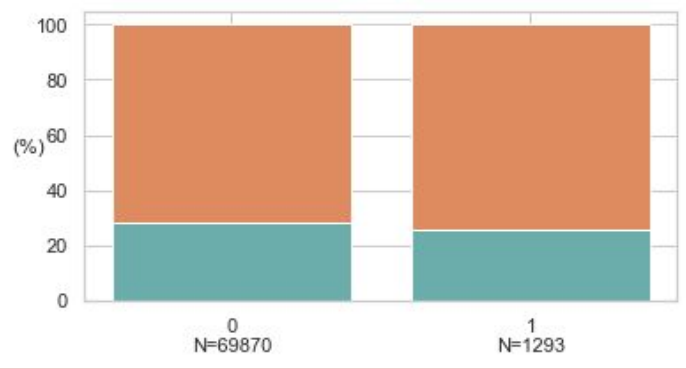
Missed Appointment Rate by Age Group



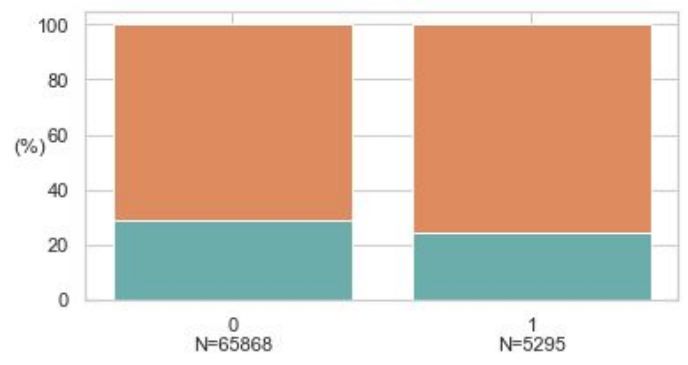
Missed Appointment Rate by Conditions



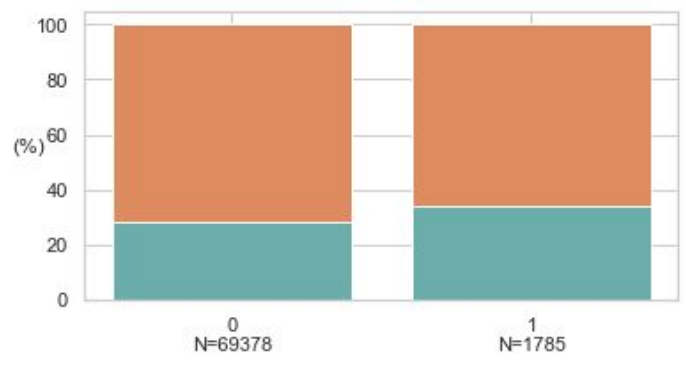
