Executive Summary

This report presents the methodology for the Overall Hospital Quality Ratings. This report describes CMS's approach to construct a methodology for generating an Overall Hospital Quality Rating for each eligible hospital publicly reporting quality information on Hospital Compare.

Overview of Project Objective

Hospital Compare includes information on over more than 80 quality measures and more than 3,000 hospitals. The primary objective of the Overall Hospital Quality Star Ratings project is to develop a statistically sound methodology for summarizing information from the existing measures on Hospital Compare in a way that is useful and easy to interpret for patients and consumers. Consistent with other CMS Rating programs, this methodology assigns each hospital between one and five stars, reflecting the hospital's overall performance on selected quality measures.

Overview of k-Means Clustering

CMS considered several approaches for translating summary scores to Star Ratings, including categorizing hospitals by percentile, setting statistical significance cut-offs, and using a clustering algorithm.

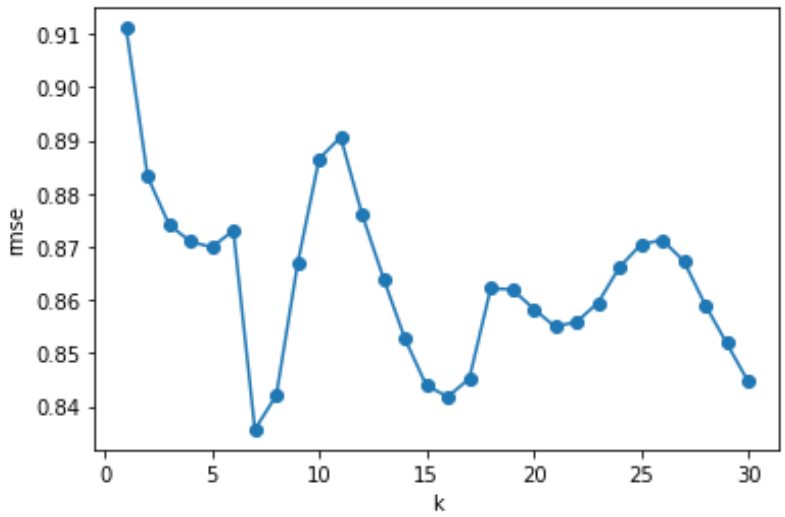
The Star Rating methodology utilizes k-means clustering. The k-means clustering analysis is a standard method for creating categories (or clusters) so that the observations (or scores) in each category are closer to their category mean than to any other category mean. The number of categories is prespecified; CMS specified five categories, so that k-means clustering analysis generates five categories based on hospital summary scores in a way that minimizes the distance between summary scores and their assigned category mean. Stated in another way, hospitals were organized into one of five categories such that a hospital's summary score is "more like" that of the other hospitals in the same category and "less like" the summary scores of hospitals in the other categories. The final Star Rating categories were structured such that the lowest group is one star and the highest group is five stars. The rationale for the decision to use k-means clustering is as follows:

- k-means optimally designates five "means" for five-star categories within the distribution of hospital summary scores. This minimizes the within-category and maximizes the between category differences in summary scores.

- Hospitals in a cluster will have similar summary scores.

- In comparison to alternative approaches, the k-means clustering approach produced a slightly broader distribution of star ratings.

- This approach is aligned with the similar clustering approach used to calculate the HCAHPS Star Ratings, also reported on Hospital Compare.

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The minimum rmse is obtained at k = 7
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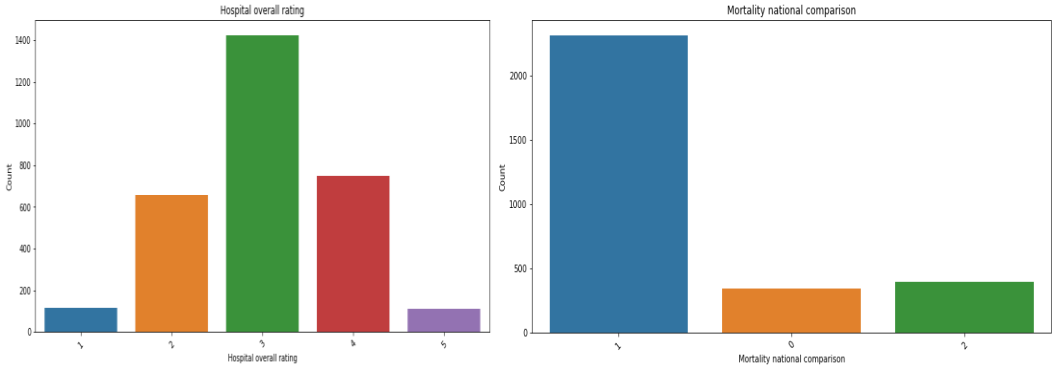
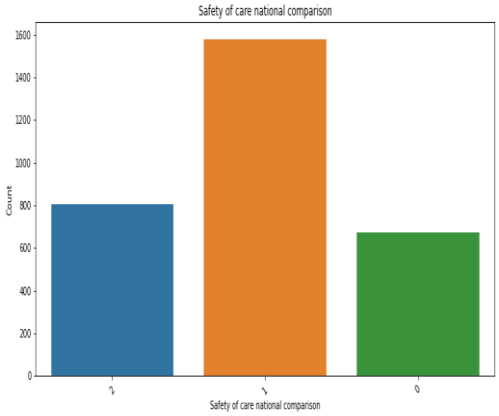
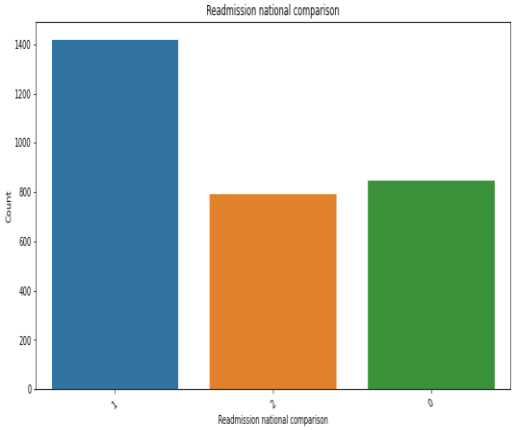
Visualisation of rating distribution and features:




Safety of care national comparison
Count
Safety of care national comparison
2
1
0


Readmission national comparison
Count
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1
2
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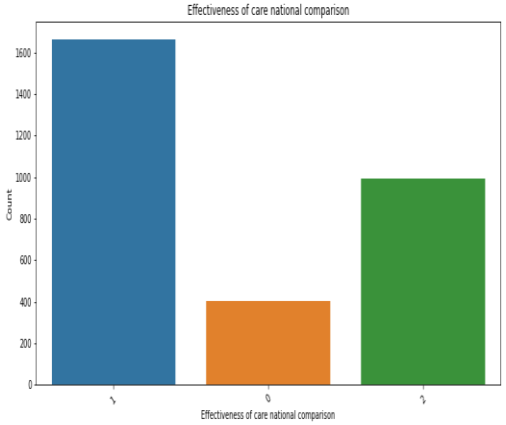
Effectiveness of care national comparison
Count
Effectiveness of care national comparison
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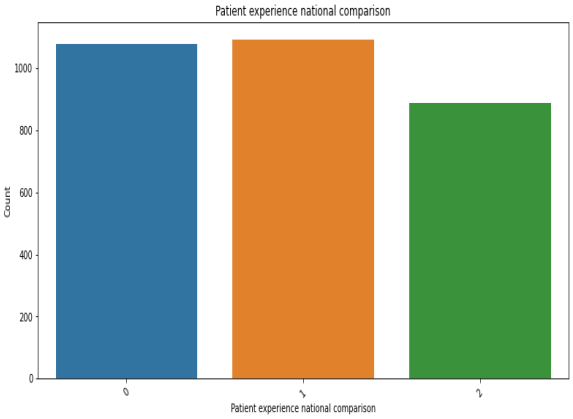
0
2


Patient experience national comparison
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Patient experience national comparison
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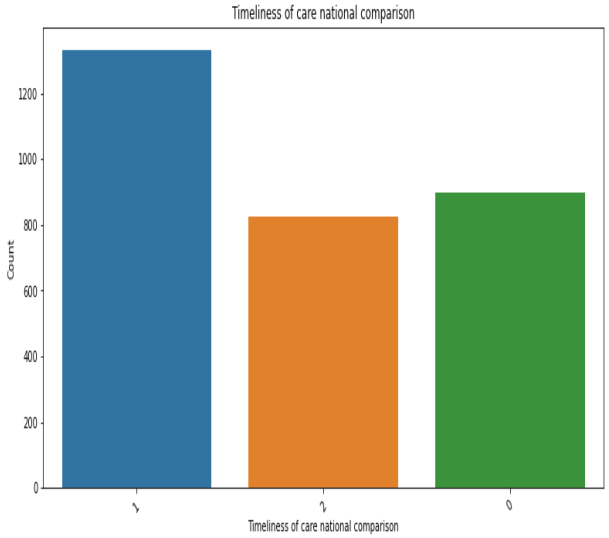
2


