

Predicting readmissions in diabetics

executive summary

The problem

The Centers for Medicare and Medicaid Services (CMS) have recently placed an emphasis on having patients covered by their services spend less time admitted to hospitals as inpatient. They have identified readmissions as one of the factors contributing to this concern. CMS defines a readmission as an encounter where a patient was admitted as inpatient within 30 days of being discharged with the same diagnosis (CMS, 2020). In 2014, Virginia Commonwealth University (VCU) published a study linking HbA1c tests during the initial encounter to lower readmission chances (Strack et al, 2014). VCU focused their analysis defining the relationship between HbA1c tests and readmission chances through the test alone and several interactions between the test and other variables. However, a patient's HbA1c is considered an average blood glucose over the previous 60-80 days from the test and no explanation was offered as to why this would impact the patient's readmission probability. This analysis uses the data VCU collected to find additional insights by not giving any bias to HbA1c testing.

- H_0 : There are no further significant relationships between a patient's readmission status and the variables collected.
- H_a : There is at least one other statistically significant relationship between a patient's readmission status and the variables collected.

Analysis process

VCU partnered with Cerner to access their Health Facts database containing patient charts from hundreds of healthcare systems around the US. They compiled a dataset of inpatient encounters for diabetic patients between 1999 and 2008, de-identified it, flagged encounters that were readmitted and after their analysis, published the data to the University of California Irvine's Machine Learning Repository. This analysis began by re-creating several of the steps VCU described. One notable deviation is that this analysis used Greenacre's method to group primary diagnoses during the index visit where VCU had grouped primary diagnoses according to their ICD-9 hierarchy.

The analysis was conducted in SAS and used a 70/30 split of the data set for training and testing. From there, proc logistic with forward selection was used to identify significant variables and interactions. Backwards selection was used to verify that none of the effects identified by forward selection had become insignificant in later steps. Finally, best subset selection was used with the remaining factors to score all possible models and determine the champion model with the best balance between limited effects and accuracy in the test set. None of the models generated predicted any readmissions, so scoring was based on the percentage of cases that were not readmitted and had predicted probabilities for readmission lower than the cases that were. The champion model contained 17 variables and was 62% accurate in the test set.

Results

This analysis did yield the expected result of chances for readmission being strongly tied to the primary diagnoses for the index encounter. This is well known and accepted among providers. However, the clustering results may provide additional insights outside of the normal diagnosis related groups. It also found that patients who had another inpatient (1.8x) or ER (1.4x) encounter in the 12 months before the

index encounter were also more likely to be readmitted. As expected, patients between 80 and 90 years old were also 1.4x more likely to be readmitted.

As possible new insights, the analysis found that patients that had been prescribed Metformin before or during the index encounter were only 0.875x as likely to be readmitted. Also, in some scenarios, patients that were discharged to home were less likely and patients that had been transferred to other, non-inpatient facilities were more likely to be readmitted. Shockingly, patients who had been admitted for surgery and then discharged for care in another non-inpatient setting were 1.8x as likely to be readmitted.

Limitations

This analysis was limited by the dataset's long lineage from many disparate sources. The deidentification process necessitated by HIPAA also contributed to these limitations. Together, they make it impossible to validate the dataset to the data contained in patient's charts. This limitation led to several assumptions and inferences about the dataset that could severely impact the results if they were incorrect. The sample was also not collected from a randomized trial. Under logistic regression, these results are not guaranteed to apply to another sample from a different population. The scope of the results is limited to the population VCU extracted from Health Facts. The analysis was also limited in compute resources available from SAS University Edition. If more compute were available, additional interactions between variables could have been tested.

Proposed action

- Providers in the hospital setting may consider Metformin for their patients who are not already taking it.
- This dataset was collected for a period that ended near to when CMS began to incentivize lowering readmission rates. Collecting a newer data set would provide an estimate at how effective the incentives and penalties have been.
- Diabetic patients who had been admitted for a surgical procedure and then discharged into non-inpatient care were 1.8x more likely to be readmitted. This could be related to slower wound healing for diabetics (NIH, 2020). If this is found to be the cause, surgeons could work with wound care specialist nurses and providers to prevent readmissions.
- The diagnosis clusters in this analysis showed significant relationships to readmissions. The clustering could be reviewed by providers for unexpected associations between diagnoses and readmissions.

Expected benefits

CMS currently penalizes hospitals that have fallen below their peers in readmission rates up to 3% of all Medicare fee-for-service diagnosis related group payments (CMS, 2020a). For most hospital systems, this could mean hundreds of thousands or millions of dollars in lost revenue. Identifying variables and interactions that can predict a readmission is the first step to preventing them. CMS also publicly publishes readmission rates for hospitals (Medicare, 2020) via their Care Compare tool. Additionally, it has been shown that readmissions provide a short-term increase in margin, but impact profitability negatively in the long term (Upadhyay, Stephenson & Smith, 2019). In summary, readmissions impact hospital finances negatively through reduced payments, bad publicity, and lower profit margins. Reducing readmissions helps to guarantee full payments from CMS, generates good publicity, and increases long-term profit margins.

References

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