Hypertension



Handicap

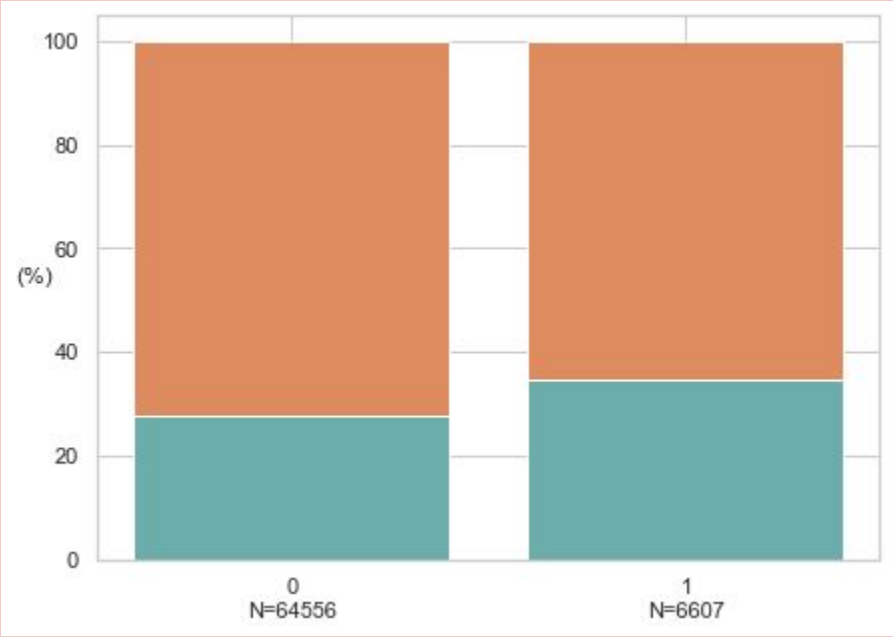


Diabetes



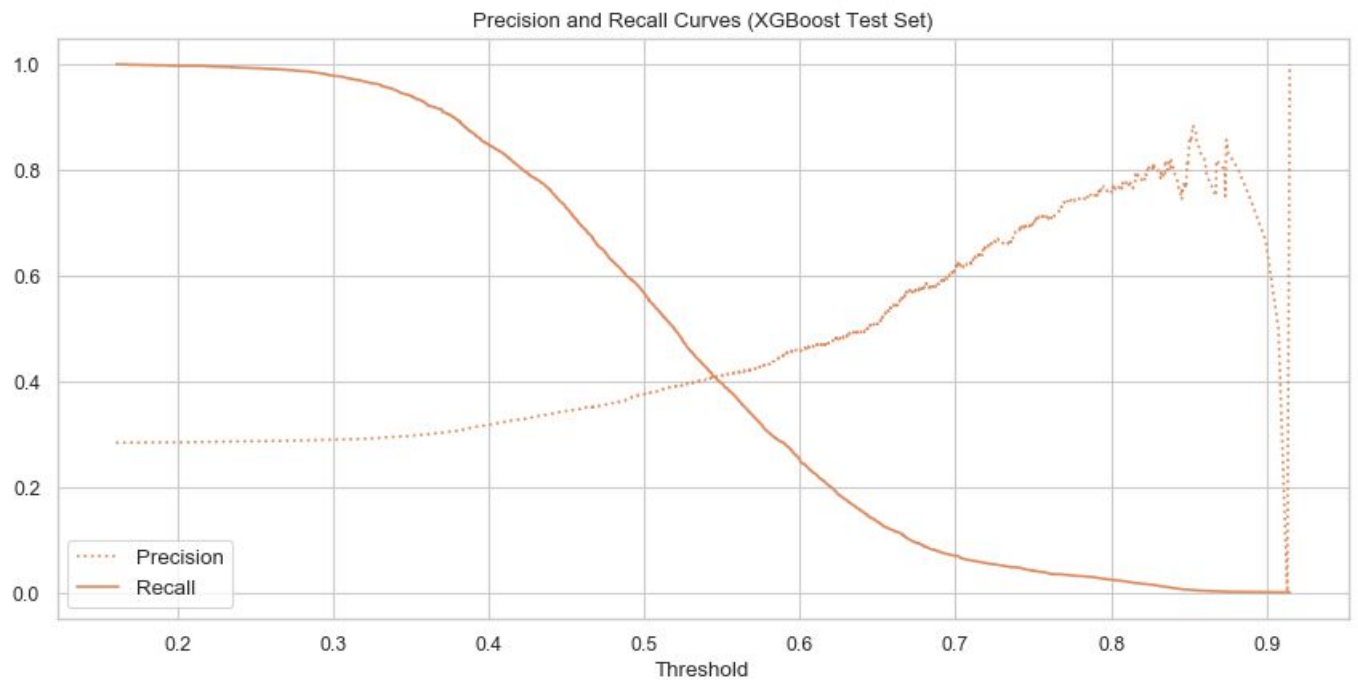
Alcoholism

Missed Appointment Rate by Public Assistance Status



