DBA5106 Group Project

Predictive Modeling to Identify Diabetic Patients

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Meeting Agenda

- **Introduction**
  - Problem Statement
  - Proposed Solution and Metrics
- **Data Analysis**
  - Datasets Overview
  - Exploratory Data Analysis (EDA)
- **Model Selection**
  - Model Performance
  - Results and Expected Benefits
- **Implementation**
  - Business Implication and Implementation
  - Next Steps

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The true costs of diabetes

7th

Leading Cause of Death

Annual Cost

US$327 Billion

1 in 4

Healthcare Dollar Expenditure

Who covers these costs? We do.

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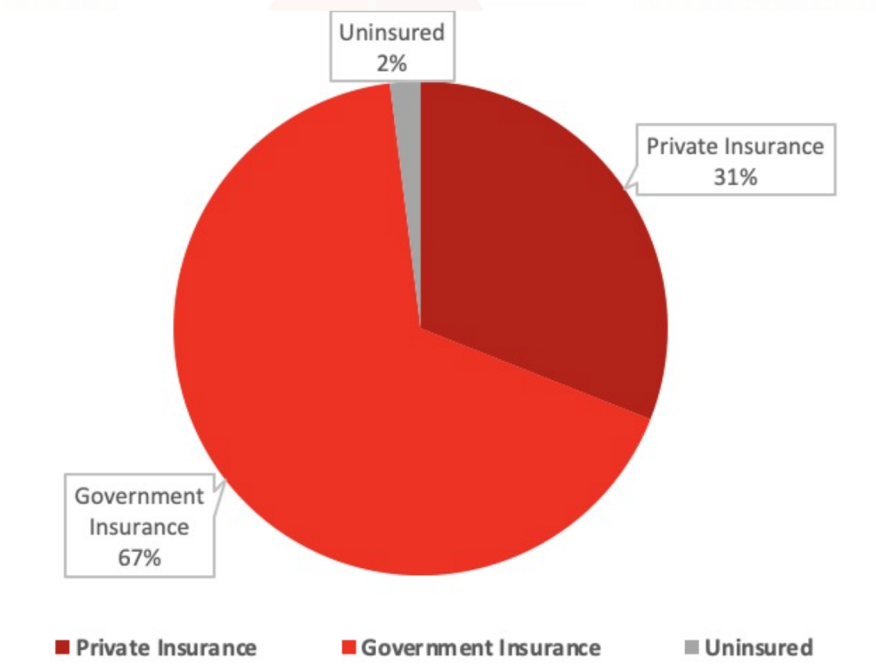
A costly problem

Distribution of Diabetes Treatment Claims Coverage



Annual cost (per individual)

Up to $18,652

Existing classification method detects only 30% of diabetics cases.

Average premium charged

$7,470

Annual loss (per individual)

$11,182

What can we do to manage this risk?

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Our proposed solution

A **classification model** with 2 key objectives:

(1) Compute the probability of diabetes diagnosis given lifestyle & medical test variables
(2) Identify high risk individuals for monitoring and intervention

Medical and personal data are readily available to us, let's take advantage.

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Our proposed performance metric

$$\begin{aligned} &Expected\ Value\ of\ Diabetes\ Expenses\ Claims\ = \\ &P(Diabetic) \times [\ P(Predicted\ Diabetic \mid Diabetic)\ \times \$16,752\ +\ P(Predicted\ NonDiabetic \mid Diabetic) \times \$18,652] \\ &+\ P(NonDiabetic) \times [\ P(Predicted\ NonDiabetic \mid NonDiabetic) \times \$0\ +\ P(Predicted\ Diabetic \mid NonDiabetic) \times \$200] \end{aligned}$$

Probability	Case	Cost	Remark
P(Predicted Diabetic | Diabetic)	True Positive	$16,572	Base cost of diabetes treatment.
P(Predicted NonDiabetic| Diabetic)	False Negative	$18,652	Base cost + cost associated with complications due to the lack of early treatment ($1,900).
P(Predicted NonDiabetic | NonDiabetic)	True Negative	$0	No cost.
P(Predicted Diabetic | NonDiabetic)	False Positive	$200	Cost for diabetes screening test.

