Virginia Mason Franciscan Health oversees the Rainier Health Network, a Medicare Accountable Care Organization (ACO). Risk score is a healthcare metric used to identify and triage patients with higher care needs. Within the Medicare and Medicaid Shared Savings Plan (MSSP) it also serves to help balance ACO patient populations and define quality of care. The end of benefit year calculation is used to reimburse ACOs for the health care provided to the patient population. Risk stratification models are positioned to grow in importance as ACO populations become older with increased healthcare needs. These models require demographic and detailed patient information including current and past healthcare expenditures, acute and chronic diagnoses, and preventative care utilization.

**Objective**

Risk score calculation and population stratification is a widely used tool for health expenditure prediction and quality of care management. Research has shown that risk score calculation and population stratification cannot be predicted on patient demographics alone.

1. Identify the features that predict population risk scores.
2. Build a predictive model to predict future benefit year risk score based on current and historical data.

**Methodology**

1. Perform descriptive analytics.
2. Draft hypotheses based on univariate and multivariate relationships.
3. Complete principle component analysis, variable importance, and covariance testing.
5. Select appropriate methods, train, test, and score models.
6. Predict future population risk score and test for accuracy.
7. Review features and weights to draw insights about the population and compare to initial hypotheses.

**Background**

Risk score stratification models are widely used for health expenditure prediction and quality of care management. Risk score is a healthcare metric used to identify and triage patients with higher care needs. Within the Medicare and Medicaid Shared Savings Plan (MSSP) it also serves to help balance ACO patient populations and define quality of care. The end of benefit year calculation is used to reimburse ACOs for the health care provided to the patient population.

For new patients earlier diagnosis and demographic details will increase accuracy of predicting current year risk score. For both new and continuing patients previous year risk score was important in predicting current year risk score. The strongest demographic value was age for both populations. Assigned specialty provider and diagnostic codes were the most important features in predicting risk score. Population complexity considerations:

- For new patients earlier diagnosis and demographic details will increase accuracy of prediction, a recommendation would be to ensure consistent data availability for these features and attempt to establish early in the benefit year.
- Category 3 bears additional insights into its compositions and risk score trends, more precise metrics on age and medical history may support better predictive outcomes.
- From earlier data the utilization of out patient versus in patient encounters and unplanned readmissions are likely factors in high risk score categorization.

**Results**

**New Patients**

<table>
<thead>
<tr>
<th>Model Accuracy</th>
<th>Feature Importance</th>
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<tbody>
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<td>New Patient Risk Score Feature Weights</td>
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<td>Age</td>
<td>Provider Specialty</td>
</tr>
<tr>
<td>Category 1</td>
<td>Category 2</td>
</tr>
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<td>Impacted by missing demographics data but is a group predominately in the 70-70 year old age category. This category’s relationship with diagnosis and provider specialty is closely aligned with category 3 reducing the model’s accuracy.</td>
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**Category 1**

- Defined by low utilization and younger average age, these patients typically have lower occurrence of high risk diagnoses and a diverse demographic profile. This group was the smallest category in both new and continuing patients.

**Category 2**

- The most complex category to predict. These patients show similar relationships in age, diagnosis, and provider specialty as categories 2 and 4. This variability is indicative of a missing feature and explains the lack of accuracy in predicting this category.

**Category 4**

- The highest risk categorization prediction is impacted by provider specialty and diagnostic coding, more than age categorization seen in the lower risk score categories.

**Features impacting risk score calculation**

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- Assigned specialty provider and diagnostic codes were the most important features in predicting risk score.

**Population complexity considerations**

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- Category 3 bears additional insights into its compositions and risk score trends, more precise metrics on age and medical history may support better predictive outcomes.
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**Insights**

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**References**


In partnership with and gratitude for Virginia Mason Franciscan Health - CommonSpirit Health and our faculty advisors.

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