XGBoost Model Performance

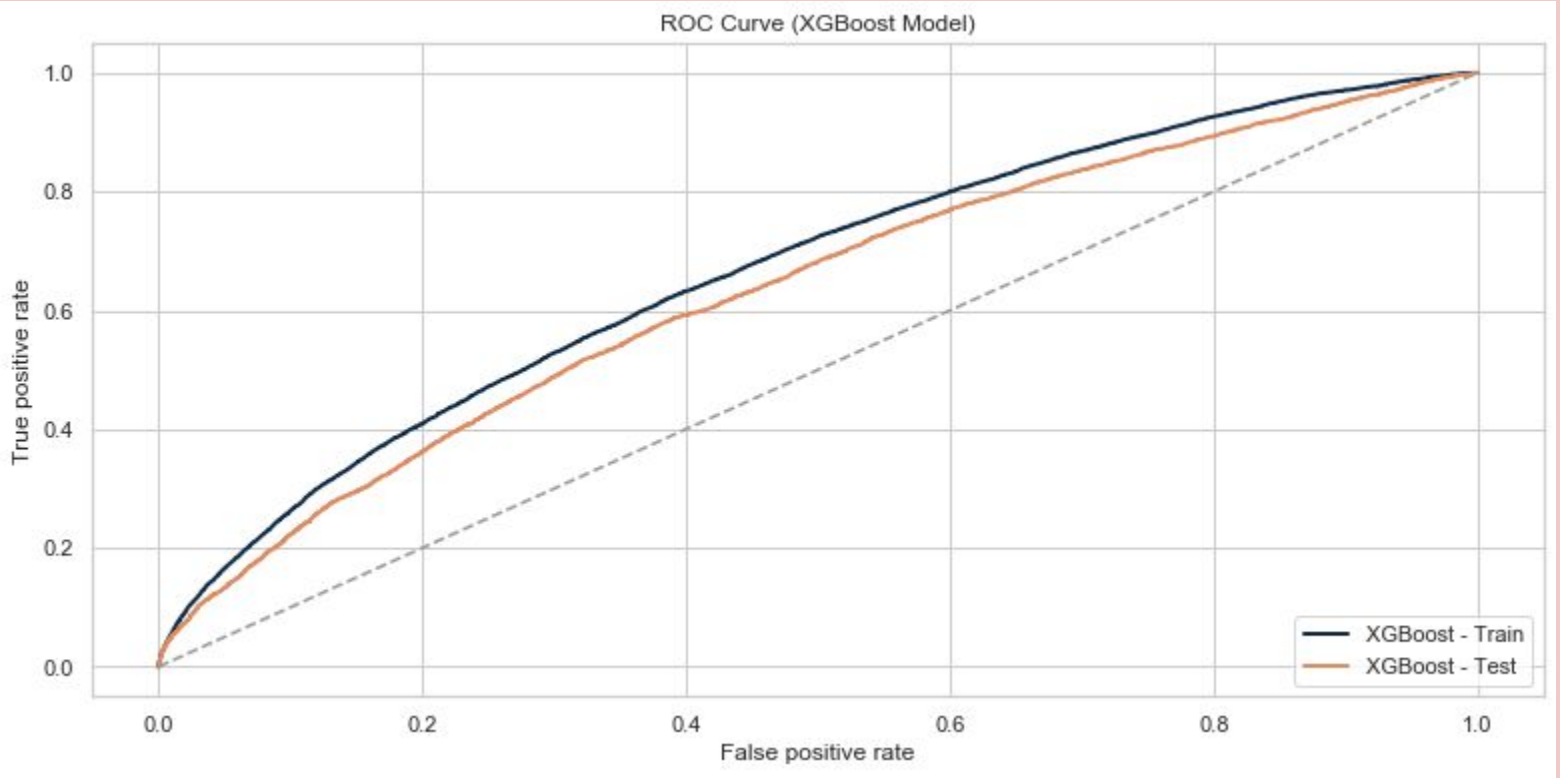
	Train	Test
Recall	0.600	0.566
Precision	0.620	0.375
F1	0.610	0.451
Accuracy	0.616	0.611
AUC	0.666	0.633



