VARIATION IN HOSPITAL PERFORMANCE UNDER THE MEDICARE VALUE-BASED PURCHASING PROGRAM

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ABSTRACT

The Medicare Hospital Value-Based Purchasing (HVBP) Program was established under the Affordable Care Act as a way to incentivize hospitals to provide efficient, high quality care. Hospital performance under the HVBP program varies considerably. Because program performance ultimately affects the amount Medicare pays for hospital services (the largest category of health expenditures), it is important for hospitals and policymakers to have a good understanding of the factors that explain this variation. Drawing from a sample of the most recent HVBP performance results (n = 2,487), this paper examines the extent to which different hospital characteristics - such as the bed size, ownership structure and patient mix - explain the variation in performance. This paper also contributes to existing research on the relationship between hospital spending and quality. Analysis of the most recent performance results supports the proposition that higher spending is not necessarily associated with higher quality. In fact, higher spending was observed to be associated with a slight reduction in quality (p-value <.035). This paper concludes with an analysis of the likelihood of receiving a penalty in the HVBP program based on certain characteristics. Some have asserted that hospitals treating a higher proportion of patients with low socio-economic status are more likely to be penalized by Medicare's incentive programs, and the most recent program results provide credible evidence to support this claim.

INTRODUCTION

The need to control health care costs is compelling. In 2017, health care expenditures were nearly 18% of gross domestic product, and the average annual growth rate in health care expenditures over the past ten years (4.3%) has eclipsed the GDP growth rate (3.1%). CMS, Office of the Actuary 2018. The growth in health care expenditures in relation to funding sources is also creating the risk of insolvency for the nation's largest health care program: Medicare. Today, around 60 million Americans have Medicare coverage, and the most recent Medicare Annual Report projects that fund assets will be depleted by 2026. CMS, 2018 Annual Medicare Trustees Report.

In recent years, there has been a call to move away from "paying for volume" and toward "paying for value." In 2015, the Centers for Medicare and Medicaid Services (CMS), the federal agency that administers the Medicare program, announced broad initiatives to tie provider payment to value: "When it comes to improving the way providers are paid, we want to reward value and care coordination – rather than volume and care duplication." CMS, Fact Sheet 2015. Among other initiatives, CMS is administering three hospital incentive programs that were authorized by the Patient Protection and Affordable Care Act, commonly referred to as the ACA:

- The **Hospital Value-Based Purchasing (HVBP) Program** which measures hospital performance across four domains and rewards or penalizes hospitals based on their performance.
- The **Hospital-Acquired Condition (HAC) Program** which measures the incidence of certain infections acquired in the hospital and penalizes hospitals whose performance is in the bottom quartile.
- The **Hospital Readmission Reduction Program (HRRP)** which measures hospital readmission rates for certain conditions and penalizes hospitals whose rate is above the expected peer group rate.

Combined, these three incentive programs could reduce Medicare payment for inpatient services by 6%: the maximum penalty under HVBP is 2.0%, and the maximum penalties under HAC and HRRP are 1.0% and 3.0%, respectively. Accordingly, hospitals have considerable financial motivation to improve performance in the areas being measured. These improvements will have beneficial spill-over effects. Even if another health care purchaser does not adopt a Medicare incentive program for its enrollees, hospitals that undertake efforts to improve performance under a Medicare incentive program will implement the same processes for all their patients, and this performance improvement will inure to the benefit of all payors.[1]

[1] The Medicare Payment Assessment Commission (MedPAC) was established by statute to advise Congress on Medicare payment policy. MedPAC has found that Medicare readmission rates have fallen since the establishment of the HRRP Program (MedPAC, Data Book 2018). It is reasonable to assume that readmission rates among other patients likewise fell since the same hospital processes to reduce readmissions would have been applied regardless of the patient's insurer.

THE HVBP PROGRAM

The HVBP program currently has four domains: clinical care; safety; patient satisfaction or experience of care; and efficiency. **Appendix 1** provides a summary of the measures of each domain. In brief, **clinical care** measures mortality rates (death during the inpatient admission or within 30 days from discharge); **safety** measures the extent to which patients acquire certain infections during their admission that may have been caused by the hospital (e.g., catheter-related infections); **patient satisfaction** or experience of care measures patient responses to survey questions across different subject matters, such as the effectiveness of communication with doctors and nurses; and **efficiency** measures Medicare spending per beneficiary for preadmission testing, the hospital admission and services furnished 30 days post-discharge (such as follow-up care in physician offices and nursing home stays).

A hospital receives a **Total Performance Score** or **TPS** based on its performance across the four domains.[2] Currently, each domain is equally weighted. The HVBP program incepted in 2013, and over the years, the number of domains and their weights have changed. Moreover, the scope of what is included in each domain has changed. For example, in the early years, the clinical care domain was focused more on *process* measures (such as performing blood cultures prior to prescribing an antibiotic) as opposed to *outcome* measures (such as mortality rates for heart attack patients). This presents some challenges in comparing this paper's results to the research findings on hospital variation from earlier years.

Under the HVBP program, CMS allocates 2% of hospital inpatient payments for payment on the basis of TPS scores, and this amount is estimated to be $1.9 billion for the current year. CMS, Fact Sheet 2018. From the federal government's perspective, the program is budget neutral as no additional spending occurs for hospital services; instead, 2% is being reallocated based on "value." CMS converts the TPS scores to payment adjustment factors, and hospitals with payment

[2] The TPS for a hospital is the sum of its weighted domain points, and hospitals can earn "achievement" points when their performance exceeds a nationally set threshold, as well as "improvement" points when they improve performance relative to their own prior period performance.

adjustment factors greater than 1.0 will receive a "bonus" (the largest payment adjustment factor for 2019 was 1.0367, resulting in a 3.67% bonus). Conversely, hospitals with payment adjustment factors less than 1.0 will incur a penalty (the smallest payment adjustment factor for 2019 was 0.9841, resulting in a 1.59% penalty). **Table 1** presents a summary of the number of hospitals receiving HVBP bonuses or penalties in the current year:

Table 1: 2019 HVBP Bonuses and Penalties

	HVBP Bonus	HVPB Penalty	Average TPS Score	Average Payment Adjustment
All Hospitals	1350	1137	37.51	0.134%
	54%	*46%*		
Ownership				
Nonprofit	963	700	38.29	0.178%
Proprietary	205	280	35.08	**-0.005%**
Government	182	157	37.15	0.113%
Teaching Status				
Non-teaching	904	581	39.59	0.252%
Other teaching	325	394	34.77	**-0.022%**
Major teaching	121	162	33.57	**-0.091%**
Geographic Location				
Other urban	470	466	36.03	0.050%
Rural	382	156	42.83	0.437%
Large urban	498	515	36.05	0.051%

LITERATURE REVIEW

There have been several studies of variation of hospital TPS scores, although research has not uncovered a recent study that explores the variation under the current four, equally weighted domains.

Several studies have found that the following variables are statistically significant in explaining variation in TPS scores: size of hospital (measured by the number of beds), the number of low income patients treated by the hospital, Medicare utilization, Medicaid utilization, teaching status and geographic region. (Borah 2012; Zhao 2015). Some studies also included as explanatory variables the scores that hospitals earned on specific clinical processes of care.

