Predicting hospital readmission for patients with multiple chronic conditions

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Motivation

Decreasing readmission rates will
• Decrease health care costs
• Help hospitals to avoid Medicare readmission penalties (since October 1, 2012)
• Improve patient care

Statistics
• In 2015, 2,592 US hospitals out of 5,627 registered hospitals received penalties from the CMS (losing a combined $420 million)
• Historically, nearly 20% of all Medicare discharges had a readmission within 30 days.
Goal

To develop, implement and evaluate an algorithm to predict hospital readmission for patients with multiple chronic conditions.
Objectives

1. Prepare the data to which the analysis will be based
2. Develop a prediction model
3. Evaluate the prediction model
Expected Impact

• To adjust the care of an individual with a high risk of readmission
  o Reduce costs
  o Improve quality of life
1. Dataset with computed features
2. Source code for models
3. Literature review XLS and report
4. Final report
Original Humana dataset

Includes 4 tables:
Med (57G) 716,464,506 rows x 35 columns
Lab (69G) x 13 columns
Rx (120G) 662,379,439 rows x 22 columns
Pat (1.3G) 12,913,657 rows x 42 columns

Deidentified records of three years
01/2013-12/2015
Challenge: 2 files out of 4 are corrupted.
Objective 1: Tasks

1. Define my cohort
2. Write R script to filter and analyze cohort
3. Compare positives and negatives
4. Derive new features from the comparison
5. Write R script to compute new features
6. Partition to training, testing, and validation datasets
Objective 1: Remaining Work

✓ 1. Define my cohort
2. Write R script to filter and analyze cohort
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5. Write R script to compute new features
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Objective 2: Tasks

1. Conduct literature review on hospital readmission; highlight commonly used methods and features
2. Implement SVM
3. Implement RF
## Objective 2: Results

<table>
<thead>
<tr>
<th>Publication</th>
<th>Year</th>
<th>Methods</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating Patient Readmission Risk: A Predictive Analytics Approach</td>
<td>2018</td>
<td>SVM, RF, Gradient Boost</td>
<td>55 (HbA1c, Gender, Discharge disposition, Admission Source, Primary diagnosis, Race, Age, Time in hospital)</td>
</tr>
<tr>
<td>Assessment of Machine Learning vs Standard Prediction Rules for Predicting Hospital readmission</td>
<td>2019</td>
<td>CNN</td>
<td>382 including demographic data (sex, race, hospital service)</td>
</tr>
<tr>
<td>An integrated machine learning framework for hospital readmission</td>
<td>2018</td>
<td>DNN, SVM</td>
<td>demographic, social and economic status, treatment and clinical, health care utilization</td>
</tr>
<tr>
<td>Prediction modeling and pattern recognition for patient readmission</td>
<td>2016</td>
<td>FC NN, Regression</td>
<td>130 (patient data, claims data, drug count data, lab count data, outcome data)</td>
</tr>
</tbody>
</table>
Objective 2: Remaining Work

1. Conduct literature review on hospital readmission; highlight commonly used methods and features
2. Implement SVM
3. Implement RF
Objective 3: Tasks

1. Identify the failure cases
2. Improve features and iterate for a better accuracy and AUC
Objective 3: Remaining Work

1. Identify the failure cases
2. Improve features and iterate for a better accuracy and AUC
1. Data pre-processing is a laborious task
2. Medical data is complex and hard to understand
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