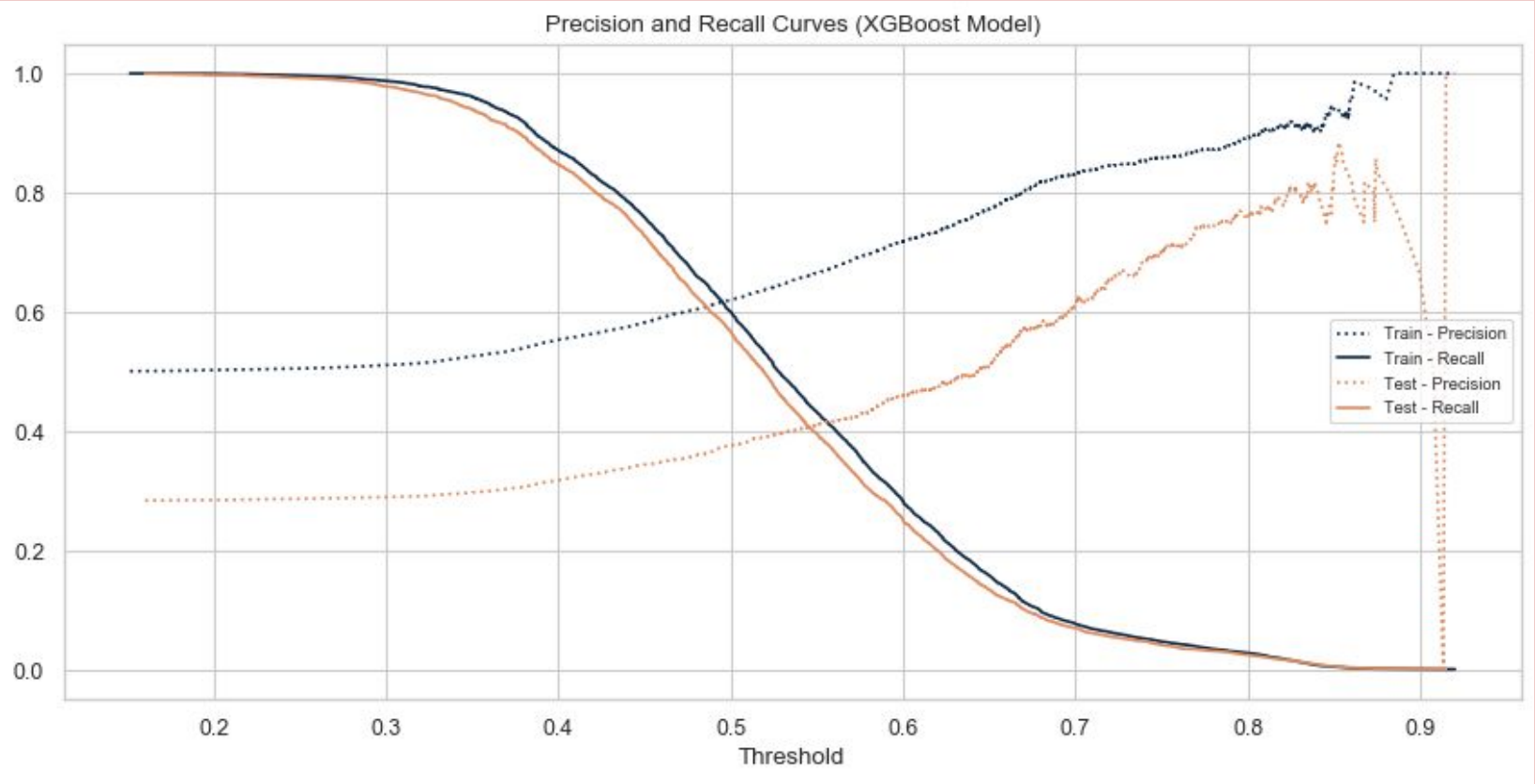
50% Threshold:

Recall	56.6%
Precision	37.5%

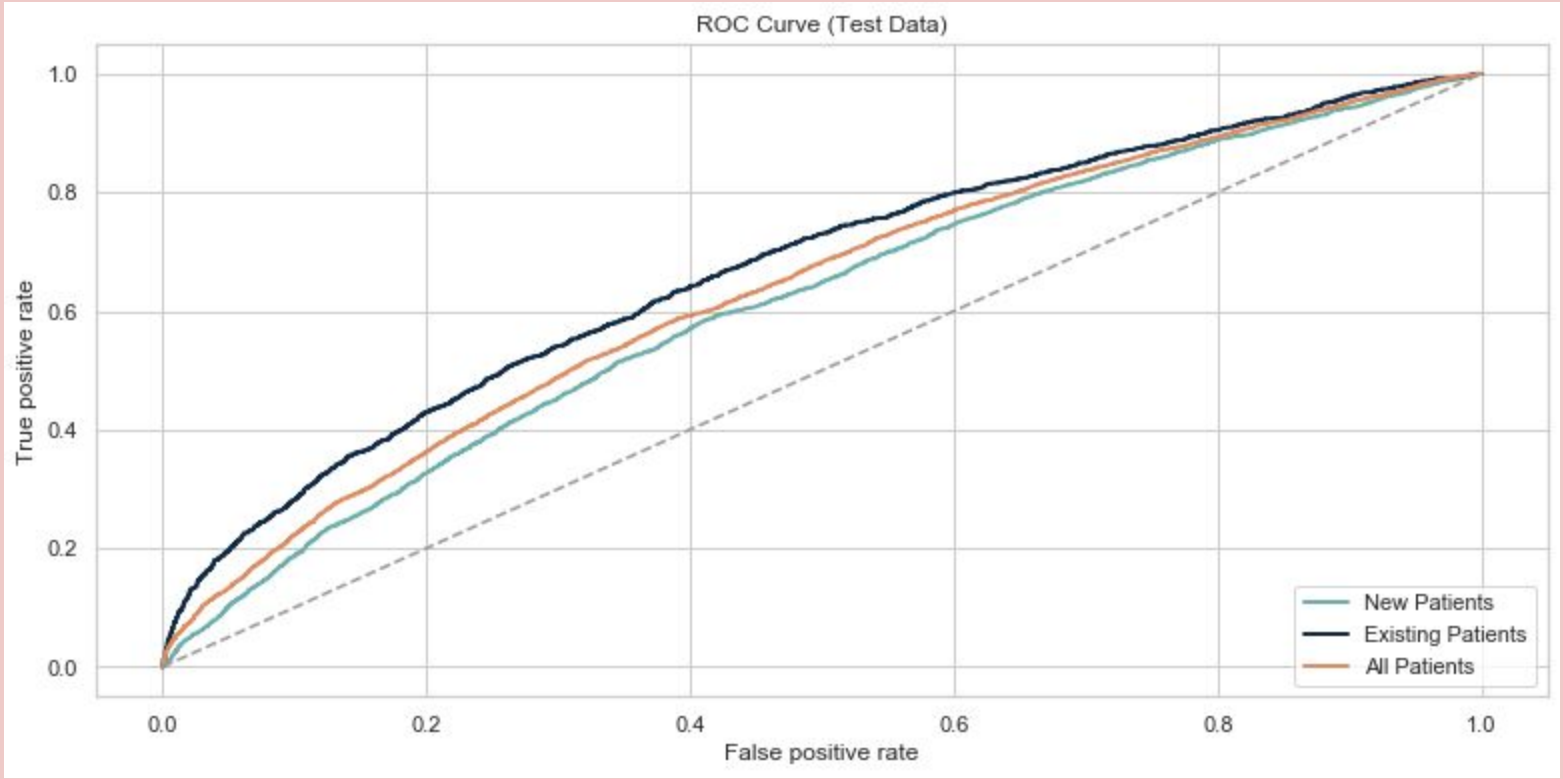
XGBoost Model Performance



Model Evaluation?