Although many variables were found to be statistically significant, the reported R-square was low (e.g., 0.20).

One study explored whether a hospital belonging to a health system, and the level of centralization and control at the health system, were significant. This study also considered the level of hospital market concentration, as measured by the Herfindahl-Hirschman index. (Spaulding 2018). It concluded that system affiliation and centralization were significant variables in TPS and individual domain scores. Interestingly, a hospital's market concentration was not statistically significant for TPS, but was found to be significant for clinical processes of care and patient satisfaction. The reported R-square was quite low, approximately 0.03 for TPS and ranging from 0.05 to 0.17 for the domains.

Several studies have reviewed the incidence of penalties in the HVBP program, some of them finding that safety net hospitals, large hospitals (as measured by bed size) and major teaching hospitals are more likely to be penalized. (Gilman 2015; Kahn 2015). The statistical analyses in these studies included chi-square and t-tests to test the differences between safety net hospitals and other hospitals, as well as logistic regression.

An extensive study was conducted of the impact of social risk factors under Medicare incentive programs, including HVBP, HAC and HRRP. (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation 2016). Social risk factors include the patient's income, education, race and ethnicity, employment, community resources and social support. The report found that a patient's dual eligibility in Medicare and Medicaid was a good indicator of social risk. It also found that dually enrolled beneficiaries had higher Medicare spending per episode. Congress required CMS to take dual status into account beginning in 2019 for purposes of the HRRP program by establishing peer groups based on dual proportions.[3] A study reported in this month's issue of JAMA Internal Medicine found that the stratification of hospitals into peer groups under the HRRP program resulted in a statistically significant changing of the odds of receiving a penalty. (Maddox 2019).

[3] Section 15002 of the 21st Century Cures Act, Pub. Law 114-255 (December 13, 2016).

STUDY OBJECTIVES

This paper examines the extent to which hospital characteristics explain the variation in hospital performance in the HVBP program. Because of changes in domains and weights over the years, it will be important to explore whether the results of earlier studies, such as the greater likelihood of penalties among safety net and major teaching hospitals, continue to hold.

This paper also examines the relationship between quality and spending as measured by the HVBP program. In particular, it will be explored whether an increase in the **Medicare spending per beneficiary (MSPB)** is associated with an increase or decrease in quality (as measured by the combination of scores in the other three domains).

This paper concludes with an examination of the likelihood of incurring a penalty in the HVBP, HAC and HRRP programs based on certain hospital characteristics, such as ownership, teaching status and geographic region. Also, this year is the first year that peer groups were established in connection with the HRRP program, and the analysis considers whether peer group assignment is statistically significant relative to the odds of being penalized in each of the three programs.

DATA

CMS maintains publicly accessible data files for the HVBP, HAC and HRRP programs. In addition, as part of the development of hospital payment rates for inpatient services, CMS maintains a DRG Impact File. This file includes many payment-related factors that were accessed to serve as explanatory variables for this study, including number of beds and average daily census (from which an occupancy rate can be calculated), case mix index, geographic location and residents-to-beds ratio. **Appendix 2** contains a list of the principal data sources and website links.

The data for this study is cross-sectional. TPS and domain scores are generally based on performance during calendar year 2017, and the variables utilized from the DRG Impact File were based on hospital cost reports during fiscal years 2015 and 2016.

The total number of hospitals for which CMS reported TPS and domain scores was 2,786. Because of incomplete data or unusual data discrepancies, the final data set included 2,487 observations. This data set was used for the principal regression. Because it is possible for a hospital to have zero points in a particular domain, but still have an overall TPS, it was necessary to eliminate a small group of hospitals when performing regressions on the domains (a double log regression specification was used, and it was not possible to take the log of zero). Consequently, the data set for the regressions relating to domain scores had 2,429 observations.

There were a large number of hospitals that had zero points for the efficiency domain. In lieu of eliminating those hospitals from the data set, the regression relating to the efficiency domain was based on MSPB ratios. (Even if a hospital scored zero points on efficiency, CMS calculates and publishes the hospital's MSPB ratio.)

To analyze the relationship between cost and quality, a **composite quality score (CQS)** was calculated. The CQS is not a CMS-reported measure. The CQS for each hospital was calculated as the hospital's TPS score minus the hospital's efficiency domain points, if any. Thus, if a hospital had a TPS score of 60 and earned 12 domain points for efficiency, its CQS was calculated as 48. The CQS was the dependent variable in the regression that included the efficiency explanatory variable (MSPB ratio), as well as all other explanatory variables used in the principal regression.

SELECTED VARIABLES AND FUNCTIONAL FORM

The principal regression used TPS as the dependent variable and the following as explanatory variables:

Beds - the number of beds (measures hospital size)

Occupancy Rate - reported average daily census divided by reported number of beds (measures how busy a hospital is and indirectly its profitability)

Beds * Occupancy Rate - this interaction term measures the additional impact on TPS when the size of a hospital (beds) and its busyness (occupancy rate) are combined

CMI - the case mix index (measures average complexity of the hospital's services to its patients)

DSH - the disproportionate share hospital percentage (measures the extent the hospital treats low income patients)

Dual Proportion - this is a percentage of the hospital's patients that are dually covered by Medicare and Medicaid and considered a measure of social risk

Teaching Status - categorical variable for non-teaching (reference), other teaching (residents-to-beds ratio is greater than 0 and less than .25) and major teaching (ratio greater than .25)

Geographic Location - categorical variable for other urban (reference), rural and large urban

Ownership Status - categorical variable for nonprofit (reference), proprietary and government-owned

Safety Net - categorical variable where safety net is defined as DSH percentage in top quartile (>38.34%)

HAC Penalty - categorical variable where the hospital is subject to a penalty in the HAC program

HRRP Penalty- categorical variable where the hospital is subject to a penalty in the HRRP program

The selection of the explanatory variables was primarily informed by the literature. In addition, the variables of occupancy rate (and the related interaction term) were added given the program's inclusion of an efficiency domain. Earlier research studies have not examined this domain. Higher occupancy hospitals are likely to experience gains from economies of scale. Moreover, large hospitals with higher occupancy rates are likely to have numerous physicians on staff, and thus better positioned to address low performing physicians. Smaller hospitals with low occupancy rates may be constrained in their efforts to eliminate low performing physicians.

While other studies have examined the incidence of penalties in the HVBP, HAC and HRRP programs, they have not considered penalties in the HAC and HRRP programs as explanatory variables for purposes of analyzing HVBP variation. These variables are included here because there is considerable overlap between the matters being measured in the different programs. For example, both the safety domain of HVBP and the HAC program are measuring the incidence of specific hospital-acquired infections. Similarly, the clinical care domain of HVBP measures mortality rates for certain conditions (such as heart attacks), while the HRRP program is measuring readmission rates for those same conditions. Given this overlap, it is theorized that HAC and HRRP penalties are statistically significant explanatory variables that are negatively correlated to TPS.[4]

The double log regression functional form was selected based on issues with heteroscedasticity. As illustrated in **Appendix 3**, there was visual evidence of heteroscedasticity with respect to certain of the variables under a level-level regression. The need to change the functional form was also confirmed by the Ramsey reset test (F-statistic 11.811; p-value <.001). The selection of the double log functional form was anticipated to improve the heteroscedasticity issues, as well as make it possible to interpret the coefficients as elasticities.

