Rating and Provider Analysis

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Background – CMS Star Rating Methodology and Provider Analysis

CMS rates providers on a scale of 1 to 5. The objectives of the analysis are to:
• Understand the star rating methodology and identify the important variables affecting star ratings
• Recommending ways for Evanston Hospital to improve their current star rating of 3 to 4 at-least

The analysis is divided into four parts:
1. Data Understanding – Groups and Measures
2. Identifying important measures affecting star ratings
3. Predictive modelling of star ratings
4. Provider analysis: Recommending ways for Evanston Hospital to improve their rating

1. Data Understanding – Groups and Measures

• Identifying important measures affecting star ratings
• Predictive modelling of star ratings
• Provider analysis

- 7 Groups, 62 Measures

CMS included 62 measures (or variables) classified under 7 groups having a certain weightage as follows:

1. Groups
• Mortality, Readmission, Safety of Care, Patient Experience (22% weightage groups)
• Timeliness of care, Effectiveness of care, Medical Imaging Efficiency (4% weightage groups)

2. <u>Measures (some examples)</u>
• Positive measures: Patients given appropriate vaccines, Patients given timely treatment etc.
• Negative measures: All mortality measures, readmission measures, timeliness measures (avg. time taken to provide emergency care etc.)

<u>- Quality Issues: Format, Standardization and Missing Values</u>

The three main data quality issues in the raw data provided by hospital compare are:

1. <u>Data format</u>
• The original data is in 'wide-format' in approx. 55 files which was converted into one 'long' master file such that each row represents a provider and each column a measure
• Each cell is a numeric score of a measure

2. <u>Standardization of Measures</u>
• Measures need to be standardized such that 'higher value indicates better performance'
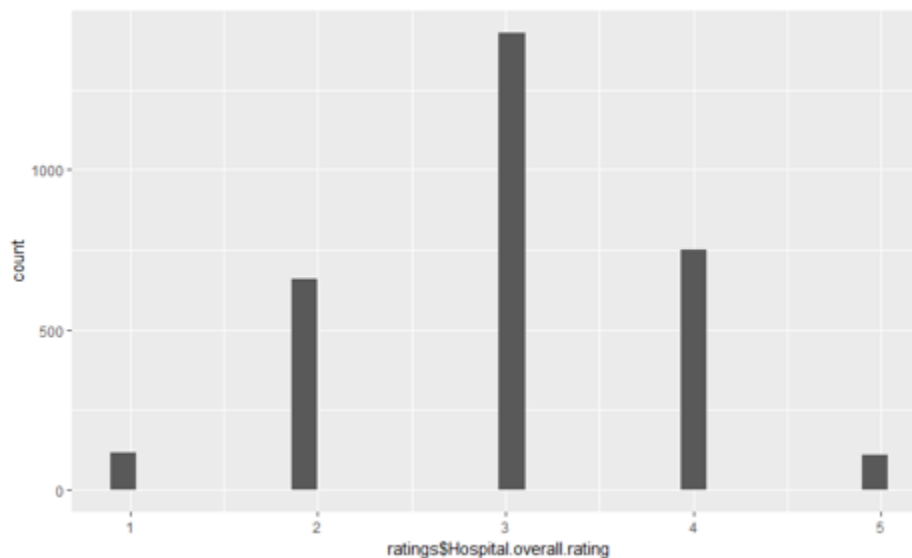
3. <u>Missing values</u>
• About 50% measures have a large number of missing values – they have been imputed as per the guidelines provided by CMS

- Distribution of Star Ratings

Table – Provider Rating Distribution

| Rating	Number of providers
1	117 (3.4%)
2	659 (19.5%)
3	1426 (42.2%)
4	749 (22.1%)
5	110 (3.3%)
NA	321 (9.5%)

Plot - Provider Rating Distribution

- Approx. 42% providers have 3 star rating
- Approx. 20% have 2 and 4 each; 3.5% have 1 and 5 each

