
Hospital Rating Prediction

— Samrudhi Keluskar —

Agenda

- Introduction
 - Background
 - Objective
 - Data Source
- ML Models for Rating Prediction
- Key Findings
- Recommendations

Introduction

Background:

- The hospital's **CMS rating** has remained at '**3**' for the **past 5 years**, despite spending a significant amount of resources on improving its services
- The number of patients and insurance companies opting for the hospital's services had **declined by ~5%** every year for the last 5 years
- It was found that the Evanston Hospital's net profit has had a steady **decline of ~7%** for the last 6 quarters.

Objective:

- Build a Statistical/ML Model that estimates hospitals' ratings
- Identify key features which negatively affect Evanston Hospital's overall rating
- Provide recommendations to improve their overall rating

Data source: Centres for Medicare and Medicaid Services (www.cms.gov)

ML Models for Rating Prediction

- This exercise can be considered as both, a classification as well as a regression problem. Hence, metrics like Accuracy and R^2 of each model were used for checking model performance.
- Following are the models with their performances:

Model	Accuracy		R2	
	Train Set	Test Set	Train Set	Test Set
Linear Regression (Ridge)	0.92	0.91	0.88	0.86
Logistic Regression	0.97	0.90	0.95	0.84
Gradient Boosting Regressor	0.94	0.90	0.92	0.84
Random Forest Regressor	1.00	0.86	1.00	0.77
Gradient Boosting Classifier	0.95	0.85	0.92	0.76
Random Forest Classifier	0.98	0.78	0.97	0.65

We see that Linear Regression (Ridge) has the best performance (on the test set) with respect to Accuracy as well as R^2

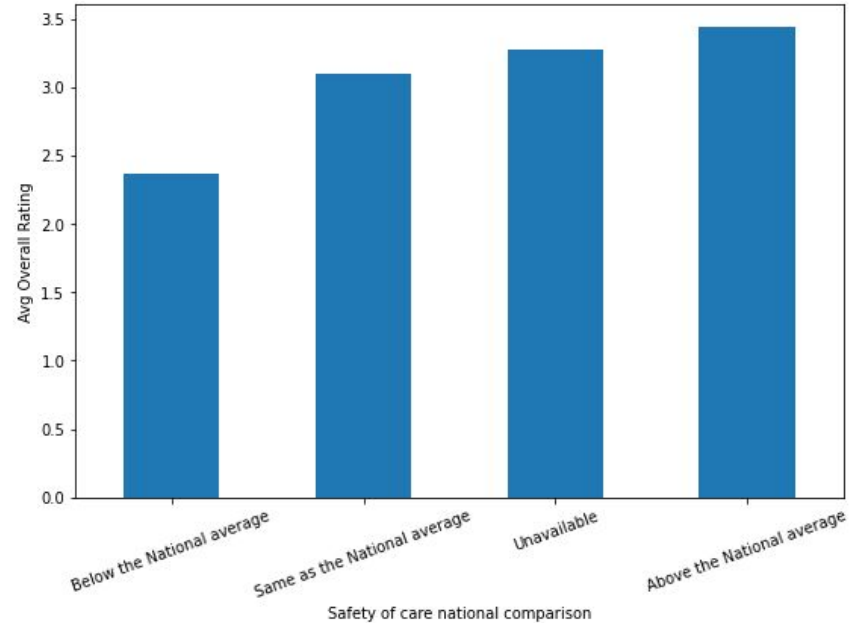
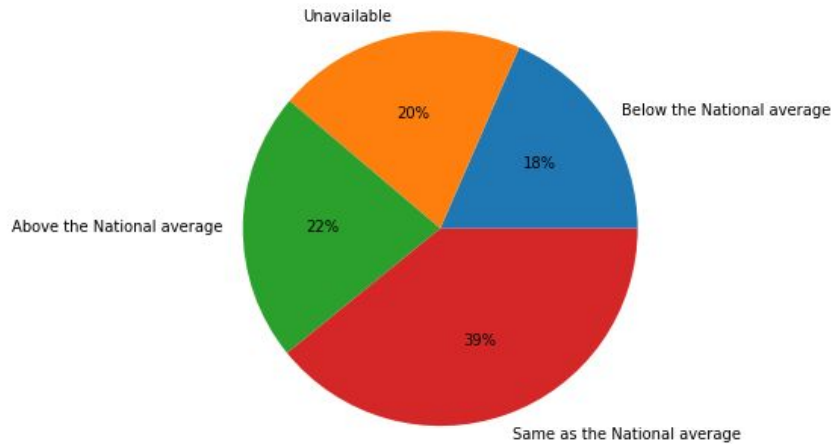
Top causes for Evanston's non-improving overall rating

- **Safety of care score** is below the national average as higher number of patients suffer from:
 - serious blood clots after surgery
 - serious complications in patient's health during the course of their medical treatment
- **Patient experience score** is below the national average
 - Especially patient's discharge experience