Proposed metric measures <u>cost saving</u> as compared to current classification method.

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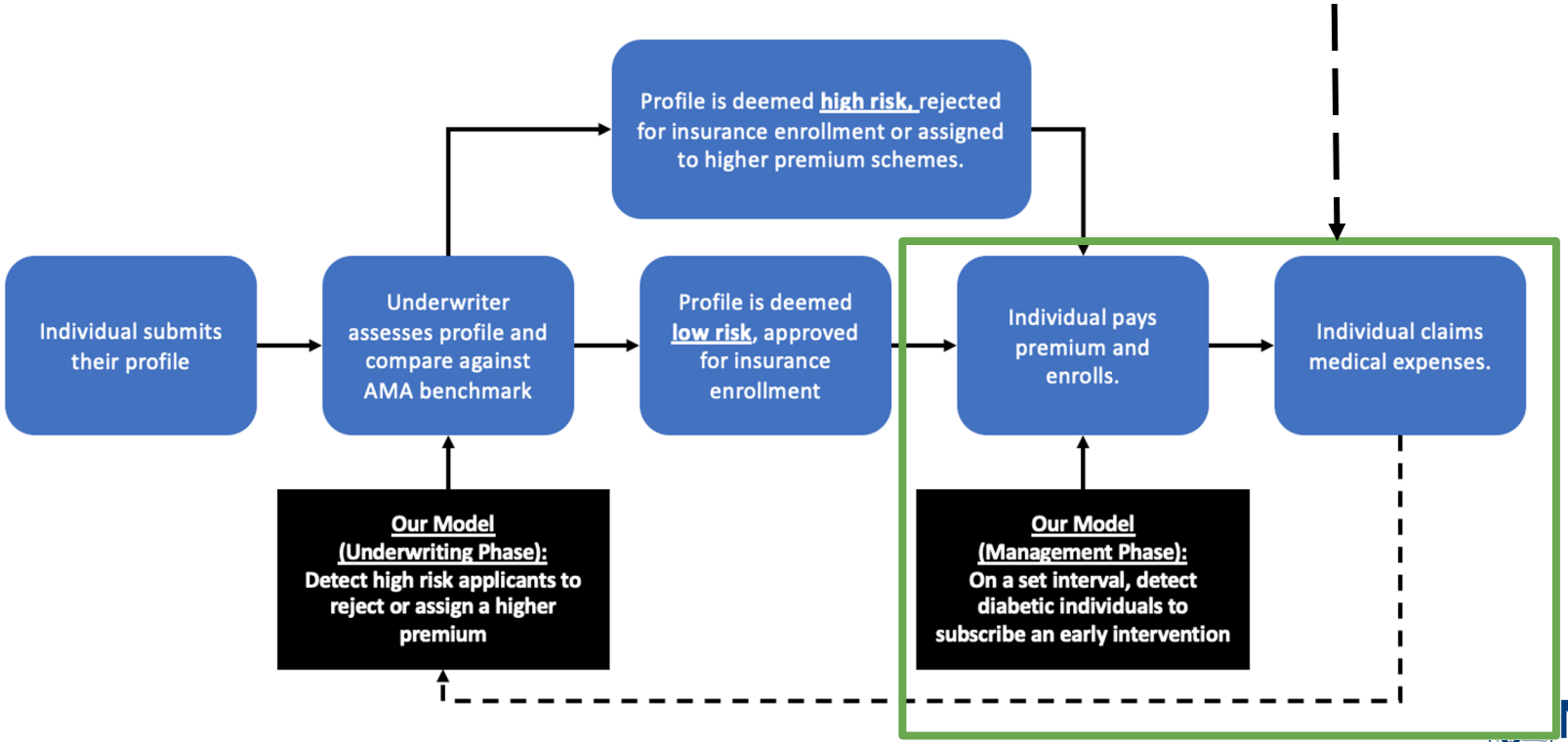
Integration with our operations

Trial run should focus on our existing customer first.



