**Assessment of CMS Metrics for Hospital Reimbursements**

Phillip Vance

Colorado State University Global

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Dr Steve Chung

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**Assessment of CMS Metrics for Hospital Reimbursement**

Healthcare facilities must perform well on quality metrics measured by the Centers for Medicare and Medicaid Services (CMS) and need to understand the intricacies of those metrics. Reimbursement by CMS for care provided for Medicare and Medicaid patients is tied to performance on specific quality metrics that include excess readmission ratio (ERR) and mean spending per beneficiary (MSPB). ANOVA was used to measure differences of means of those metrics between organization types and correlations calculated to see the effect of patient population severity as measured by the case mix index (CMI) on those metrics. ERR and MSPB are also directly compared, and the correlation calculated. For-profit facilities were found to be differ in means of ERR and MSPB from other facility types. CMI was also found to weakly correlate with MSPB and ERR suggesting some inherent characteristics of facilities affecting those metrics. ERR and MSPB were also weakly correlated to one another again suggesting an institutional knowledge that allows for care processes to provide quality and efficient patient care. The differences between organizations and the correlations among these metrics are useful to establish a more in-depth analysis of care processes of organizations performing well on those metrics to understand what makes them successful and implementing initiatives to emulate those care processes.

# **Introduction**

Healthcare organization finances have had to evolve over the last two decades as reimbursement for care has changed. Healthcare had previously been founded on a fee for service model where organizations billed for the services rendered, but due to ballooning healthcare costs the United States federal government has established multiple programs tying reimbursement to performance to rein in costs. The Centers for Medicare and Medicaid Services (CMS) withholds a portion of the reimbursements for care rendered for Medicare and Medicaid patients and pays that money back based on performance on various value-based initiatives (Centers for Medicare & Medicaid Service, 2023). When organizations excel as compared to their peers and benchmarks determined by CMS the hospitals are rewarded, but otherwise lose that withheld money. Each program acts separately from each other, and the reimbursement withheld for individual programs may be as high as 3% (Centers for Medicare & Medicaid Service, 2023). Some of these programs include the hospital value-based program (VBP) to improve the quality and efficiency of care resources utilized and the hospital readmission reduction program (HRRP) to improve the initial care provided and reduce readmissions for the same condition. The programs are intended to improve the quality of care given to patients while also promoting a more efficient system with real financial incentives.

The financial impact of the incentives can be quite large for some organizations. Medicare pays an average of 40% of the total healthcare expenses in the United States (Rosko et al. 2020). This is already a substantial portion of revenue and can be even greater for those organizations servicing a disproportionate number of Medicare and Medicaid patients. Performing well on these programs is especially critical because many organizations operate on small profit margins and a quarter of healthcare organizations have negative margins (Hayford et al. 2018). For hospitals to ensure profitability or maintain solvency in this landscape, quality care as measured by those CMS metrics must be achieved and maintained.

Besides a financial incentive to study the CMS VBP and HRRP metrics, healthcare organizations must already balance finite resources to efficiently maintain and improve patient care. Evaluating the readmission rates and efficiency scores of hospitals will provide insight into how successful organizations manage care. These two measures represent opposing components; readmissions rates represent a deficiency in resources used leading patients to seek additional services while efficiency scores measure too many resources.

# **Objectives**

The first objective of this project is to assess and understand the differences if any which exist in the quality measures between types of organizations. If differences exist, then organizations which perform best may be identified and characteristics supporting that superior performance be recognized. The specific quality measures being investigated are the mean spending per beneficiary (MSPB) to measure the efficiency of resources utilized per care episode in response to the VBP and the excess readmission ratio (ERR) as part of the HRRP. Organization features include the type of ownership (proprietary or for-profit, physician owned, government managed, or non-profit). Organizations also differ based on patient severity which can be measured by the case mix index (CMI) and is a standardized measure of patient population wellness based on summing the severity weight for each diagnosis related group (DRG). A higher value represents sicker, more complex patients. Facilities that have the capacity to treat critical care patients in trauma centers and intensive care units (ICUs) or chronically ill patients with more comorbidities have a higher CMI and represent more resources needed to care for those patients as compared to counterpart facilities without those capacities.