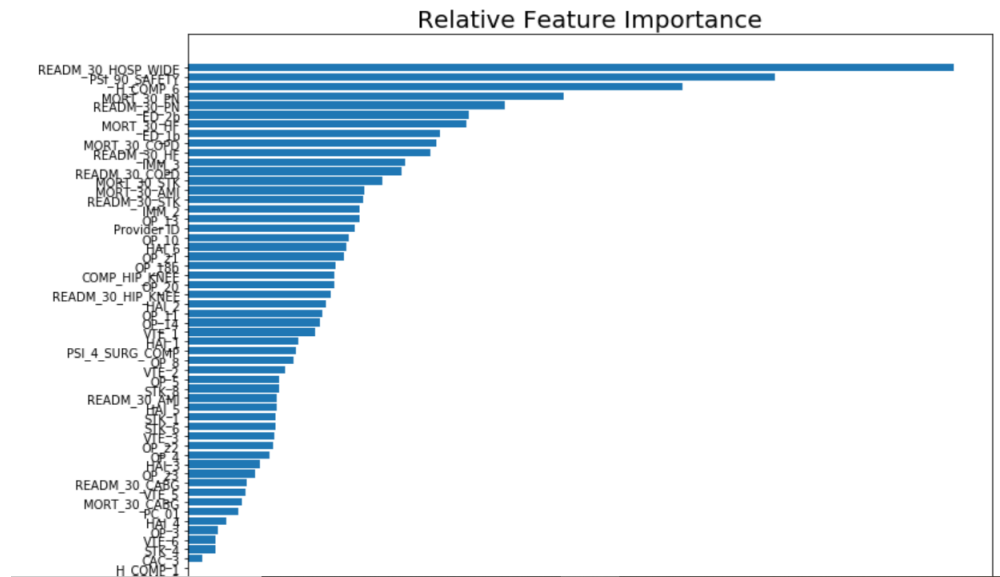# 2. Identifying important measures affecting star ratings

- Correlated measures carry higher weightage

Within each group, measure **weights are proportional to the correlation** of the measure within the group.
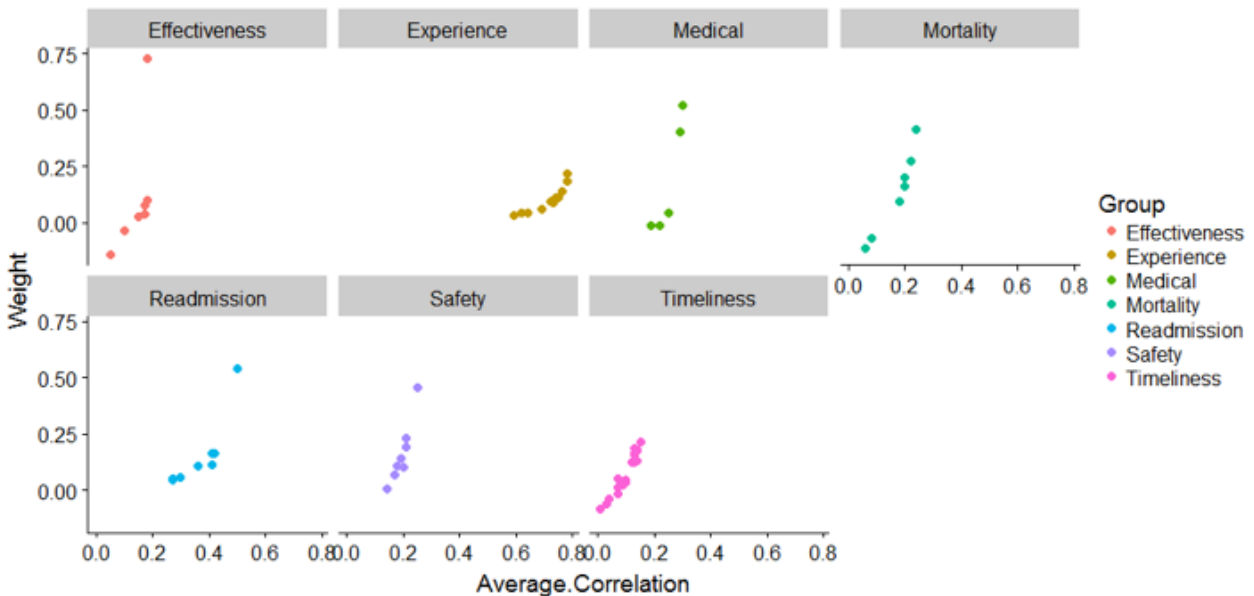
- Top 10 measures carry approx. 80% weight

Measures	Group
READM_30_HOSP_WIDE	Readmission
READM_30_PN	
READM_30_HF	
PSI_90_SAFETY	Safety
H_COMP_6	Patient Experience
MORT_30_PN	Mortality
MORT_30_HF	
MORT_30_COPD	
ED_2b	Timeliness of Care
ED_1b	

Relative Feature Importance

3. Predictive modelling of star ratings

- Overall Accuracy of approx. 65% with Random Forest
- Overall Accuracy of 54% using Factor Analysis and Clustering Model

- Process
• Using the measure weights calculated using factor analysis, each group's score is calculated
• The group scores are multiplied by the weight of group (22% or 4%) to calculate the final score
• Based on the final score, 5 clusters are created

- Results
•Random Forest predicts star ratings with an overall accuracy of **approx. 65%.**
•Clustering model using factor analysis is able to predict star ratings with an overall accuracy of **about 57%.** Class-wise accuracies are approx. 66%, 77%, 68%, 73%, and 85% for ratings 1, 2, 3, 4 and 5 respectively.