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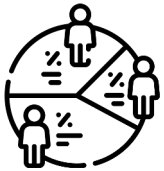
Our existing dataset

4	10,175	83
Tables	Observations	Original Features



Demographics

1. Gender
2. Age Group
3. Race
4. Education
5. Household income

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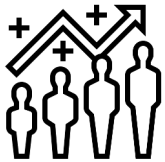

Physical Exam

1. Body Mass Index
2. Blood pressure
3. Height
4. Weight
5. Grip strength

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Blood Chemistry

1. Glycohemoglobin
2. Potassium
3. Lead
4. Cadmium
5. Insulin

...

Diabetic (y/n)

Identifying key features

Notable Key Features Engineered & Relabeled:

- BMI Group
- Age Group
- Socioeconomic Status
- Marital Status
- **High Risk**

High Risk
(based on AMA Guidelines)

Body Mass Index (BMI) ≥ 25

Glycohemoglobin (%) ≥ 5.7

Oral Glucose Tolerance Test Level (mg/dL) ≥ 140**

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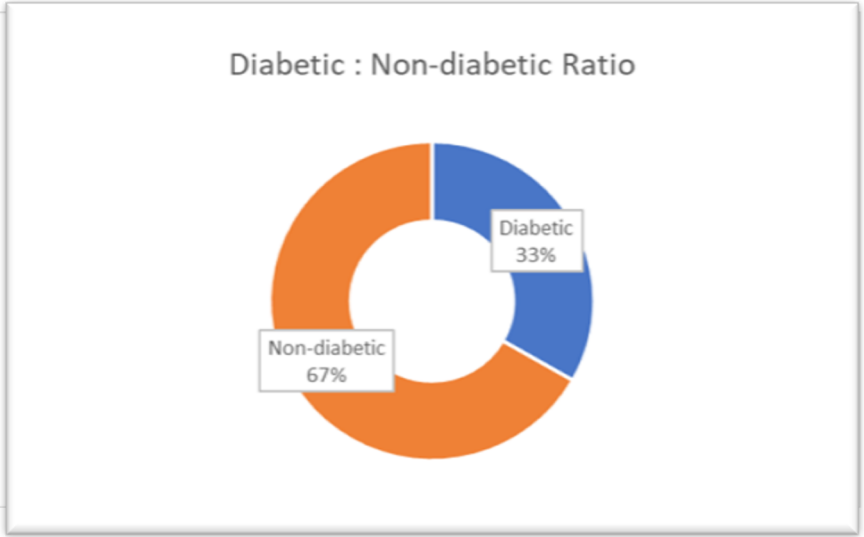
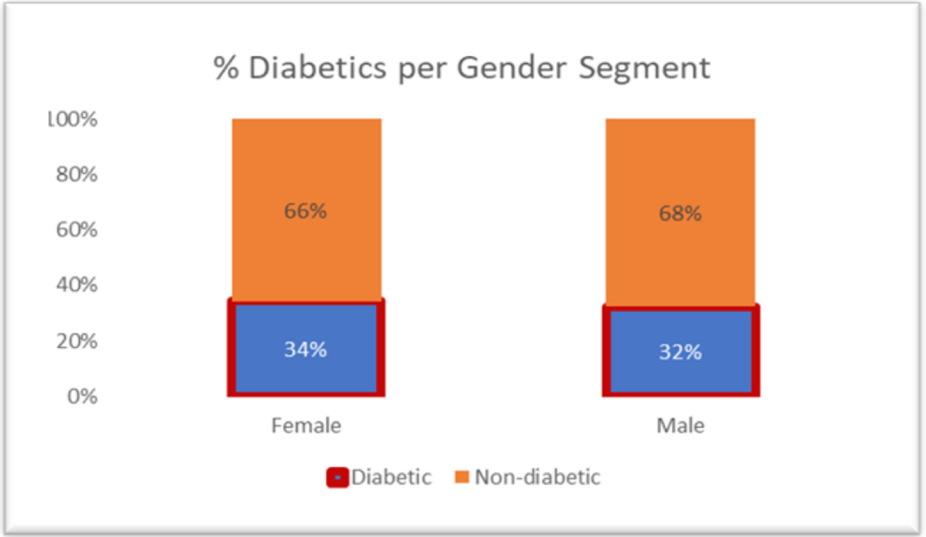
Exploratory data analysis

Focus is to find relevant features that could affect predisposition to diabetes.