The Ramsey reset test for the double log regression resulted in an F-statistic of 2.971 and a p-value of 0.051. Although not technically a misspecification error at 5%, it is very close. Efforts were undertaken to test other functional forms to have greater confidence that there was not a misspecification error. For example, it was theorized that the number of beds and DSH percentage each have a quadratic relationship to TPS. For example, in the case of beds, one can expect scale and a higher level of sophistication to improve TPS as a hospital becomes larger; on the other hand, a hospital can be so large that it is not effective in communicating and enforcing best practices among its medical staff, and patients in large hospitals can feel "lost," thus depressing

[4] It is recognized that there may be an issue of reverse causality; namely, that HAC and HRRP penalties are not explaining the variation in TPS, rather the performance of the hospital as measured by TPS is explaining whether the hospital is likely to be subject to penalty in the HAC or HRRP programs.

TPS after a certain point. The polynomial equation, however, still had a high F-statistic (10.341) and low p-value (<.001).[5]

Following the selection of the double log functional form, tests for multicollinearity, serial correlation and heteroscedasticity were conducted. These results are reported on **Appendix 4**. There was still heteroscedasticity with the double log form (BP statistic: 50.94; p-value <.001), and the standard errors were corrected accordingly, as reflected in **Appendix 4**. There were no issues with multicollinearity (all of the variance inflation factors with the exception of those relating to the interaction term were below 3.5). The Durbin-Watson test indicated serial correlation (p-value <.01); however, because the data is not time series data, the serial correlation is probably arising from omitted variable bias. Accordingly, no correction for serial correlation was undertaken.

RESULTS AND ANALYSIS

This section of the paper is divided into three sections corresponding to the three study objectives.

1. Variation in TPS and Domain Scores

Table 2 presents a summary of the output from the principal regression (TPS as dependent variable). Six variables were significant at the 1% significance level; three variables were significant at the 5% significance level; and three variables were significant at the 10% significance level. Dual proportion, major teaching and safety net status were not statistically significant. This is somewhat counter to the literature reviewed, and discussed in more detail below. Although many of the variables are statistically significant, it is noteworthy that none of the coefficients is relatively large. Among the continuous variables, the largest coefficient is associated with occupancy rate, where a 1% increase in occupancy rate is associated with a decline of 0.30% in TPS. Among the categorical variables, being subject to a HAC penalty is expected to lower the TPS score by 14.6%.

[5] A level-log regression equation was also tested. It also resulted in a high F-statistic (5.1972) and low p-value (<.006).

The regression model had a relatively high F-statistic (52.83) and very low p-value, confirming that it is more effective in explaining variation than simply using the average TPS score. The adjusted R-square was 0.2393 which compares more favorably than the R-square reported in the prior studies that were reviewed.

Table 2: Total Performance Scores

	Coefficient	Standard Error	T Score	P-Value	
(Intercept)	4.02825	0.09509	42.363	< 2e-16	***
Continuous Variables					
lnBeds	-0.10209	0.017737	-5.756	9.68E-09	***
lnOccupancy.Rate	-0.301642	0.117925	-2.558	0.01059	**
lnBeds.lnOccRate	0.044085	0.02382	1.851	0.064326	*
lnCMI	0.179089	0.048435	3.697	0.000222	***
lnDSH	-0.043965	0.018392	-2.39	0.016902	**
lnDual.Proportion	0.007811	0.016991	0.46	0.645771	
Teaching Status					
Nonteaching (*reference*)					
Other.Teaching	-0.025846	0.012724	-2.031	0.042337	**
Major.Teaching	0.011426	0.020175	0.566	0.571221	
Geographic Location					
Other urban (*reference*)					
Rural	0.033624	0.017475	1.924	0.05446	*
Large.Urban	0.024481	0.011314	2.164	0.030582	*
Ownership Status					
Nonprofit (*reference*)					
Proprietary	-0.106487	0.013617	-7.82	7.73E-15	***
Government	-0.047781	0.016926	-2.823	0.004797	***
Safety.Net	0.00695	0.017139	0.405	0.685162	
HAC.Penalty	-0.146274	0.012303	-11.889	< 2e-16	***
HRRP.Penalty	-0.061885	0.018477	-3.349	0.000823	***

*p<0.10 **p<0.05 ***p<0.01

Adjusted R Square	**0.2393**
Number of Observations	2,487
F-statistic: 52.83 on 15 and 2471 DF, p-value: < 2.2e-16	
Standard errors corrected for heteroscedasticity	

It is interesting that major teaching status was not statistically significant given that, as a group, major teaching hospitals had the largest negative adjustments under HVBP, and the incidence of incurring a penalty (57.2%) was the second highest among the different categories of

hospitals reviewed (see **Table 1**). A chi-square test was performed relative to the observed versus expected penalty frequency among major teaching hospitals, and this test found that the difference was statistically significant:

Observed

	Bonus	Penalty	Totals
count of major teaching	121	162	283
count of other teaching	325	394	719
count of non-teaching	905	582	1487
total count	1351	1138	2489

Expected

	Bonus	Penalty	Totals
count of major teaching	154	129	283
count of other teaching	390	329	719
count of non-teaching	807	680	1487
	1351	1138	2489

Chi-square Statistic	64.97	Sum(observed - expected)^2/expected
Chi-square Critical Value (alpha 5%)	5.99	
P-Value	7.8E-15	

Because TPS is the summation of points across four domains, it is possible that a hospital's subpar performance in one domain is more than offset by its above-average performance in one or more of the other domains. This cross-offsetting feature may mask the impact that some variables have in explaining variation. To evaluate whether the selected variables explain more of the variation of performance within a domain, as opposed to performance across all domains, separate regressions were performed on each domain score. The double log functional form was used, and it was necessary to correct the standard errors for heteroscedasticity for three of the four domains (patient satisfaction did not have issues of heteroscedasticity). The results of the domain regressions, along with the TPS regression are presented in **Table 3**.