Model predicts better for existing vs. new patients

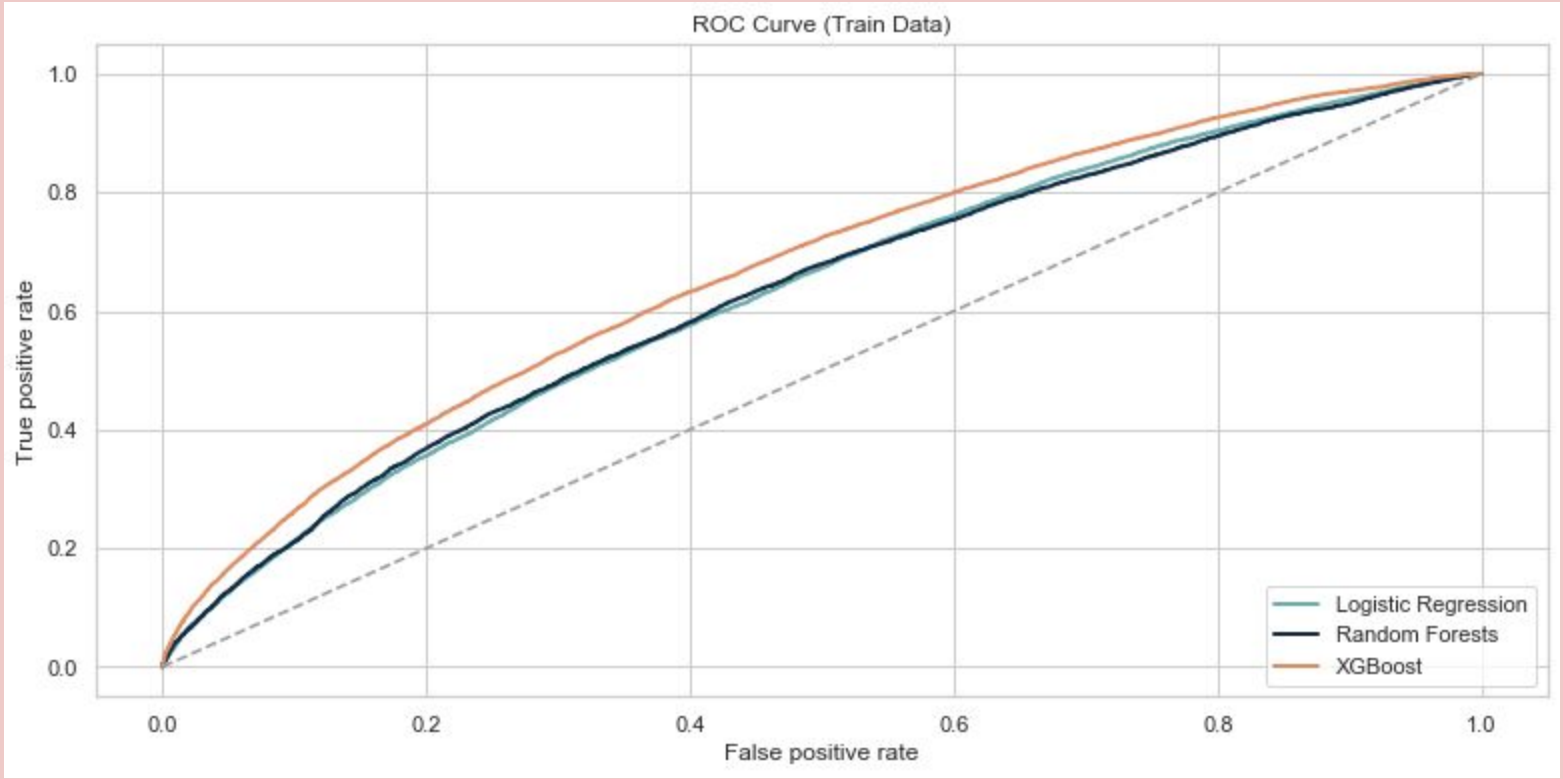


Model Selection

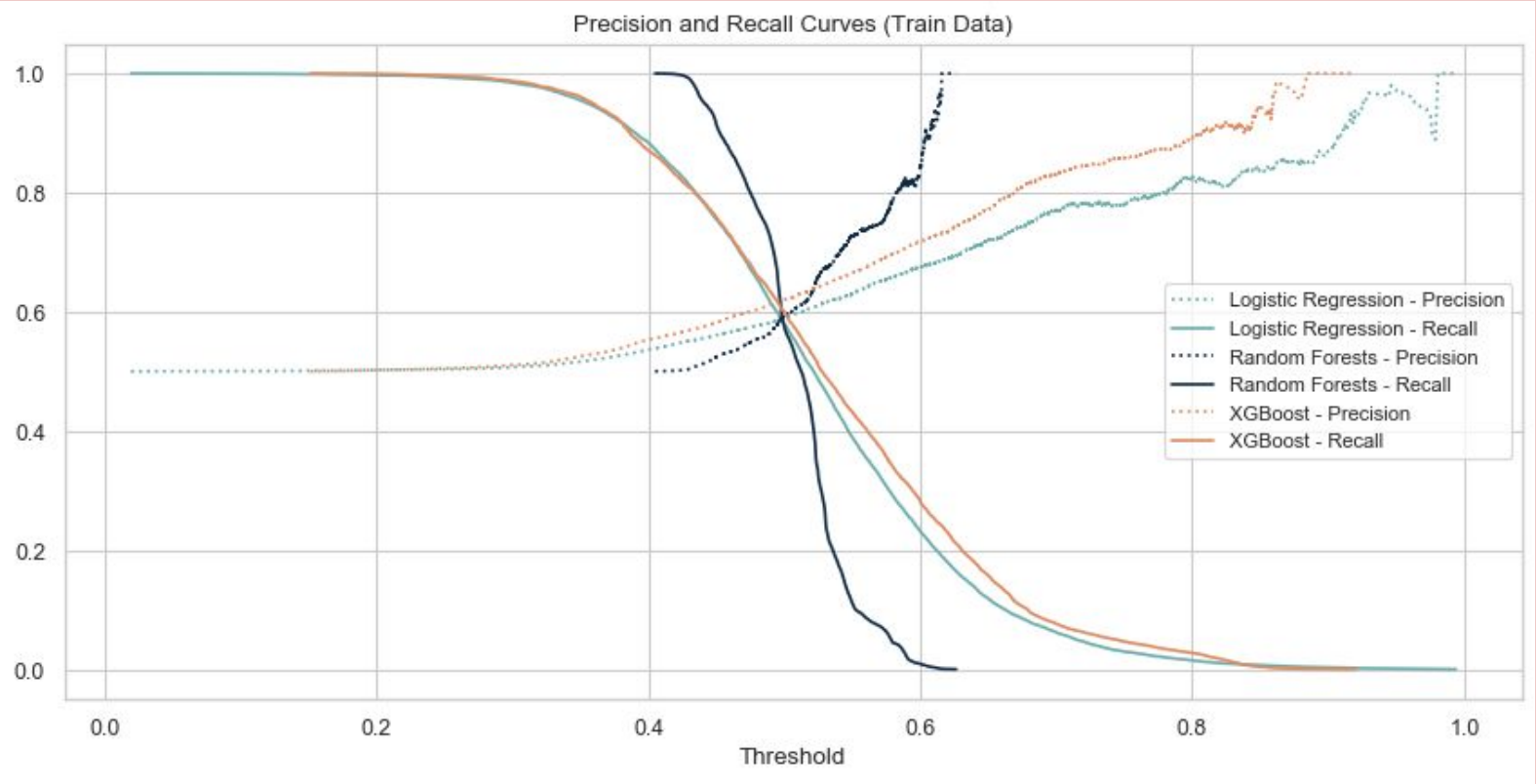
Average Cross-Validation Scores

	Logistic Regression	Random Forests	XGBoost
Recall	0.571	0.583	0.587
Precision	0.358	0.358	0.364
F1	0.440	0.444	0.450
Accuracy	0.589	0.587	0.593
AUC	0.621	0.620	0.631