A second objective is to determine how these quality measures interact with each other. Understanding the interplay of various quality aspects may inform organizations seeking to implement quality initiatives. The analysis will not include causative, but purely correlative findings. With this knowledge organizations may focus on implementing targeted quality initiatives to have the greatest impact when multiple systems and quality measures may be impacted. Or more narrowly, how implementing projects to improve one quality measure may potentially impact others.

# **Overview of Study**

Multiple statistical tools will be utilized to answer and meet the objectives. ANOVA will be used to compare ERR and MSPB across organization characteristics. If differences exist, subsequent analysis includes comparison of specific organization types. Measuring the correlation between CMI and ERR and between CMI and MSPB, may provide insight into how organizations with different patient population severities perform on these metrics. Finally, the correlation between quality measures ERR and MSPB will be evaluated to determine what relationship exists between these two metrics.

# **Research Questions and Hypotheses**

Healthcare organizations must efficiently utilize resources to keep and improve patient care and to maximize reimbursements for those CMS programs. Evaluating readmissions and efficiency scores of hospitals will provide insight into characteristics of organizations successful at managing care. Readmission rates for patients returning within 30 days of discharge for the same condition are calculated as a rate from the overall number of patients with those conditions. If a patient must be readmitted for the same condition within 30 days, then the supposition is that the care received was not adequate and not enough resources were provided to the patient for proper care. On the other hand, efficiency of care represents the relative amount of resources used to treat a patient. The efficiency metric is the amount billed to CMS but standardized based on location and patient severity and is an estimate of the total care received. Higher values represent providing unnecessary or redundant care beyond what peer organizations deliver. These two measures represent opposing components: a deficiency and an excess of resources utilized to care for patients.

To improve care and maintain a high level of quality, a thorough understanding of these various metrics is needed from the perspective of an individual organization and comparison to peer organizations across the United States. CMS establishes benchmarks and thresholds for some metrics from industry experts to determine cutoffs for penalizations and reimbursements. CMS also compares an organization’s measure value in relation to its peers; the top decile of organizations gets full reimbursement while the remainder of the top 50% receive partial relative to their rank (Centers for Medicare & Medicaid Service, 2023). The bottom half receives no portion of the withheld amount. Improvement awards can also be rewarded when organization metrics as compared to baseline values improve.

Comparing facilities based on different characteristics can identify those who perform well on readmission and efficiency metrics. Facilities can be compared based on ownership status which will compare non-profit, to private for profit (proprietary), to government run organizations and physician owned facilities. How organizations are managed may impact patient care. Atala and Kroth (2020) found that non-profit organizations had worse patient outcomes and complications than for-profit, and government run facilities. However, non-profits can reinvest surpluses back into the organization to supplement existing care structures to improve patient care. Alternatively, for profit organizations may have greater financial incentives to identify and enact processes which maximize resource utilization for the most efficient care delivery.

Another way to compare facilities is through the CMI or average patient severity or sickness. Patients are assigned diagnosis codes for each of the presenting issues and those codes have been weighted based on a clinical severity rating. The more benign issues will have a lower rating, while the sickest patients will be higher. The ratings are averaged and presented as the case mix index (CMI). Hospitals which tend to treat the sickest patients or have the highest CMI tend to be teaching hospitals, larger facilities, and level 1 trauma centers (Mendez et al. 2014). In comparing the level of CMI of facilities, any differences in the efficiency of care delivered or the readmissions would be identified. Both measures have already been standardized and adjusted for patient severity, but a correlation may suggest some factor inherent in facilities dealing with the sickest patients that imparts better or worse care. For instance, hospitals treating more of the very sick patients may have care processes in place to maximize the care delivered based on institutional experience and knowledge. Alternatively, the facilities with the highest CMI may need to routinely utilize excess resources to care for the very sick which then carryover to the general population of patients in the form of redundant or extra care and lead to worse efficiency scores overall.

A third comparison would be directly between readmissions and efficiency scores. Each of these measures has an opposing effect and facilities must balance the care provided to result in the best patient outcomes. More resources used to treat patients are inefficient, but more resources may result in better patient outcomes or fewer readmissions. Less resources used may translate to worse patient care and result in worse outcomes and higher readmissions. Understanding the dynamic between the two measures may be informative to how facilities should balance the resources used to care for patients.

Hypothesis 1:

HO: There is no statistical difference in the means of excess readmission ratios between proprietary for-profit, non-profit, physician owned, and publicly run facilities.

HA: Alternatively, there is a statistical difference in the means of excess readmission ratios between proprietary for-profit, non-profit, physician owned, and publicly run facilities.