Features	Evanston's Score	National Average	Comparison Judgement
Serious Blood Clots After Surgery Score	15.8	5.0	Lower score is better
Serious Complications Score	1.5	0.9	Lower score is better
Discharge Information Score	84.0	86.9	Higher score is better
Patient experience national comparison	Below the National average	National Average	Above the National average is better
Safety of care national comparison	Below the National average	National Average	Above the National average is better

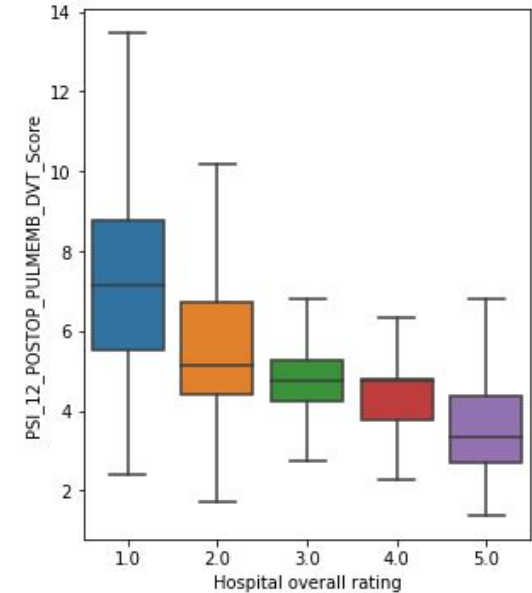
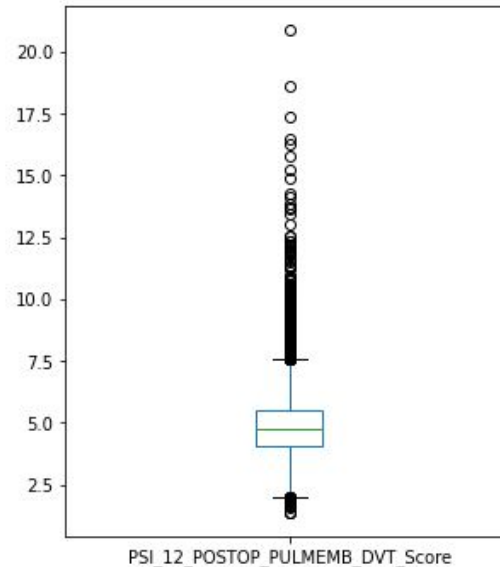
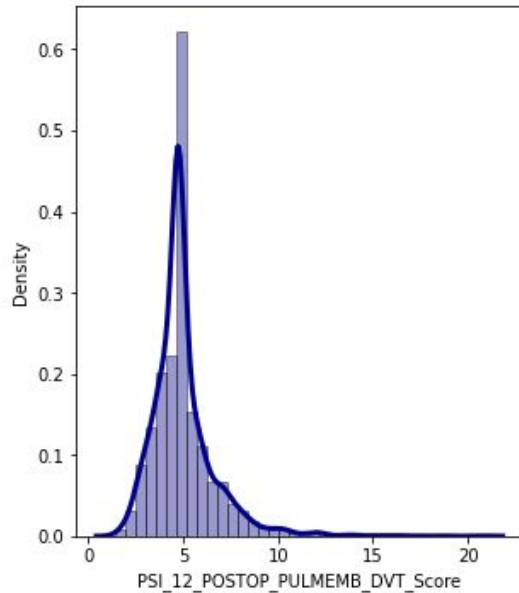
Next, let's take a look at the relationship between *Overall Rating* and *Safety of Care* as well as *Patient Experience*

Safety of Care - National Comparison



Hospitals with *safety of care* below the national average tend to have a lower overall rating compared to hospitals above the national average