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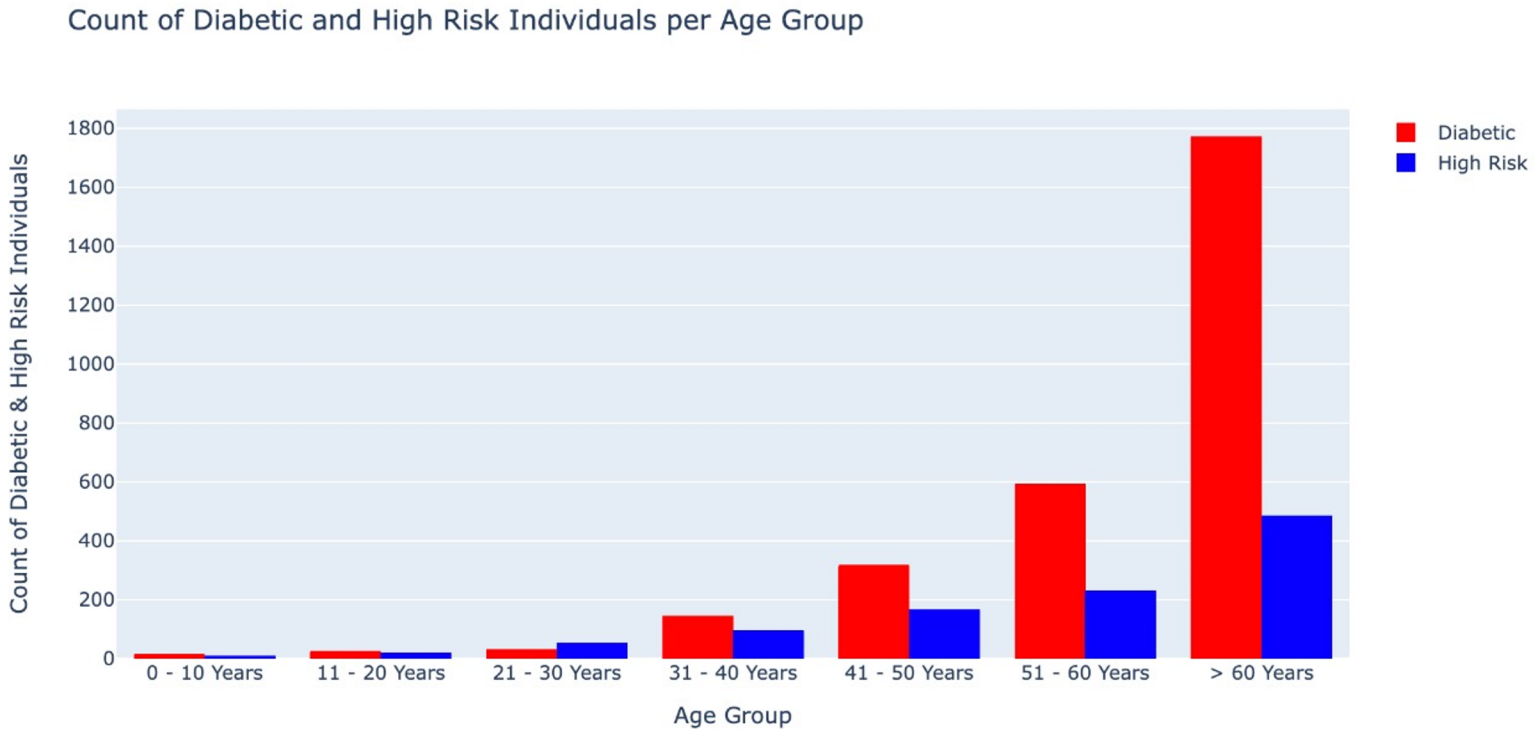
Exploratory data analysis



How can we use these insights to <u>manage our risks</u>?