Hypothesis 2:

HO: There is no statistical difference in the means of MSPB scores between proprietary for-profit, non-profit, physician owned, and publicly run facilities.

HA: Alternatively, there is a statistical difference in means of MSPB scores between proprietary for-profit, non-profit, physician owned, and publicly run facilities.

Hypothesis 3:

HO: A facility’s average patient severity using the CMI has no statistically significant correlation to excess readmission ratios.

HA: A facility’s average patient severity using the CMI has a statistically significant correlation to excess readmission ratios.

Hypothesis 4:

HO: A facility’s average patient severity using the CMI has no statistically significant correlation to the MSPB score.

HA: A facility’s average patient severity using the CMI has a statistically significant correlation to the MSPB scores.

Hypothesis 5:

HO: A facility’s excess readmission ratio has no statistically significant correlation to its MSPB score.

HA: A facility’s excess readmission ratio has a statistically significant correlation to its MSPB score.

# **Literature Review**

There have been previous reports of differences to readmission rates and efficiency scores based on facility characteristics in the literature. Jindal et al. (2018) found differences in readmission rates based on ownership status of the facility (profit, non-profit, and government owned) but supposed those differences were attributable to the severity of the patient populations as different groups use each of the different types of facilities. Interestingly, CMS is already accounting for severity in the readmission rates, so Jindal et al. (2018) mused that organizations with higher CMI had the resources and infrastructure already in place to manage the care of the sickest and prevent readmissions. Rosko et al. (2020) found differences in MSPB scores based on ownership but attributed the differences to motivations of the facility; non-profit organizations reinvest profits back into the facility on education opportunities and initiatives and improving community outreach. Herrin et al. (2022) also showed that MSPB and total performance scores (TPS) were impacted by ownership with for-profits having a worse value.

Size and geographical location of the facility have also been shown to impact CMS program scoring. Readmission rates differ based on facility size which may reflect the complexity of patients seen where larger facilities are able to handle more complicated and complex cases (Jindal et al. 2018). MSPB or efficiency of resource utilization is also improved in larger facilities likely due to economy of scale (Rosko et al. 2020). However conflictingly, Herrin et al. (2022) found that smaller and rural facilities have a better value when comparing both MSPB and TPS together. Readmission rates differ based on geographic location (Jindal et al. 2018). MSPB and TPS changed with regional differences (Herrin et al. 2022). Chen et al. (2019) also identified regional differences in TPS. Regional differences in CMS scores may reflect variations in patient populations serviced by facilities.

Also of note is the varying results and impacts on patient care by the VBP and HRRP programs which were devised to improve the care provided. Waters et al. (2022) found little to worsening changes in mortality outcomes and mixed results with safety measures and efficiency scores but only studied 14 states based on the most complete data available. Chen et al. (2018) using regression found that the prior year’s scores were the best predictor of future total performance scores (TPS) and not more salient characteristics regarding processes of care. In fact, the top 5% of facilities stayed at the top with improving scores while the median scores worsened (Revere et al. 2021). This suggests that a top select few organizations are thriving at the top, but the remainder of facilities are not seeing consistent improvements in patient care. Figueroa and Wadhera (2022) evaluated the effectiveness of the HRRP on improving care and found the modest decrease in readmission rates since the implementation of HRRP could be attributable to the previous misclassifying of some short inpatient admissions to simple observations. Meaning previous readmission data was incorrectly reported and artificially increased and this would negate the modest decrease in rates.

CMS programs are evolving with changes and modifications to programs based on feedback from the healthcare community and results of the initiatives. Facilities were not held responsible for metrics obtained during the COVID-19 public health crisis to account for the extraordinary circumstances and potential for reporting metrics not reflective of the facility’s quality (Centers for Medicare and Medicaid Services, 2023). So, despite some existing data in the literature CMS metrics should be reevaluated to identify changes or new trends as facilities adopt new policies or mechanisms to improve care and in response to CMS program changes.

# **Methodology**

Medical spending per beneficiary (MSPB) is the specific efficiency score by CMS. MSPB is the amount billed to CMS but standardized based on location and patient severity and is an estimate of the total care received. Higher values represent providing unnecessary or redundant care beyond what peer organizations deliver. The measure is meant to further incentivize hospitals to provide efficient care and ultimately drive costs down (NEJM Catalysts, 2018).