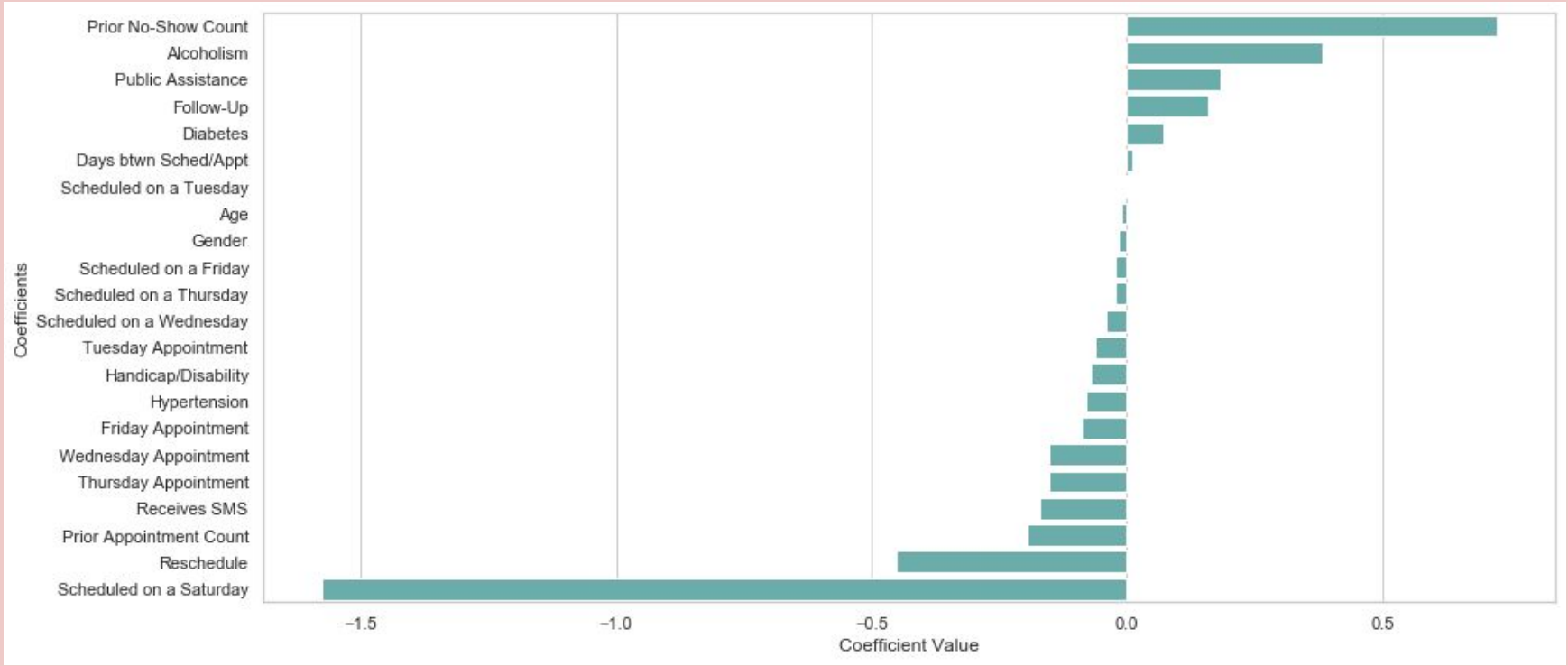
Model Selection



Model Selection



Best fitting logistic regression model



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