4. Provider analysis: Recommending ways for Evanston Hospital to improve their rating

- Final (Predicted) Provider Score is comparable to 4/5 rated hospitals

Provider Score

Final Score with Star Rating
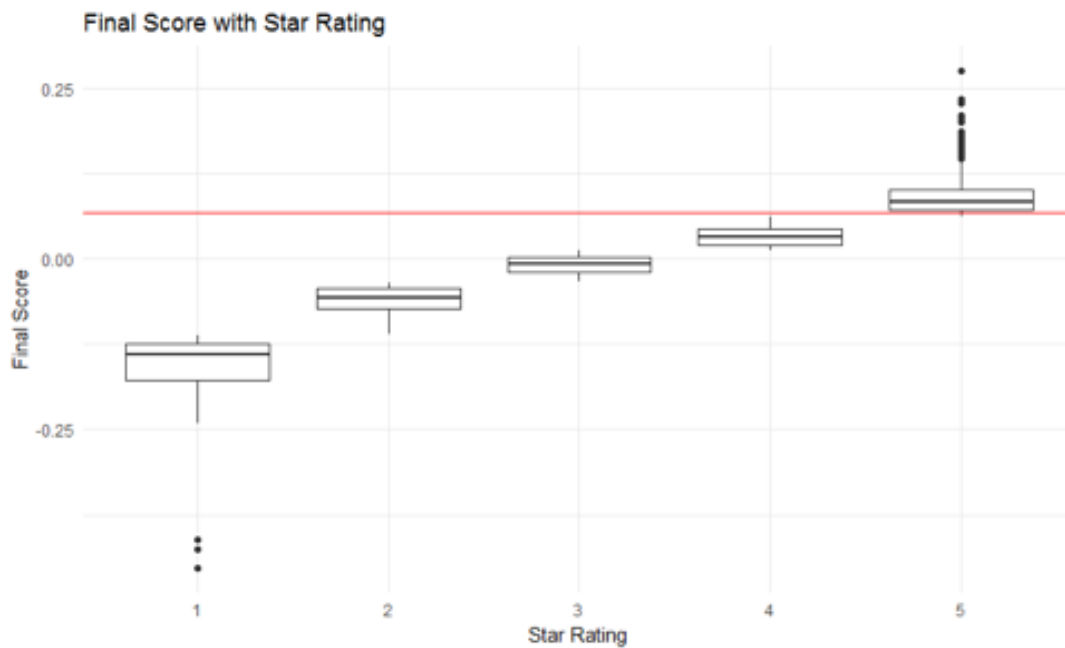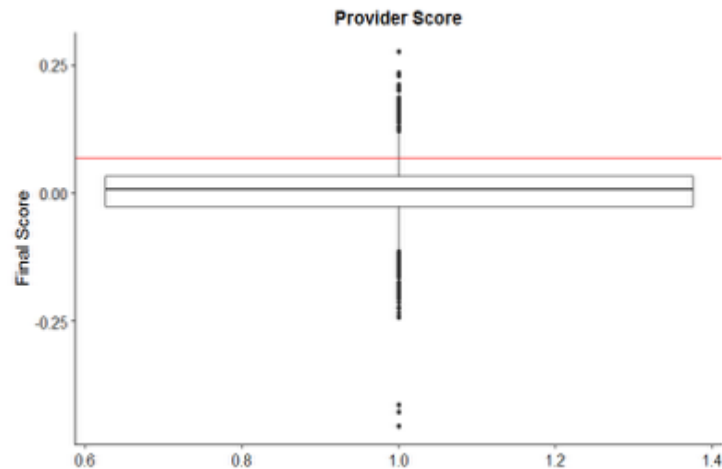
- Safety and Patient Experience scores are lower than national average