Readmission rates are an indirect measure of resource usage for the value-based program. Readmissions within 30 days of discharge for acute myocardial infarction, chronic obstructive pulmonary disease, heart failure, pneumonia, coronary artery bypass graft surgery, or elective primary total hip arthroplasty or total knee arthroplasty are calculated. Then an expected readmission rate is calculated by CMS based on the severity of the patients and utilizing readmission rates from comparable facilities. If a patient must be readmitted for the same condition within 30 days, then the supposition is that the care received was not adequate and not enough resources were provided to the patient for proper care and essentially measures the amount and effectiveness of the resources initially utilized.

Comparing facilities based on different characteristics can identify those who perform well on readmission and efficiency metrics. Facilities can be compared based on ownership status which will compare non-profit, to proprietary, physician owned, and government managed organizations. How organizations are managed may impact patient care. As previously reviewed various publications have already identified differences in CMS metrics based on ownership status.

Another way to compare facilities is through the average patient severity or sickness. Patients are assigned diagnosis codes for each of the presenting issues and those codes have been weighted based on a clinical severity rating (CMI). Comparing the level of CMI of facilities can identify if there is a difference in the efficiency of care delivered or readmissions based on the severity level of the average patient. Both measures have already been standardized and adjusted for patient severity, but is there a factor inherent in facilities dealing with the sickest patients that imparts better or worse care? For instance, hospitals treating more of the very sick patients may have care processes in place to maximize the care delivered based on institutional experience and knowledge. Alternatively, the facilities with the highest CMI may need to routinely utilize excess resources to care for the very sick which then carryover to the general population of patients in the form of redundant or extra care and lead to worse efficiency scores.

A third comparison would be directly between readmissions and efficiency scores. Each of these measures has an opposing effect and facilities must balance the care provided to result in the best patient outcomes. More resources used to treat patients are inefficient, but more resources may result in better patient outcomes or fewer readmissions. Less resources used may translate to worse patient care and result in worse outcomes and higher readmissions. Understanding the dynamic between the two measures may be informative to how facilities should balance the resources used to care for patients.

# **Methods**

The data used in this project is made available through the CMS website: <https://data.cms.gov/provider-data>. CMS publishes the data submitted by healthcare facilities to promote transparency and empower patients as consumers to choose the healthcare that best suits their needs (Centers for Medicare and Medicaid Services, 2020). The CMS data will be utilized for this project because it represents the largest and most comprehensive data set of healthcare facilities in the United States that is publicly available. However, the data is published in multiple datasets so will need to be combined for the purposes of this work. The datasets will be joined based on a unique facility identifier. Any data points not present in all four datasets will be excluded; however, the efficiency dataset is the smallest and its constituents will likely dictate the final dataset.

The first dataset is the efficiency and cost reduction data that details the efficiency scores for participating healthcare organizations. There are 2517 unique facilities included in this dataset. The data set includes identifying information for each of the facilities, but this project will be limited to using the unique facility identification number. Efficiency scores are derived from a risk adjusted and standardized assessment of the medical spending per beneficiary (MSPB) of Medicare and Medicaid patients. Achievement points are awarded by CMS for facilities performing better than the threshold level for MSPB and range from no points to ten points for facilities in the top decile.

The Case mix dataset details the severity of the patient population seen by each facility. The facility is identified by a unique identifier labeled as provider. There are 3214 unique facilities represented in this dataset. The case mix index is a numerical representation of the average severity of the patients discharged.

The readmission reduction program dataset details information about readmissions for each of six conditions for each facility. There are 3,165 unique facilities identified by the Facility ID included in the dataset and with six conditions being measured which results in 18,990 unique readmission data in the dataset. The six conditions are pneumonia, hip or knee replacement, heart failure, chronic obstructive pulmonary disease, coronary artery bypass graft, and acute myocardial infarction. For each condition CMS includes the number of discharges and readmissions and calculates the actual readmission rate which is labeled as the predicted readmission rate. Within the data set CMS has also calculated an expected readmission rate which factors in patient severity from the CMI and compares similar size hospitals. The purpose of this project is not to investigate outcomes by a specific condition; instead, data from all the conditions is used and an overall readmission rate and expected readmission rate calculated. The final metric utilized by CMS to determine performance and reimbursement is the excess readmission ratio (ERR) which is calculated based on the total readmission data available. The ratio is the predicted readmissions divided by the expected where values above 1.0 represent more readmissions than a comparable facility.