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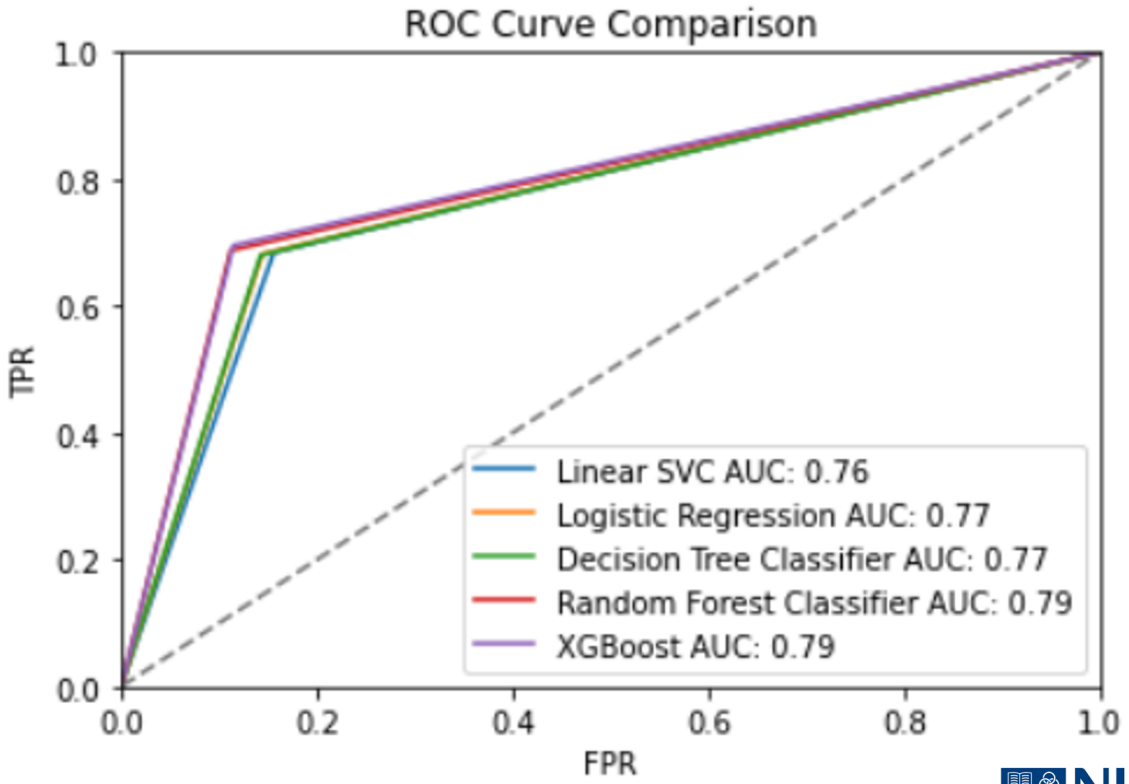
Selected model based on performance