Table 3: TPS and Domain Scores

	Total Performance Scores	Clinical Care	Safety	Patient Satisfaction	Efficiency (MSPB Ratio)
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
(Intercept)	4.02825 ***	2.483273 ***	3.4557403 ***	1.689675 ***	-0.0777173 ***
Continuous Variables					
lnBeds	-0.10209 ***	-0.009247	-0.1752663 ***	-0.052398 *	0.0146965 ***
lnOccupancy.Rate	-0.301642 **	0.593587 ***	0.2293047	-1.096007 ***	0.1025471 ***
lnBeds.lnOccRate	0.044085 *	-0.106995 ***	-0.0832775 *	0.189061 ***	-0.0187525 ***
lnCMI	0.179089 ***	0.278161 ***	-0.4265208 ***	0.406783 ***	-0.0443952 ***
lnDSH	-0.043965 **	-0.116173 ***	0.0876415 **	-0.085625 ***	-0.0025961
lnDual.Proportion	0.007811	0.068788 **	-0.0316202	-0.1839 ***	0.0056225
Teaching Status					
Nonteaching (*reference*)					
Other.Teaching	-0.025846 **	-0.039736 *	-0.0165104	-0.043973 **	-0.0020479
Major.Teaching	0.011426	0.079258 **	-0.0262633	-0.013372	-0.003862
Geographic Location					
Other urban (*reference*)					
Rural	0.033624 *	-0.013219	0.0121333	0.036996	-0.0121452 ***
Large.Urban	0.024481 *	0.096719 ***	0.019987	-0.034974 *	0.0186239 ***
Ownership Status					
Nonprofit (*reference*)					
Proprietary	-0.106487 ***	-0.026755	-0.0126418	-0.175555 ***	0.034691 ***
Government	-0.047781 ***	-0.102096 ***	0.0007899	0.005638	0.0010902
Safety.Net	0.00695	0.012361	-0.0194918	-0.020258	-0.0009347
HAC.Penalty	-0.146274 ***	-0.036736 **	-0.3422713 ***	-0.071498 ***	0.0080351 ***
HRRP.Penalty	-0.061885 ***	-0.007258	-0.0573566	-0.051674 *	0.014431 ***
*p<0.10	**p<0.05	***p<0.01			
Adjusted R Square	**0.2393**	**0.1166**	**0.196**	**0.2498**	**0.206**
Number of Observations:	2,487	2,429	2,429	2,429	2,429
F-statistic:	52.83	19.95	39.13	54.9	37.79
P-Value:	< 2.2e-16	<2.2e-16	<2.2e-16	<2.2e-16	<2.2e-16
Standard errors corrected for heteroscedasticity except for patient satisfaction					

Appendix 5 contains the full regression output for each domain regression.

Case mix was statistically significant for TPS and each domain score. Case mix measures the complexity of services furnished by the hospital, and it makes sense that the complexity of

services would affect mortality rates (clinical care) and infection rates (safety). It is unusual, however, that a 1% increase in case mix tends to *increase* the hospital's performance under clinical care (+0.28%) yet *decrease* its performance under safety (-0.43%). One would expect the sign to be the same for both. A similar change in sign is present with respect to DSH.

HAC penalties were statistically significant across TPS and each domain. One would expect this result, particularly with the safety domain since the infection rates measured in that domain are also measured in the HAC program. The HRRP penalty is significant at the 1% level for TPS and efficiency (and at 10% level for patient satisfaction); it is not, however, significant for clinical care. This is surprising since clinical care measures mortality rates for the very same conditions that are measured in the HRRP program. It is reasonable to expect that if there are care deficiencies leading to excess readmissions for a specific condition (like heart attacks), those same care deficiencies would show up in the clinical care score which considers mortality rates among heart attack patients.

Proprietary ownership status had a downward impact on TPS and three of the four domains. It had an upward impact on the efficiency variable, but in this case, a higher MSPB ratio means lower efficiency (higher spending). At first instance, it may seem incongruent for proprietary hospitals to score less favorably on efficiency. Proprietary organizations would presumably want to be as efficient as possible in order to maximize profits. This MSPB measure, however, is not really examining hospital cost efficiency, but rather the level of Medicare spending. A hospital that provides a substantial amount of services post-discharge may have a higher MSPB ratio, but its margin on those services may more than offset any "hit" under the HVBP program.

It is noteworthy that safety net status was not statistically significant for TPS or ***any*** domain. In addition, the variable dual proportion was not statistically significant for the efficiency domain. As noted earlier, a recent government study found that dual beneficiaries had higher spending per episode. (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation 2016).

2. Relationship between Spending and Quality

The composite quality score (CQS) was regressed against all of the other explanatory variables plus the MSPB ratio in order to evaluate the relationship between spending and quality. This is particularly relevant since some assert that it is not reasonable to expect hospitals to be both low cost and high quality. A double log regression functional form was utilized. The Breusch-Pagan test identified issues with heteroscedasticity (BP statistic: 42.021; p-value <.01), and the standard errors were corrected accordingly. The MSPB ratio had a negative coefficient that was statistically significant at the 5% level. For every 1% increase in the MSPB ratio, the CQS can be expected to decline by 0.177%. *See* **Appendix 6** for the full regression output. While the impact on quality of a 1% increase in the MSPB ratio is quite small, the direction is significant and supports that view that spending and quality are inversely related.

3. Odds of Incurring a Penalty in the Incentive Programs

The logistic regressions used HVBP Penalty, HAC Penalty and HRRP Penalty as the dependent variables (yes=1), and the same explanatory variables from the principal regression. In addition, binary variables were established for peer group assignment. For 2019, CMS determined HRRP penalties by comparing a hospital's performance relative to its peers, and five peer groups were established based on the proportion of dually eligible beneficiaries. (A hospital's dual proportion ratio is also used as a continuous independent variable.) The likelihood of receiving a penalty in each of the three incentive programs was examined, and the results by select hospital characteristics are presented in **Table 4.** The full logistic regression output is set forth in **Appendix 7**.

Table 4: Odds of Receiving a Penalty by Select Hospital Characteristics

		Odds Ratios		
		HVBP Penalty	HAC Penalty	HRRP Penalty
Teaching Status				
	Non-teaching	*reference*	*reference*	*reference*
	Other teaching	1.19	0.78 **	0.89
	Major teaching	0.89	1.13	2.15 **
Geographic Location				
	Other urban	*reference*	*reference*	*reference*
	Rural	0.81	1.13	0.8
	Large urban	0.88	1.33 **	2.03 ***
Ownership				
	Nonprofit	*reference*	*reference*	*reference*
	Proprietary	2.30 ***	0.86	2.22 ***
	Government	1.29 *	1.34 **	1.12
Peer Group				
	1	*reference*	*reference*	*reference*
	2	1.45 **	1.29	1.32
	3	1.33 *	1.19	1.16
	4	1.61 **	1.79 ***	1.14
	5	1.72 *	1.77 *	1.12
Safety Net		1.11	1.34 *	1.34

*p<0.10
**p<0.05
***p<0.01

The odds of major teaching hospitals being penalized in HVBP were not greater (from the standpoint of statistical significance) than the odds associated with non-teaching hospitals. This result is similar to the result under the principal regression which did not find this variable to have statistical significance (see **Table 2**). The odds ratio for large urban hospitals being penalized in the HAC and HRRP programs were much higher than other urban hospitals (33% and 103%, respectively). Proprietary ownership also had higher odds for penalties in the HVBP and HRRP programs - more than double the odds that nonprofit hospitals have of being penalized. Government ownership was also significant for two programs.

Peer group assignment (which is based on the proportion of dually eligible patients) was statistically significant for the HVBP program for each peer group. This appears somewhat

anomalous with the results of the principal regression; namely, changes in the continuous variable for dual proportion were not statistically significant in explaining changes in TPS (see **Table 2**). Peer Group 1 is comprised of hospitals having the lowest proportion of dual patients, while hospitals in Peer Group 5 have the largest. The odds of being penalized increase with peer group assignment/dual proportions. Thus, a Peer Group 2 hospital has a 45% greater chance of being penalized than a Peer Group 1 hospital, and a Peer Group 5 hospital - which is among hospitals that have the largest dual proportions - has a 72% greater chance of being penalized as compared to a Peer Group 1 hospital. Assignment in the highest peer groups was also significant for the likelihood of HAC penalties.