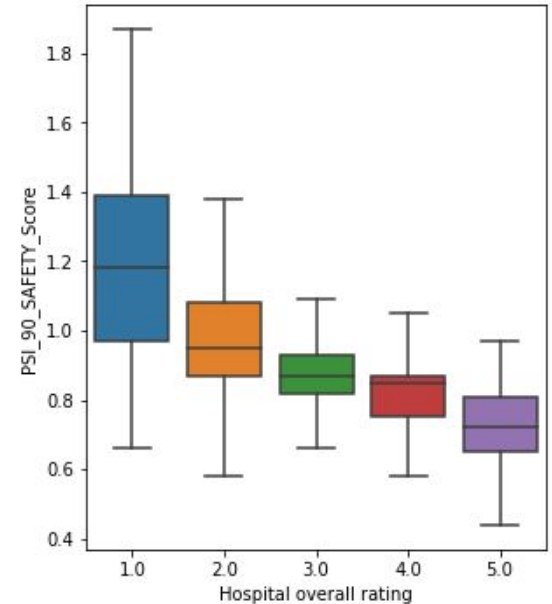
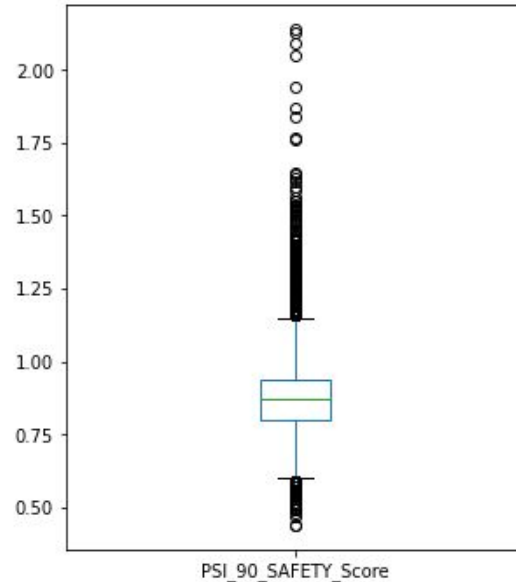
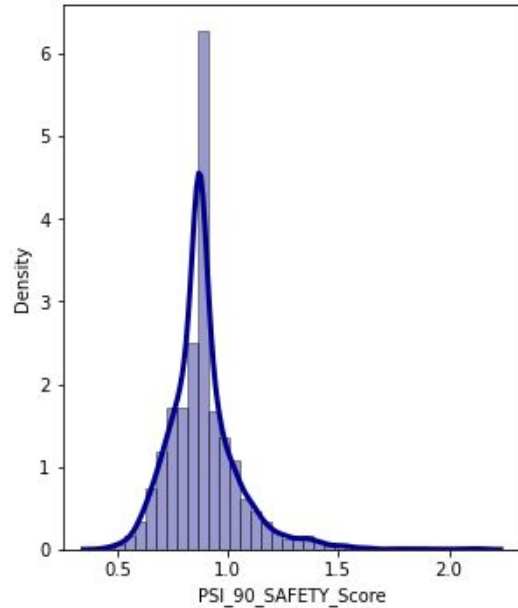
Safety of Care - Serious Blood Clots after Surgery Score



PSI_12_POSTOP_PULMEMB_DVT : Serious blood clots after surgery

Hospitals with higher number of people suffering from serious blood clots after surgery tend to have a low overall rating

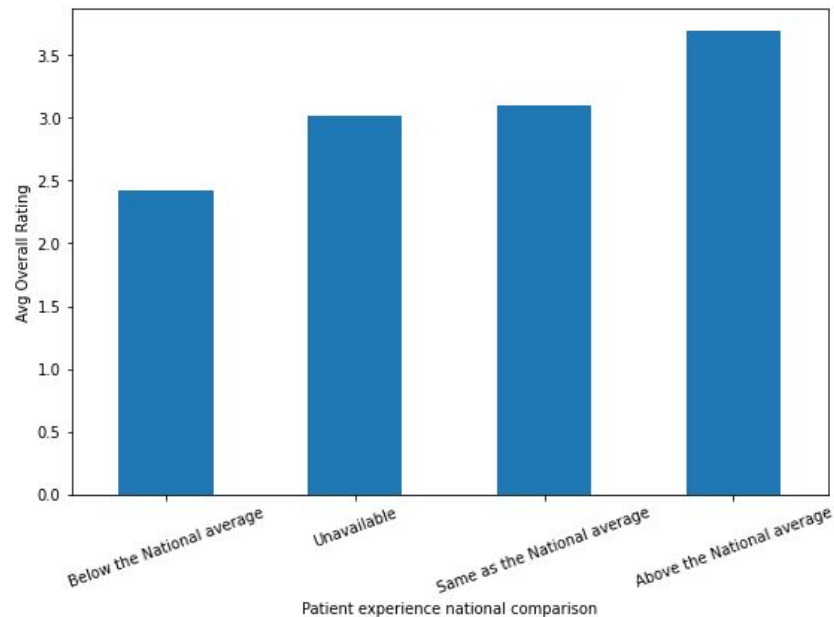
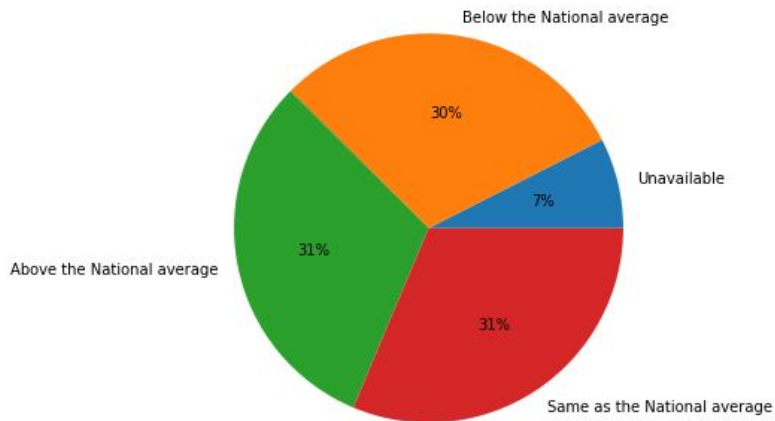
Safety of Care - Serious Complications Score