5
Models Compared

XG Boost performed best



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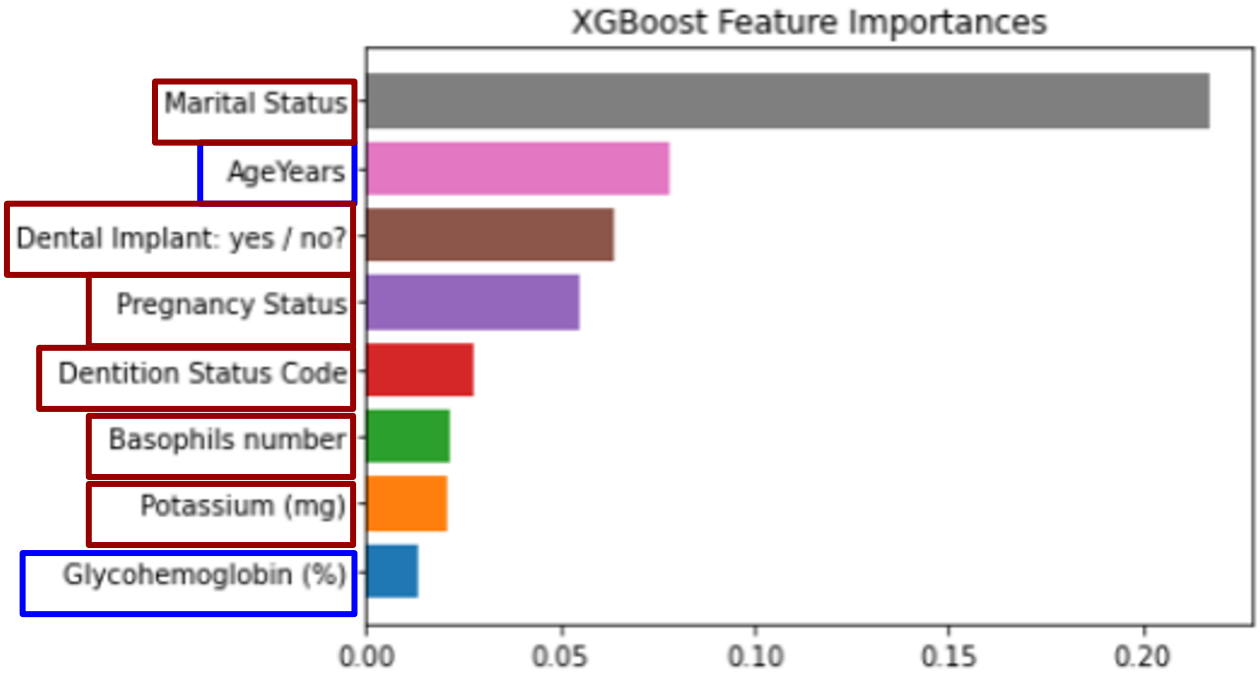
Interesting insights from top features



Extracted model features improve on the current detection capability and allow early intervention and better risk management.

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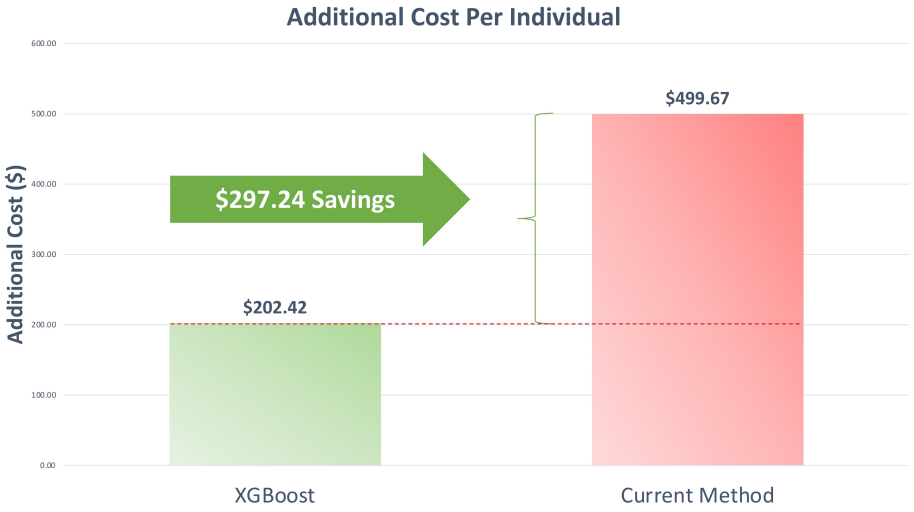
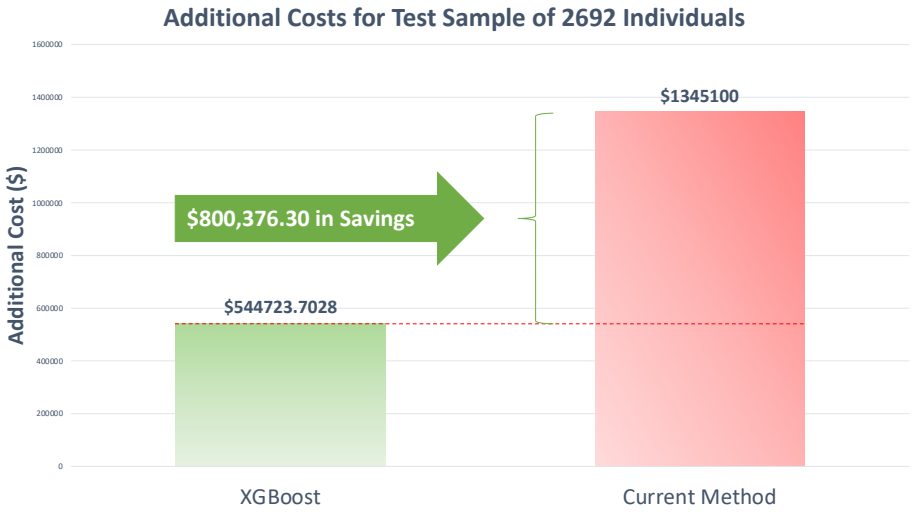
Our results and their expected benefit