Peer group assignment was not statistically significant for HRRP. This is to be expected. The changes to the HRRP program result in hospitals being measured against their peers, so by design, the likelihood of being penalized should not differ depending on peer group assignment.

Although there have been a number of studies positing that safety net hospitals are more likely to be penalized, this was only evident with respect to the HAC program (a 34% higher likelihood than non-safety net hospitals). The fact that the HVBP penalty odds ratios between safety net and non-safety net hospitals are not different (from the standpoint of statistical significance) is similar to the result under the principal regression where the p-value for this variable was above 68% (see **Table 2**).

SUMMARY AND CONCLUSIONS

The multivariate regression analysis identified numerous variables as statistically significant in explaining the variation in TPS. Among those variables significant at the 5% or lower level are number of beds, occupancy rate, CMI, DSH, other teaching hospital status, and ownership status. In addition, the variables with respect to HAC and HRRP penalties were also significant. Despite some earlier studies finding major teaching status and safety net hospital status as significant, this was not the case here.

The regression is missing important variables that explain the variation in TPS scores. From a statistical perspective, this is evident from the low adjusted R-square (around 24%). While this compares favorably to prior studies, it still means that more than 75% of the variation is explained by other factors. The Ramsey reset test results, as well as Durbin-Watson serial correlation test results, may also be due to omitted variables. From a theoretical perspective, the variables selected deal primarily with matters that are relevant for determining hospital payment rates in the Medicare program; after all, most of the variables come from the principal file used for rate development (the DRG Impact File). In the case of HVBP, variables that are not necessarily payment related are more likely to be explanatory, such as nurse-patient ratios; the percentage of physicians who are employed; whether the hospital has formal relationships with post-acute providers, such as nursing homes to manage care transitions; the presence of an electronic health record which can be accessed by providers outside of the hospital; the participation of the hospital in other Medicare value-based initiatives, such as accountable care organizations and bundled payment; and medical malpractice loss experience.

Earlier studies examined whether being part of a health system, the level of control by the health system, and hospital market share explain TPS variation. Analysis of these variables in future studies would be helpful, although access to this information is not through federal government sources. In earlier versions of the HVBP program, there was greater emphasis on process measures, such as cholesterol screening. System affiliation and parent company control may be highly relevant to process improvement, but less relevant to outcomes (the focus of the current HVBP program), and this merits further study.

The relationship between quality and spending is an important relationship. This study finds an inverse relationship, but the magnitude of the effect of higher spending on quality was found to be slight (less than a 0.2% decrease). The HVBP, HAC and HRRP programs provide a wealth of data to develop composite quality scores. While the MSPB ratio provides a readily available spending metric, it is not necessarily a measure of hospital efficiency. Spending that occurs outside of the hospital and outside of the hospital's control is part of the MSPB ratio, and it may be more appropriate to regress quality against a hospital cost metric, such as average cost per case.

The logistic regression analysis provides an assessment of the likelihood of being penalized in the program and specifically examines peer group assignment. Since this is the first year of peer group assignment, further research is likely to explore whether the HRRP peer group methodology should be "imported" to the HVBP and HAC programs. This analysis finds that peer group assignment changes the likelihood of being penalized in the HVBP program, and if this result is confirmed through further research, it may increase calls for adopting a similar peer group methodology for HVBP. This study, however, does not support the view that safety net hospitals are more likely to incur downward payment adjustments in the HVBP program.

There are some limitations from the data set in terms of consistency of time periods. The TPS scores are based on performance in 2017 (and for some measures, earlier periods). On the other hand, many of the continuous variables are derived from the DRG Impact file, and these are from an earlier period (around 2015-2016). It is possible that variables such as case mix, DSH and bed size do not change significantly from year to year, but no robustness check was done to confirm this assumption.

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APPENDIX 1

2019 HVBP Measures and Domains

Measure ID	Measure Description	Domain
CAUTI	Catheter-Associated Urinary Tract Infection	Safety
CLABSI	Central Line-Associated Blood Stream Infection	Safety
CDI	*Clostridium difficile* Infection (*C. difficile*)	Safety
MRSA	Methicillin-Resistant *Staphylococcus aureus* Bacteremia	Safety
PSI-90	Patient Safety for Selected Indicators (composite)	Safety
PC-01	Elective Delivery Prior to 39 Completed Weeks Gestation	Safety
SSI	Surgical Site Infection: • Colon • Abdominal Hysterectomy	Safety
MORT-30-AMI	Acute Myocardial Infarction (AMI) 30-Day Mortality Rate	Clinical Care
MORT-30-HF	Heart Failure (HF) 30-Day Mortality Rate	Clinical Care
MORT-30-PN	Pneumonia (PN) 30-Day Mortality Rate	Clinical Care
MSPB-1	Medicare Spending per Beneficiary (MSPB)	Efficiency and Cost Reduction
Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey	• Communication with Nurses • Communication with Doctors • Responsiveness of Hospital Staff • Communication about Medicines • Hospital Cleanliness and Quietness • Discharge Information • 3-Item Care Transition* • Overall Rating of Hospital	Patient and Caregiver-Centered Experience of Care/ Care Coordination

APPENDIX 2

Data Sources and Website Links

Note: FFY = Federal Fiscal Year

HVBP FFY 2019 Total Performance Scores and Domain Scores
https://data.medicare.gov/Hospital-Compare/Hospital-Value-Based-Purchasing-HVBP-Total-Perform/ypbt-wvdk

HVBP FFY 2019 Payment Adjustment Factors - Table 16B
https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/FY2019-IPPS-Final-Rule-Home-Page-Items/FY2019-IPPS-Final-Rule-Tables.html?DLPage=1&DLEntries=10&DLSort=0&DLSortDir=ascending

Hospital Compare - data on ownership and underlying HVBP Performance
https://data.medicare.gov/data/hospital-compare

MSPB FFY 2019
https://healthdata.gov/dataset/medicare-spending-beneficiary-%E2%80%93-hospital

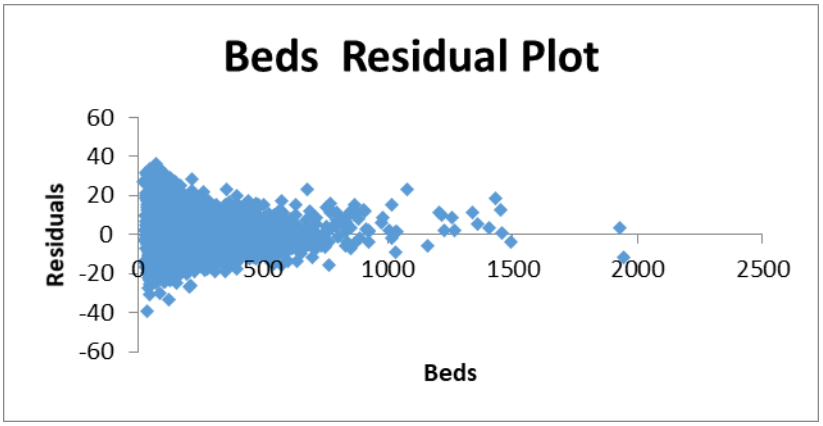
DRG Impact File FFY 2019
https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/FY2019-IPPS-Final-Rule-Home-Page-Items/FY2019-IPPS-Final-Rule-Data-Files.html