PSI_90_SAFETY : Serious complications

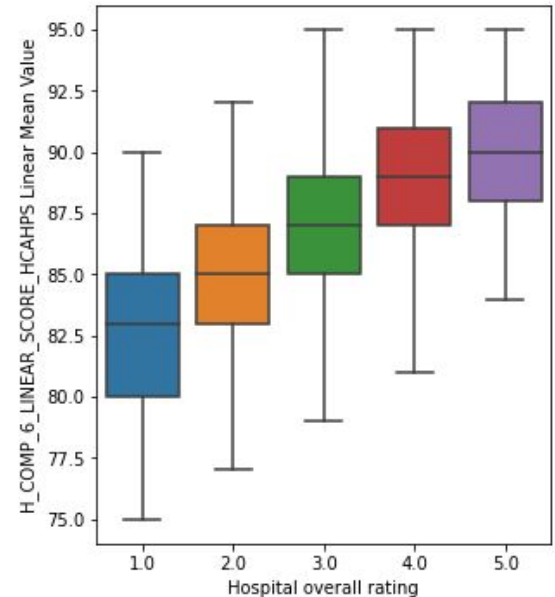
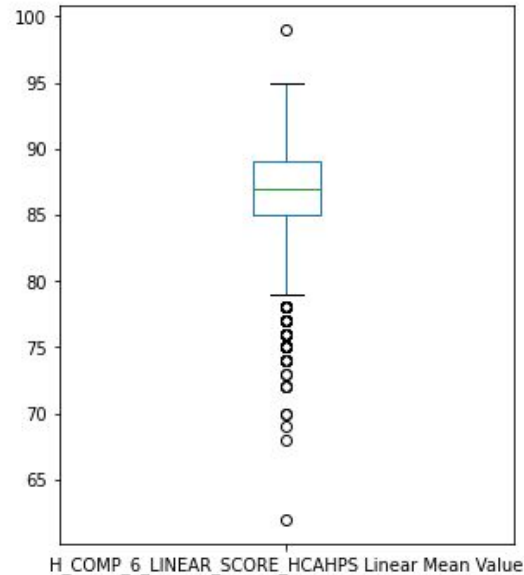
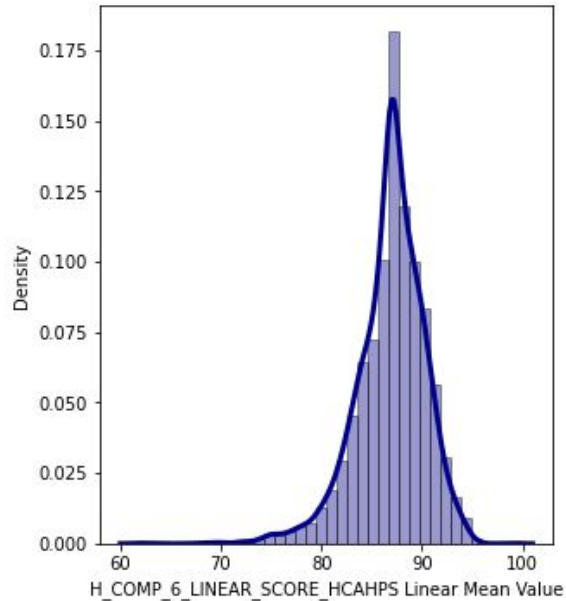
Hospitals with higher number of people suffering from serious medical/surgical complications during the course of their medical treatment tend to have a low overall rating

Patient Experience - National Comparison



Hospitals with *patient experience* below the national average tend to have a lower average overall rating compared to hospitals above the national average

Patient Experience - Discharge Information Score



H_COMP_6_LINEAR_SCORE : Discharge information linear mean score

Hospitals with a higher Discharge information linear mean score tend to have a higher overall rating

Recommendations

- Take measures to improve **patient experience**. This can be done by improving:
 - a. Discharge information experience
 - b. Communication and responsiveness of the hospital staff
 - c. Cleanliness and quietness of the hospital environment
 - d. Pain management and transition of care
- Take measures to improve the **safety of care** during the course of their medical treatment. This can be done by avoiding:
 - a. Surgical complications
 - b. Health-care associated infections

By acting on these recommendations they should be able to boost their overall rating by at least 1 whole point to 4 Stars

Thank You!