Potential cost saving is 59.49% from early and improved detection vs current industry standard…

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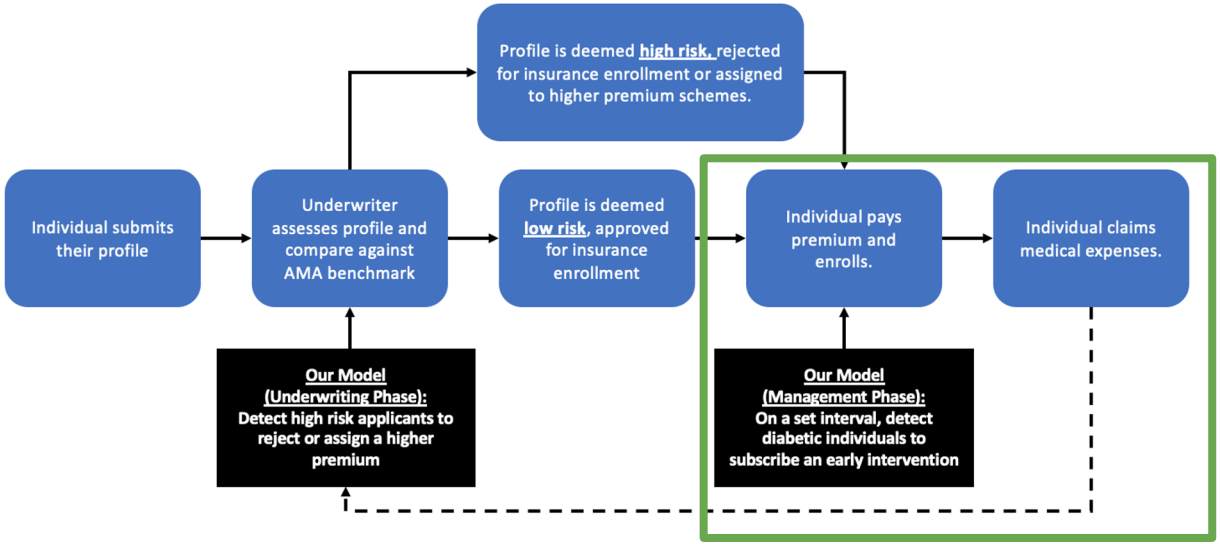
Implementation & Next Steps

Three steps to up to 59.49% cost-saving:

- Model deployment in management phase.
- Incentive or penalty scheme for those detected as diabetic.
- Track cost-savings as a performance metrics.



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Future Considerations

Phase 1 (Now)

- Deployment to Management Phase
- Compute Probability of Positive Diagnosis
- Identify High Risk Individuals

Performance & Business Impact Reviews

Phase 2

- Target Pre-Diabetic Cases
- Deployment to Underwriting Phase
- Provide Medical Benchmarks
- Connect Patients with Merchant Partners

The model is scalable and its cost-saving impact can be easily measured.

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Thank You

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Appendix

References:

Dataset: https://wwwn.cdc.gov/nchs/nhanes/
Model Libraries: https://scikit-learn.org/stable/user_guide.html
Facts on Diabetes(1): https://www.who.int/news-room/fact-sheets/detail/diabetes
Diabetes costs (2): https://www.diabetes.org/resources/statistics/cost-diabetes
CDCP Statistics (3): https://www.cdc.gov/diabetes/library/features/diabetes-stat-report.html
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