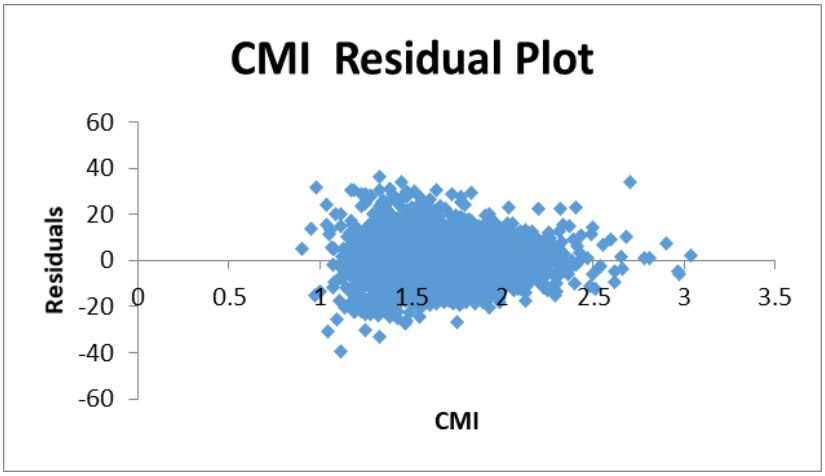
HRRP FFY 2019:
https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/FY2019-IPPS-Final-Rule-Home-Page-Items/FY2019-IPPS-Final-Rule-Data-Files.html

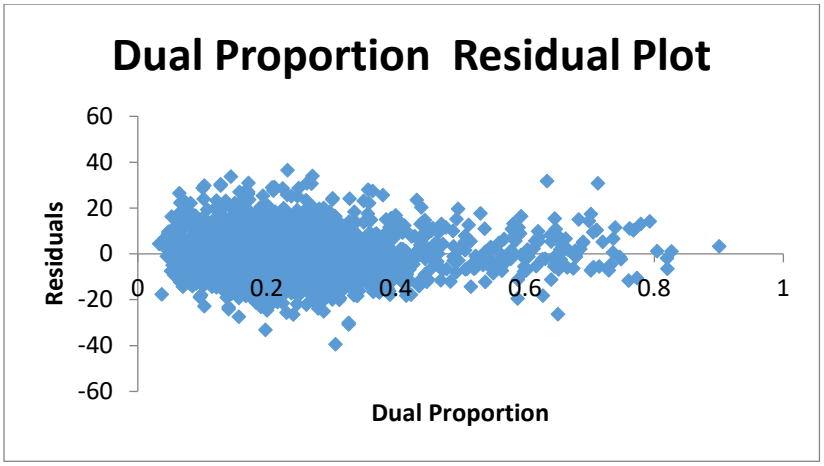
HAC FFY 2019:
https://data.medicare.gov/Hospital-Compare/Hospital-Acquired-Condition-Reduction-Program/yq43-i98g

APPENDIX 3

Visual Evidence of Heteroscedasticity in Level-Level Regression







APPENDIX 4

Results of Multicollinearity and Serial Correlation Tests Heteroscedasticity Tests and Corrections - Double Log Functional Form

VIF Factors - Double Log

Government	1.0951
HAC.Penalty	1.048702
HRRP.Penalty	1.055052
Large.Urban	1.290941
lnBeds	6.383405
lnBeds.lnOccRate	44.983339
lnCMI	2.164519
lnDSH	3.22759
lnDual.Proportion	2.706605
lnOccupancy.Rate	57.559416
Major.Teaching	1.698344
Other.Teaching	1.395703
Proprietary	1.101974
Rural	1.78226
Safety.Net	1.962311

Ramsey Reset Test - Double Log

F-statistic == 2.971, df1 = 2, df2 = 2469
P-value = 0.05144

Durbin-Watson test - Double Log

DW = 1.9005
P-value = 0.005844
Alternative hypothesis: true autocorrelation is greater than 0

Breusch-Pagan Test - Double Log

BP = 50.936, df = 15
P-value = 0.00000846

		Before HC Correction	**After HC Correction**
Coefficients:			
	Estimate	Std. Error	Std. Error
(Intercept)	4.02825	0.087693	0.09509
Government	-0.047781	0.015581	0.016926
HAC.Penalty	-0.146274	0.011955	0.012303
HRRP.Penalty	-0.061885	0.01739	0.018477
Large.Urban	0.024481	0.011814	0.011314
lnBeds	-0.10209	0.016751	0.017737
lnBeds.lnOccRate	0.044085	0.02128	0.02382
lnCMI	0.179089	0.04675	0.048435
lnDSH	-0.043965	0.017963	0.018392
lnDual.Proportion	0.007811	0.017373	0.016991
lnOccupancy.Rate	-0.301642	0.103321	0.117925
Major.Teaching	0.011426	0.020966	0.020175
Other.Teaching	-0.025846	0.013313	0.012724
Proprietary	-0.106487	0.013536	0.013617
Rural	0.033624	0.016565	0.017475
Safety.Net	0.00695	0.016534	0.017139

APPENDIX 5
Domain Regressions - Full Output

Clinical Care	Coefficient	Standard Error	T Score	P-Value	
(Intercept)	2.483273	0.133439	18.61	< 2e-16	***
Continuous Variables					
lnBeds	-0.009247	0.026239	-0.352	0.724576	
lnOccupancy.Rate	0.593587	0.165264	3.592	0.000335	***
lnBeds.lnOccRate	-0.106995	0.03344	-3.2	0.001394	***
lnCMI	0.278161	0.073715	3.773	0.000165	***
lnDSH	-0.116173	0.025099	-4.629	3.88E-06	***
lnDual.Proportion	0.068788	0.026761	2.57	0.010217	**
Teaching Status					
Nonteaching (*reference*)					
Other.Teaching	-0.039736	0.02105	-1.888	0.059192	*
Major.Teaching	0.079258	0.03131	2.531	0.011424	**
Geographic Location					
Other urban (*reference*)					
Rural	-0.013219	0.027335	-0.484	0.628713	
Large.Urban	0.096719	0.017197	5.624	2.08E-08	***
Ownership Status					
Nonprofit (*reference*)					
Proprietary	-0.026755	0.019617	-1.364	0.172728	
Government	-0.102096	0.024964	-4.09	4.46E-05	***
Safety.Net	0.012361	0.025467	0.485	0.627464	
HAC.Penalty	-0.036736	0.018559	-1.979	0.047885	**
HRRP.Penalty	-0.007258	0.023352	-0.311	0.755985	

*p<0.10 **p<0.05 ***p<0.01

Adjusted R Square	**0.1166**
Number of Observations:	2,429
F-statistic:	19.95
P-Value:	<2.2e-16
Standard errors corrected for heteroscedasticity	