Timeliness of care national comparison
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Timeliness of care national comparison
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2
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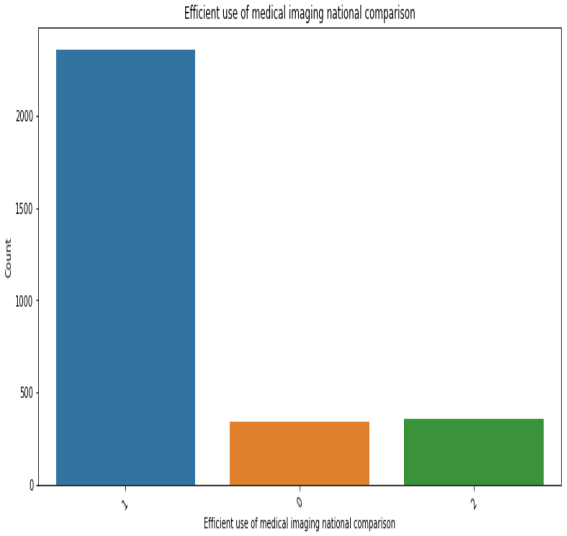
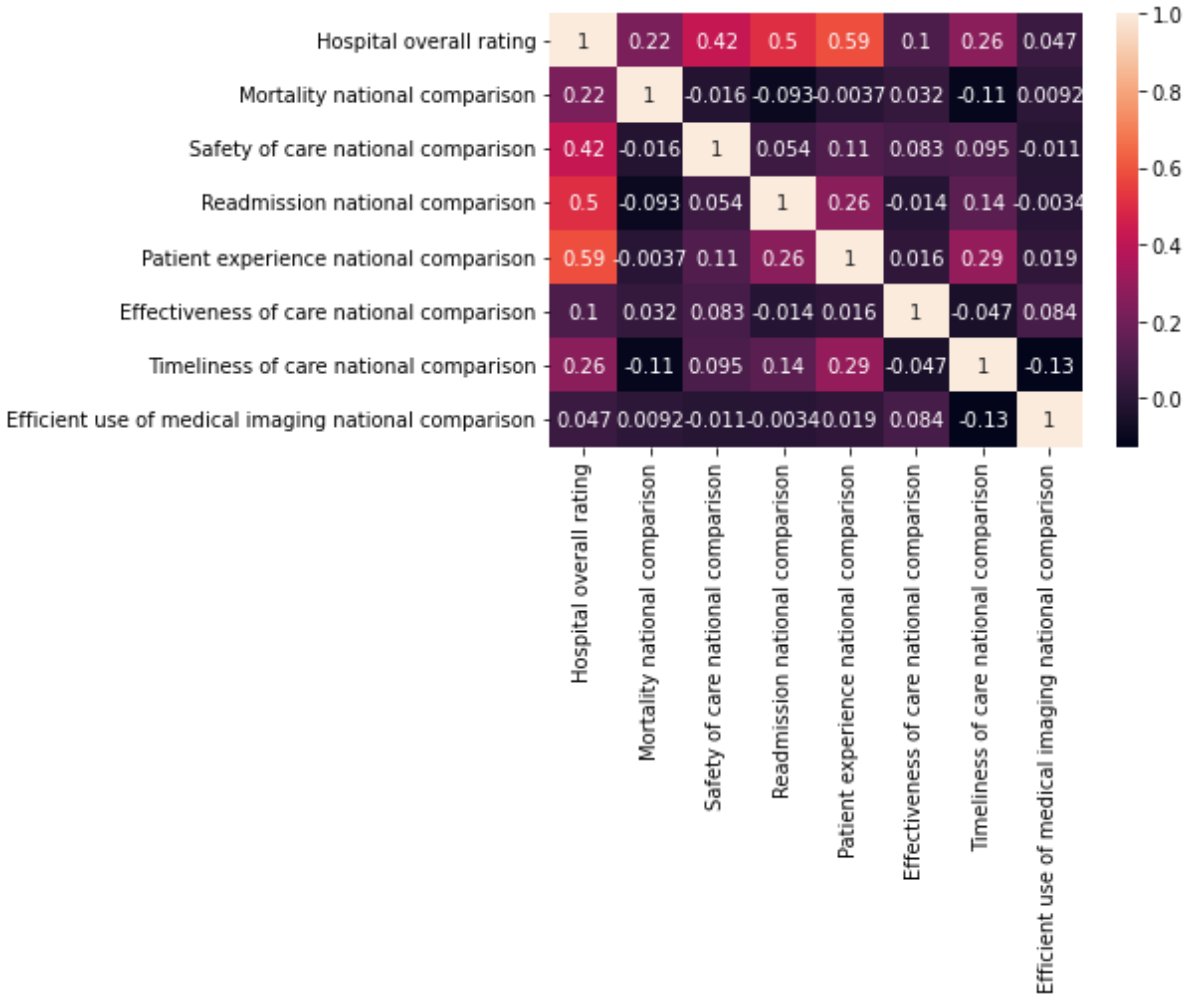

Efficient use of medical imaging national comparison
Count
Efficient use of medical imaging national comparison
1
0
2

Co-relation between main measures:



> Hospital rating is given from 1 to 5. Maximum 3 rating is observed and minimum 1 rating is observed among all the hospitals.

> Mostly all variables have positive co relation with target variable.

> Ratings are distributed among all types of hospitals. There is no specific category observed in low rating or in high rating.

> Using logistics regression model, we can predict hospital rating on above considered measures.

Conclusion

The goal of the Overall Hospital Quality Star Ratings is to improve the usability and interpretability of Hospital Compare for patients and consumers. As CMS continues to develop its Star Rating initiatives, this methodology may be updated and revised as needed.