Group	Score Compared to National Average
Mortality (22%)	Above
Safety (22%)	Below
Readmission (22%)	Above
Experience (22%)	Below
Effectiveness (4%)	Above
Timeliness (4%)	Same
Medical (4%)	Above
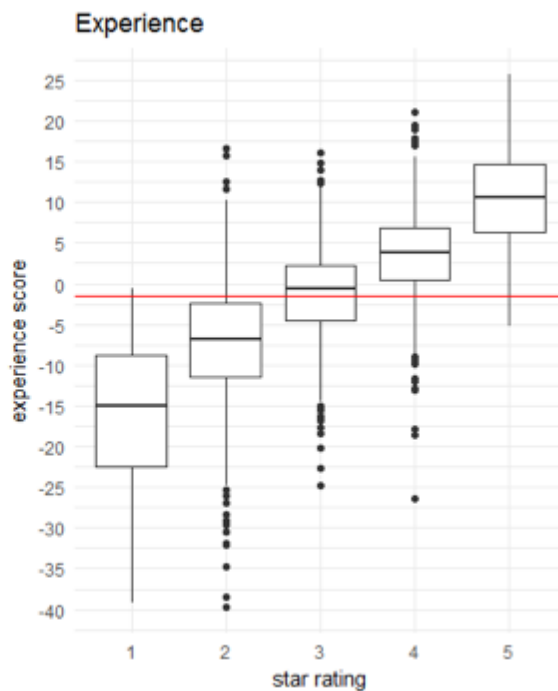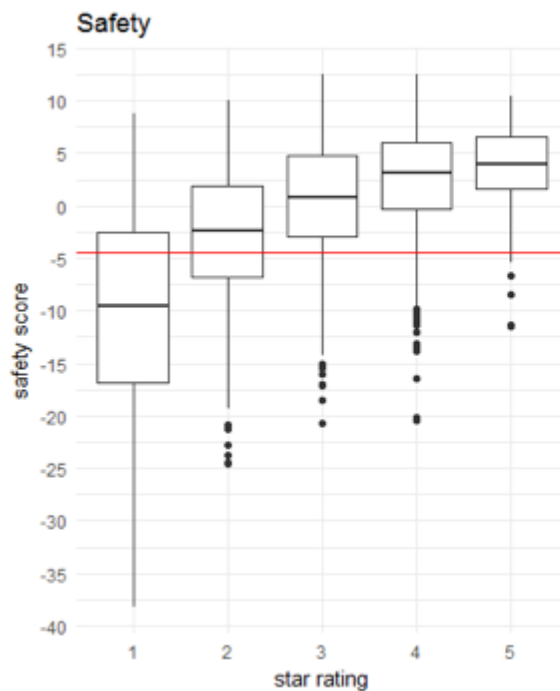
<u>- Surgical Site and MRSA Infections and Overall Patient Experience are key areas of improvement in Safety and Experience</u>

In Safety, *HAI_4 and HAI_5* scores are lower than average:
• HAI_4: Surgical Site Infection from abdominal hysterectomy (SSI: Hysterectomy)
• HAI_5: Methicillin-resistant Staphylococcus Aureus (MRSA) Blood Laboratory-identified Events (Bloodstream infections)

In Experience, *H_HSP_RATING_LINEAR_SCORE, H_RECMND_LINEAR_SCORE and H_CLEAN_LINEAR_SCORE* are lower than average:
• H_HSP_RATING_LINEAR_SCORE: Patients who gave their hospital a rating of 9 or 10
• H_RECMND_LINEAR_SCORE: Patients who reported they would recommend the hospital
• H_CLEAN_LINEAR_SCORE: Patients who reported that their room and bathroom were "Always" clean

<u>- 11 low scoring measures in 3 groups carry approx. 30% weight</u>

Low scoring measures:
• Readmission measures comprise about 20% weight
• Experience measures comprise about 6% weight
• Safety measures comprise about 4% weight

Measure Name	Group	Effective Measure Weight
READM_30_HOSP_WIDE_score	Readmission	0.097
H_HSP_RATING_LINEAR_SCORE_mean	Experience	0.036
READM_30_HF_score	Readmission	0.029
READM_30_PN_score	Readmission	0.029
HAI_4_SIR	Safety	0.024
READM_30_AMI_score	Readmission	0.020
READM_30_COPD_score	Readmission	0.019
H_RECMND_LINEAR_SCORE_mean	Experience	0.018
HAI_5_SIR	Safety	0.018
READM_30_HIP_KNEE_score	Readmission	0.009
H_CLEAN_LINEAR_SCORE_mean	Experience	0.009
Total		**0.307**