Safety	Coefficient	Standard Error	T Score	P-Value	
(Intercept)	3.4557403	0.1989563	17.369	< 2e-16	***
Continuous Variables					
lnBeds	-0.1752663	0.0373662	-4.691	0.00000288	***
lnOccupancy.Rate	0.2293047	0.2436871	0.941	0.3468	
lnBeds.lnOccRate	-0.0832775	0.0484463	-1.719	0.0857	*
lnCMI	-0.4265208	0.0995492	-4.285	0.00001903	***
lnDSH	0.0876415	0.0380242	2.305	0.0213	**
lnDual.Proportion	-0.0316202	0.0361324	-0.875	0.3816	
Teaching Status					
Nonteaching (*reference*)					
Other.Teaching	-0.0165104	0.0269558	-0.612	0.5403	
Major.Teaching	-0.0262633	0.0422443	-0.622	0.5342	
Geographic Location					
Other urban (*reference*)					
Rural	0.0121333	0.0393548	0.308	0.7579	
Large.Urban	0.019987	0.0232791	0.859	0.3907	
Ownership Status					
Nonprofit (*reference*)					
Proprietary	-0.0126418	0.0293332	-0.431	0.6665	
Government	0.0007899	0.0341284	0.023	0.9815	
Safety.Net	-0.0194918	0.0348098	-0.56	0.5756	
HAC.Penalty	-0.3422713	0.0277827	-12.32	< 2e-16	***
HRRP.Penalty	-0.0573566	0.0381306	-1.504	0.1327	

*p<0.10 **p<0.05 ***p<0.01

Adjusted R Square	**0.196**
Number of Observations:	2,429
F-statistic:	39.13
P-Value:	<2.2e-16
Standard errors corrected for heteroscedasticity	

APPENDIX 5
Domain Regressions - Full Output - *continued*

	Patient Satisfaction					Efficiency (MSPB Ratio)				
	Coefficient	Standard Error	T Score	P-Value		Coefficient	Standard Error	T Score	P-Value	
(Intercept)	1.689675	0.144652	11.681	< 2e-16	***	-0.077717	0.0220855	-3.519	0.000441	***
Continuous Variables										
lnBeds	-0.052398	0.027577	-1.9	0.057543	*	0.0146965	0.0039375	3.732	0.000194	***
lnOccupancy.Rate	-1.096007	0.171861	-6.377	2.15E-10	***	0.1025471	0.028443	3.605	0.000318	***
lnBeds.lnOccRate	0.189061	0.03527	5.36	9.09E-08	***	-0.018753	0.0056628	-3.311	0.000942	***
lnCMI	0.406783	0.076691	5.304	1.23E-07	***	-0.044395	0.0117253	-3.786	0.000157	***
lnDSH	-0.085625	0.029445	-2.908	0.003671	***	-0.002596	0.0040589	-0.64	0.522492	
lnDual.Proportion	-0.1839	0.028526	-6.447	1.38E-10	***	0.0056225	0.0041815	1.345	0.178872	
Teaching Status										
Nonteaching (*reference*)										
Other.Teaching	-0.043973	0.021648	-2.031	0.04234	**	-0.002048	0.0029143	-0.703	0.482318	
Major.Teaching	-0.013372	0.034207	-0.391	0.695892		-0.003862	0.0043792	-0.882	0.377918	
Geographic Location										
Other urban (*reference*)										
Rural	0.036996	0.027144	1.363	0.173016		-0.012145	0.004113	-2.953	0.003178	***
Large.Urban	-0.034974	0.019242	-1.818	0.06925	*	0.0186239	0.0025416	7.328	3.18E-13	***
Proprietary	-0.175555	0.022157	-7.923	3.50E-15	***	0.034691	0.0032785	10.581	< 2e-16	***
Government	0.005638	0.025607	0.22	0.825744		0.0010902	0.0038782	0.281	0.778649	
Safety.Net	-0.020258	0.027036	-0.749	0.453744		-0.000935	0.003884	-0.241	0.80985	
HAC.Penalty	-0.071498	0.019691	-3.631	0.000288	***	0.0080351	0.0027886	2.881	0.003994	***
HRRP.Penalty	-0.051674	0.028577	-1.808	0.070693	*	0.014431	0.0048197	2.994	0.00278	***
*p<0.10	**p<0.05		***p<0.01			*p<0.10	**p<0.05		***p<0.01	

Adjusted R Square	**0.2498**
Number of Observations:	2,429
F-statistic:	54.9
P-Value:	<2.2e-16
No need to correct standard errors for heteroscedasticity	

Adjusted R Square	**0.206**
Number of Observations:	2,429
F-statistic:	37.79
P-Value:	<2.2e-16
Standard errors corrected for heteroscedasticity	

APPENDIX 6

Composite Quality Score and MSPB Ratio

Composite Quality Score

	Coefficient	Standard Error	T Score	P-Value	
(Intercept)	3.637454	0.082477	44.1030	< 2e-16	***
Government	-0.042164	0.014657	-2.8770	0.00405	***
HAC.Penalty	-0.129787	0.011257	-11.5300	< 2e-16	***
HRRP.Penalty	-0.037010	0.014930	-2.4790	0.01325	**
Large.Urban	0.045445	0.010572	4.2990	0.00002	***
lnBeds	-0.046274	0.015811	-2.9270	0.00346	***
lnBeds.lnOccRate	0.031745	0.021003	1.5110	0.13080	
lnCMI	0.059072	0.043105	1.3700	0.17069	
lnDSH	-0.048963	0.017205	-2.8460	0.00447	***
lnDual.Proportion	-0.001613	0.016079	-0.1000	0.92008	
lnMSPB.Ratio	**-0.176684**	**0.083131**	**-2.1250**	**0.03366**	**
lnOccupancy.Rate	-0.229807	0.103436	-2.2220	0.02639	**
Major.Teaching	0.031104	0.018312	1.6990	0.08952	*
Other.Teaching	-0.035164	0.012029	-2.9230	0.00349	***
Proprietary	-0.049212	0.012568	-3.9160	0.00009	***
Rural	0.006210	0.015807	0.3930	0.69448	
Safety.Net	0.000151	0.015560	0.0100	0.99228	

*p<0.10 **p<0.05 ***p<0.01

Adjusted R Square	**0.1702**
Number of Observatior	2,429
F-statistic:	31.02
P-Value:	<2.2e-16
Standard errors corrected for heteroscedasticity	

APPENDIX 7

Logistic Regression Results

HVBP Penalty

Regression

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-3.403968	0.486475	-6.997	2.61E-12	***
Beds	0.010266	0.001281	8.011	1.13E-15	***
Beds.Occupancy.Rate	-0.011885	0.001752	-6.784	1.17E-11	***
CMI	-0.396221	0.230964	-1.716	0.0863	.
DSH	0.66174	0.628192	1.053	0.2922	
Dual.Proportion	-1.154581	0.998834	-1.156	0.2477	
Government	0.252146	0.135449	1.862	0.0627	.
HAC.Penalty	0.944266	0.103578	9.116	< 2e-16	***
HRRP.Penalty	0.64818	0.160183	4.047	5.20E-05	***
Large.Urban	-0.125205	0.101831	-1.23	0.2189	
Major.Teaching	-0.111013	0.176972	-0.627	0.5305	
Occupancy.Rate	3.535356	0.467197	7.567	3.81E-14	***
Other.Teaching	0.171624	0.11122	1.543	0.1228	
Peer.Group.2	0.373236	0.148328	2.516	0.0119	*
Peer.Group.3	0.287117	0.168136	1.708	0.0877	.
Peer.Group.4	0.474572	0.199961	2.373	0.0176	*
Peer.Group.5	0.545225	0.313971	1.737	0.0825	.
Proprietary	0.831885	0.117911	7.055	1.72E-12	***
Rural	-0.213497	0.142207	-1.501	0.1333	
Safety.Net	0.104313	0.167744	0.622	0.534	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Odds Ratio