The final dataset used in this project is the hospital general information dataset that details information about each of the facilities. Each of the 5446 facilities are identified using a unique Facility ID. Hospital ownership is described from twelve different groups that detail whether the facility is government, physician owned, proprietary, or non-profit. Government owned include the level (federal, state, regional, local) or whether the facility is a Department of Defense or Veterans Health Administration facility. Non-profits are further subdivided into church affiliated, private groups, or other. The ownership status however will be consolidated into four groups: proprietary (for-profit), non-profit, physician owned, or government managed.

The ERR and MSPB score will be evaluated based on hospital ownership status. Specifically identifying whether there is a difference in the means of readmission and efficiency scores between non-profit, proprietary, physician owned, and government run facilities. Using ANOVA, the means of each of those numerical scores of the four hospital types will be compared. The average patient severity using the CMI will also be evaluated against the ERR and MSPB. For each of these metrics any correlation will be assessed. The correlation coefficient between each of the numerical measures will be determined and the significance from zero calculated. Finally, the relationship between ERR and MSPB will be assessed. The correlation coefficient will be determined and the significance from zero calculated.

# **Limitations**

The data from the CMS website which is made publicly available is for Medicare patients only and is not a complete picture of the patient populations serviced by each facility. There could be differences in Medicare patients from the remaining patient population since Medicare patients are 65 and older and tend to have more comorbidities than younger patient populations and would need more resources to treat. This project may not be able to extrapolate to a facility’s larger patient population but will use the existing CMS data and report on findings for Medicare patients as a proxy for the facility.

This project will report on findings based on available data, but there are several unaccounted-for variables. Each facility will have its own unique combination of patient population and services offered, but this project is meant to offer a generalizable analysis to look for patterns or trends across many organizations. An in-depth qualitative analysis of a specific facility may be needed to investigate or implement specific quality initiatives. Another variable not taken into consideration is facility size. Jindal et al. (2018) found that readmission rates differ based on hospital size but hypothesized that the difference may reflect the complexity of patients seen as larger facilities are able to handle sicker patient workloads. Larger facilities are also able to improve MSPB or efficiency of resource utilization likely due to economy of scale (Rosko et al. 2020). Geographical and regional differences are another unaccounted-for variable and differences in readmission data also exist across regions suggesting patient populations serviced by different facilities affect CMS program scoring too (Jindal et al. 2018).

Another limitation of this project is the generalization of the analysis to evaluate the metrics without more context. For instance, efficiency of care can be gained in several ways including reducing redundant care, eliminating unnecessary care, or reducing overall hospitalization time (Cook et al. 2021). Circumstances surrounding readmissions are also complicated. Readmissions are not only influenced by the quality-of-care patients receive, but also through discharge planning and care coordination by the healthcare organization (Jindal et al. 2018). Readmissions are also affected by the demographics of the patients as previously mentioned; Jindal et al. (2018) found that socioeconomic, mental health, and behavioral health of the patients greatly influenced readmissions. These components should be considered by the healthcare organization when coordinating care. This project will only look at efficiency and readmissions as single metrics and does not have the ability to further break down or dissect facility processes or patient populations.

# **Ethical Considerations**

Data used for this project has been previously aggregated for each facility. There is no patient or personably identifiable information present and no risk of data breach to the patients. Furthermore, the data is publicly available and provided by CMS with full knowledge from each facility of the purposes and exposure of the data. No security or privacy issues are anticipated.

This work is meant to identify the facilities performing well on these metrics. Understanding how different facilities perform and the interplay of the metrics can be informative to make genuine improvements to patient care. However, this work could also be misconstrued as attempting to *game the system*. The various CMS quality programs have different reimbursement structures and attempts could be made to maximize reimbursement across all programs at the expense of quality care in individual areas.

# **Findings**

Each of the variables involved in the project were first evaluated and descriptive statistics calculated. MSPB had a mean of 0.99 with a 0.07 standard deviation (Figure 1). ERR similarly had a mean of 1.01 with a 0.05 standard deviation (Figure 2). Each of these variables has been previously standardized so the data confirms that the mean and median values are near 1.0 and distributed evenly. CMI has also been standardized, but average facility severity scoring is 1.83 with a 0.31 standard deviation (Figure 3). Ownership categories were also evaluated, and non-profits made up the majority of facilities followed by proprietary (for profit), physician owned, and government owned (Figure 4).