- Reducing Readmission rates is also a key improvement area

• **Readmission** scores are comparable to the national average, but the group **extremely important with higher values.**
• **Mortality** rates are already much better than the average
• Other three groups carry only 4% weightage each, thus can be de-prioritized
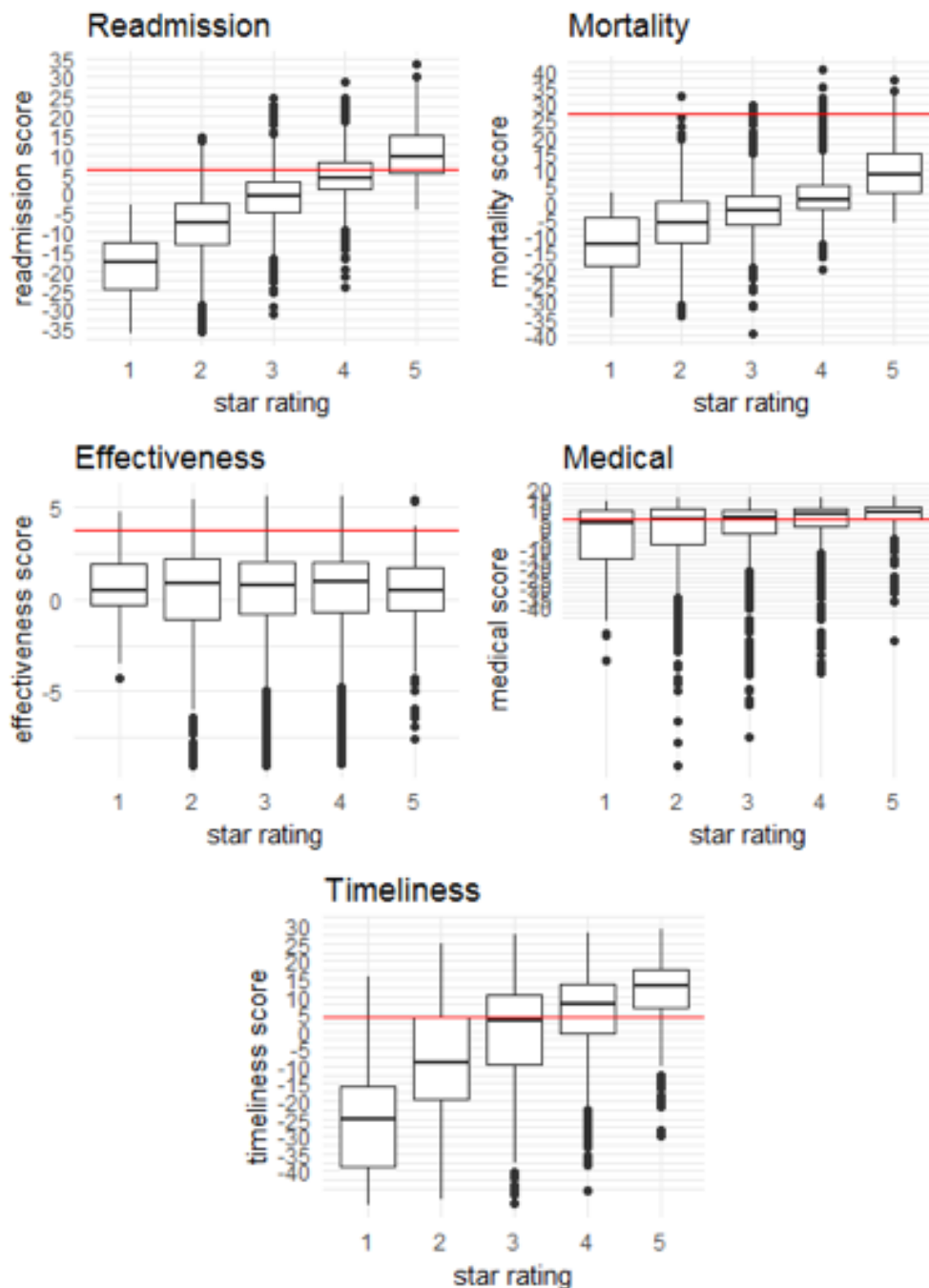
Recommendations for Evanston Hospital

The key measures of improvement are:

1. **Readmission:** Hospital-wide readmissions, readmission due to heart failure, pneumonia
2. **Patient Experience:** Discharge Information
3. Safety: PSI
4. **Timeliness of Care:** Median Time from ED arrival to ED departure and Admit decision time to ED departure time for admitted patients
5. **Mortality:** Pneumonia, Heart failure and chronic obstructive Pulmonary Disease

x---x---x---x---x