	OR	2.50%	97.50%
(Intercept)	0.0332411	0.01272039	0.08573851
Beds	1.0103189	1.00782316	1.01290477
Beds.Occupancy.Rate	0.9881851	0.98472116	0.9915269
CMI	0.6728578	0.42677479	1.05599414
DSH	1.9381627	0.56656888	6.65607312
Dual.Proportion	0.3151896	0.04457601	2.24699566
Government	1.2867842	0.98641334	1.67801502
HAC.Penalty	2.5709244	2.1004655	3.15289385
HRRP.Penalty	1.9120586	1.40254015	2.62990686
Large.Urban	0.8823159	0.72249434	1.07705251
Major.Teaching	0.8949271	0.63236094	1.26608113
Occupancy.Rate	34.3072394	13.84614618	86.59372108
Other.Teaching	1.1872309	0.95447275	1.47626061
Peer.Group.2	1.4524272	1.08660414	1.94391543
Peer.Group.3	1.3325796	0.95873273	1.85369958
Peer.Group.4	1.6073267	1.08631951	2.37975156
Peer.Group.5	1.7249959	0.93133575	3.19157108
Proprietary	2.2976463	1.8253736	2.89847055
Rural	0.807755	0.61090476	1.06704367
Safety.Net	1.1099478	0.79890405	1.54232412

APPENDIX 7

Logistic Regression Results - *continued*

HAC Penalty

Regression

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-3.13874	0.513631	-6.111	9.91E-10	***
Beds	-0.002133	0.001322	-1.613	0.10671	
Beds.Occupancy.Rate	0.002205	0.001811	1.218	0.2234	
CMI	0.669793	0.24265	2.76	0.00577	**
DSH	-1.007341	0.671153	-1.501	0.13338	
Dual.Proportion	1.244859	1.019534	1.221	0.22208	
Government	0.293397	0.140462	2.089	0.03673	*
HVBP.Penalty	0.932425	0.102798	9.07	< 2e-16	***
HRRP.Penalty	-0.008393	0.169418	-0.05	0.96049	
Large.Urban	0.282888	0.111511	2.537	0.01119	*
Major.Teaching	0.123212	0.182879	0.674	0.50048	
Occupancy.Rate	0.379947	0.501883	0.757	0.44902	
Other.Teaching	-0.247401	0.124183	-1.992	0.04635	*
Peer.Group.2	0.253869	0.170746	1.487	0.13706	
Peer.Group.3	0.175992	0.190039	0.926	0.3544	
Peer.Group.4	0.58417	0.214325	2.726	0.00642	**
Peer.Group.5	0.572807	0.323176	1.772	0.07632	.
Proprietary	-0.149312	0.128706	-1.16	0.24601	
Rural	0.118378	0.15761	0.751	0.4526	
Safety.Net	0.297517	0.176637	1.684	0.09212	.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Odds Ratio

	OR	2.50%	97.50%
(Intercept)	0.04333738	0.01572293	0.1179042
Beds	0.99786934	0.99526396	1.0004426
Beds.Occupancy.Rate	1.0022077	0.9986389	1.0057745
CMI	1.95383375	1.21277241	3.1422419
DSH	0.36518871	0.09761157	1.3574615
Dual.Proportion	3.47244571	0.46712671	25.5489572
Government	1.34097495	1.01579712	1.7624451
HVBP.Penalty	2.54066155	2.07887823	3.1109525
HRRP.Penalty	0.99164241	0.71557568	1.3917024
Large.Urban	1.32695667	1.06680852	1.6519634
Major.Teaching	1.13112369	0.78882281	1.6162995
Occupancy.Rate	1.4622078	0.54836559	3.9285824
Other.Teaching	0.78082773	0.61128401	0.9948253
Peer.Group.2	1.28900307	0.92414031	1.8058209
Peer.Group.3	1.19242883	0.8227371	1.7339035
Peer.Group.4	1.79350185	1.18053502	2.7363622
Peer.Group.5	1.77323704	0.9404098	3.3416087
Proprietary	0.86130025	0.66757051	1.1059708
Rural	1.12566983	0.82570662	1.532164
Safety.Net	1.34651067	0.95166972	1.9025311

APPENDIX 7

Logistic Regression Results - *continued*

HRRP Penalty

Regression

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	4.628597	0.677777	6.829	8.55E-12	***
Beds	0.004076	0.002218	1.838	0.06612	.
Beds.Occupancy.Rate	-0.003107	0.003193	-0.973	0.33058	
CMI	-2.530102	0.333354	-7.59	3.20E-14	***
DSH	-2.288935	1.011251	-2.263	0.02361	*
Dual.Proportion	0.877021	1.770557	0.495	0.62036	
Government	0.116498	0.206369	0.565	0.5724	
HVBP.Penalty	0.649488	0.160026	4.059	4.94E-05	***
HAC.Penalty	0.014768	0.169629	0.087	0.93062	
Large.Urban	0.707729	0.176157	4.018	5.88E-05	***
Major.Teaching	0.764373	0.36095	2.118	0.0342	*
Occupancy.Rate	1.940467	0.746244	2.6	0.00931	**
Other.Teaching	-0.116672	0.178101	-0.655	0.51241	
Peer.Group.2	0.278264	0.237004	1.174	0.24036	
Peer.Group.3	0.148929	0.265923	0.56	0.57545	
Peer.Group.4	0.12997	0.328288	0.396	0.69218	
Peer.Group.5	0.114792	0.523953	0.219	0.82658	
Proprietary	0.796064	0.220188	3.615	0.0003	***
Rural	-0.218835	0.196927	-1.111	0.26646	
Safety.Net	0.290589	0.26199	1.109	0.26736	

Signif. codes: 0 ' ***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Odds Ratio

	OR	2.50%	97.50%
(Intercept)	102.3704	27.46191984	391.7265586
Beds	1.004084	0.99975334	1.0084663
Beds.Occupancy.Rate	0.996898	0.99088285	1.0032852
CMI	0.079651	0.04125194	0.1528053
DSH	0.101374	0.01394473	0.736372
Dual.Proportion	2.403729	0.08139851	85.8038249
Government	1.123556	0.75835733	1.7066918
HVBP.Penalty	1.914561	1.40450168	2.6320115
HAC.Penalty	1.014877	0.732037	1.4249388
Large.Urban	2.029377	1.44270769	2.8810734
Major.Teaching	2.147647	1.08932402	4.5089496
Occupancy.Rate	6.961998	1.59390248	29.5941989
Other.Teaching	0.889877	0.62898931	1.2652554
Peer.Group.2	1.320835	0.82810158	2.1005805
Peer.Group.3	1.160591	0.68521896	1.9468593
Peer.Group.4	1.138794	0.59203538	2.1504633
Peer.Group.5	1.12164	0.39935038	3.1362404
Proprietary	2.216798	1.46118604	3.472712
Rural	0.803454	0.54635181	1.1830964
Safety.Net	1.337216	0.80409901	2.2482417