**Figure 1**

*Distribution of MSPB*

A graph of a performance rate

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**Figure 2**

*Distribution of Excess Readmission Ratio (ERR)*A graph of a distribution of excess readmission ratio

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**Figure 3**

*Distribution of Case Mix Index (CMI)*

A graph of a distribution of cases

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**Figure 4**

*Distribution of Hospital Ownership Categories*

A graph showing the number of individuals in the hospital

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**Figure 5**

*Comparison of MSBP Based on Ownership Status*

A screen shot of a chart

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**Figure 6**

*Homogeneity of MSPB Variance*

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**Figure 7**

*Welch’s ANOVA on MSPB*

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There was a statistically significant difference in the means of hospital efficiency scores (MSPB) between ownership statuses. ANOVA was used to compare the mean MSPB value between government, physician owned, proprietary, and voluntary non-profit facilities which resulted in a p-value of <0.001 which is statistically significant using 0.05 as the alpha (Figure 5). The variance in MSPB values within each group was also statistically significant as measured by a p-value of 0.0086 using Levene’s test (Figure 6). Due to the difference in variances among the groups Welch’s ANOVA was also utilized and resulted in a statistically significant result again suggesting a difference in means across the groups (Figure 7). Based on the findings the null hypothesis can be rejected and can conclude that there is a difference in the MSPB between the four ownership types. Going beyond the question of whether a difference exists and comparing each of the ownership types using least squares means shows a difference between proprietary and government scores and proprietary and non-profit. The difference can also be visualized in figure 5 where proprietary facilities have a higher MSPB than those other facility types. MSPB scores of government and non-profit facilities and physician owned, and all other facilities were not significantly different.

**Figure 8**

*Comparison of ERR Based on Ownership Status*

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**Figure 9**

*Homogeneity of ERR Variance*

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**Figure 10**

*Welch’s ANOVA on ERR*

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There was also a statistically significant difference in the means of hospital excess readmission ratios (ERR) between ownership statuses. ANOVA was again used to compare the mean ERR between government, physician, proprietary, and voluntary non-profit facilities which resulted in a p-value of <0.0001 and is significant using 0.05 as the alpha (Figure 8). The variance in ERR values within each group was also statistically significant as measured by a p-value of <0.018 using Levene’s test (Figure 9). Due to the difference in variances among the groups Welch’s ANOVA was again utilized and resulted in a statistically significant result suggesting a difference in the means across the group (Figure 10). Based on the findings the null hypothesis can be rejected and can conclude that there is a difference in ERR between the four ownership types. Evaluating the data further using least squares means, a difference was found between proprietary and all other hospital types (Government, physician, non-profit). The difference can be further visualized in figure 8 with proprietary facilities having a higher ERR than the other facilities. Comparisons between other ownership types were not significant.

**Figure 11**

*Relationship of CMI to MSPB*

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CMI was found to correlate with MSPB. A comparison between MSPB and CMI yielded a Pearson correlation coefficient of 0.22 with <0.0001 as the p-value (Figure 11). While the correlation is weak it is statistically significant. The null hypothesis that no correlation exists can be rejected as a correlation albeit weak, was found. The positive value of the Pearson correlation coefficient suggests that as CMI increases so does MSPB. So as the average patient severity increases for facilities so do the resources to care for those patients despite that amount having factored in patient severity already. This might suggest that facilities caring for the sickest patients still provide excess care and resources. Alternatively, facilities caring for the relatively healthier populations have found ways to be more efficient and utilize less resources. A third alternative is that the CMS calculations for standardized resource use based on patient severity do not adequately factor in CMI and tweaks to CMS models may be necessary.

**Figure 12**

*Relationship of CMI to ERR*

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Description automatically generated

CMI was also found to correlate with ERR. A comparison between ERR and CMI yielded a Pearson correlation coefficient of -0.19 with <0.0001 as the p-value (Figure 12). While the correlation is weak, it is statistically significant. The null hypothesis that no correlation exists can be rejected in favor of the alternative hypothesis that a correlation, albeit weak, exists. The negative value of the Pearson correlation coefficient suggests that as CMI increases the ERR decreases. As the average patient for a facility becomes more severe the readmissions decrease. This would suggest that facilities dealing with the sickest of patients have managed to utilize the necessary resources to treat their patients, preventing readmission. This may in part be due to increased resources being used by those facilities treating the sickest populations of patients. However, this idea is at odds when directly comparing MSPB and ERR which will be discussed next. Facilities caring for the sickest patient populations may have institutional knowledge of how best to treat or better resources (quality and not quantity of resources) to obtain better patient outcomes.

**Figure 13**

*Relationship of ERR to MSPB*

A blue dot diagram with numbers

Description automatically generated with medium confidence

Finally, MSPB and ERR were directly compared to identify whether a correlation exists. The Pearson correlation coefficient was 0.14 and <0.0001 is the p-value (Figure 13). This correlation is weak but again is statistically significant. As resources used to treat a patient increase the rate of excess readmissions increases as well. This might suggest that facilities utilizing too many resources are not seeing the improvement in patient readmissions that might be expected and that the resources are not being thoughtfully used or not targeted. The converse may also be true; that facilities who have managed to become most efficient with the care provided are also able to achieve the best patient readmission rates and that those facilities have managed to improve both simultaneously.

# **Conclusion**

The data show that there is a difference in the means of efficiency scores (MSPB) and readmissions (ERR) based on ownership. This difference corroborates similar analysis done previously that had also identified differences in those metrics. In the interim changes have been made to CMS reporting and the COVID-19 pandemic occurred. So, neither factor had such an impact to change the fact that differences still exist between organization types. An interesting finding is that the differences exclusively exist between proprietary or for-profit facilities from all other organizations. Proprietary facilities had a higher mean MSPB than government managed and non-profit facilities. Proprietary facilities also had a higher mean ERR than all other facilities so performed worse on both metrics than other facility types. For-profit facilities may have different financial motivations for managing patient care which impact care processes and therefore MSPB and ERR or differences may be attributable to the patient populations served. Ascertaining why the difference exists is unfortunately beyond the scope of this work.

Patient severity using the case mix index (CMI) also yielded interesting comparisons to MSPB and ERR. A correlation was found between CMI and both MSPB and ERR. This work corroborates previous findings of a correlation of patient severity with readmission scores despite CMS accounting for CMI when standardizing the predicted readmissions. Jindal *et al.* (2018) however categorized facilities into groups based on CMI and used regression to identify the pattern of diminishing readmissions with increasing CMI. The correlation between CMI and MSPB has not been reported but creates an interesting problem. Facilities with the sicker patients can achieve better patient outcomes and decrease readmissions, but seemingly use more resources (MSPB). However, directly comparing ERR to MSPB uncovers the opposite, that facilities which use more resources have worse patient readmission scores.

The correlations between CMI and MSPB, CMI and ERR, and ERR and MSPB are weak which suggests that there is a correlation among those variables, but that there are likely other variables impacting those metrics. Other studies in the literature have uncovered some of those potential variables: regional differences, size or capacity of facility, patient population demographics. Mendez et al. (2014) also identified higher CMI facilities tend to be teaching hospitals which could explain the greater MSPB. A deeper dive into what drives ERR and MSPB metrics may be necessary to determine what those other factors are. However, it seems that some facilities have an institutional knowledge that informs the care processes to enhance the quality of care to improve patient readmissions with the sickest of patients and improve readmissions while simultaneously providing a more efficient care and minimizing the resources utilized to care for patients. The balance between resource underutilization and overutilization does not have to impact quality of care and patient readmissions rather some facilities have found ways to maximize and improve both.

# **Recommendations**

Identifying that differences exist between facility types and patient populations is an important first step, but additional work is needed to understand what impacts those differences have. Furthermore, understanding the relationship between amount of resource utilization (MSPB) to patient outcomes indirectly suggesting resource underutilization (ERR) needs more information and scrutiny. Evaluating patient care processes in a more in-depth or qualitative study would uncover specific characteristics that would affect MSPB and ERR. From such studies quality improvement initiatives could be identified from successful organizations to improve quality of care and those quality measures. Evaluating facilities which are successful but with similar characteristics (ownership, patient severity, facility size, geographic location) may yield the most pertinent findings. It is important to concentrate efforts on initiatives that will provide the greatest return on improving care. Healthcare organizations with limited resources who need to conserve efforts will want to make the most of improvement projects or target those projects which will have the greatest impact. Beyond improving quality of care for their patients, these efforts will also maximize the reimbursement by CMS, further extending the organization’s ability to continue to make improvements.

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