Geographic Variation and Drivers of Hospital Patient Satisfaction

A Comprehensive Analysis of HCAHPS Survey Data Across US Hospitals (2023–2024)

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Abstract

Patient satisfaction remains a critical metric in healthcare quality assessment and hospital reimbursement decisions. This study analyzed 442,215 Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey records from US hospitals between October 2023 and September 2024. Using correlation analysis and multiple linear regression with cluster-robust standard errors, we identified significant geographic variation in patient satisfaction across states and quantified the relative importance of key patient experience domains. Nurse communication emerged as the strongest predictor of patient recommendations ($\beta = 0.572$, $p < .001$), followed by doctor respect and discharge planning support. Midwest states demonstrated consistently higher satisfaction ratings compared to coastal urban centers. These findings provide actionable insights for healthcare systems seeking to improve patient experience and recommendation rates.

Keywords: patient satisfaction, HCAHPS, hospital quality, geographic variation, healthcare analytics

Introduction

Patient experience significantly influences hospital reimbursement, reputation, and clinical outcomes. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, developed by CMS, is the first national standardized instrument capturing patient perspectives on inpatient care across the United States (Centers for Medicare & Medicaid Services, 2024). While patient satisfaction encompasses multiple dimensions of communication, responsiveness, environment, and discharge planning (Press Ganey, 2023) the relative importance of these factors and their geographic variation remain incompletely understood.

This study analyzed the most recent national HCAHPS dataset to pursue three objectives: quantify geographic variation in patient satisfaction across US states, identify key drivers of patient recommendations using correlation and regression analysis, and provide healthcare systems with evidence-based insights for quality improvement initiatives.

Methods

Data Source and Sample

We analyzed publicly available HCAHPS survey data from the CMS Provider Data Catalog spanning October 2023 through September 2024. The dataset contained 442,215 individual survey records representing responses from patients discharged from acute care hospitals across all 50 US states, Washington DC, and several US territories. Survey items measured patient perceptions across 11 distinct domains: nurse communication, doctor communication, staff respect for patients, responsiveness to call buttons, assistance with basic needs, pain management, medicine explanation, hospital cleanliness, hospital quietness, discharge information, and hospital recommendation likelihood.

Data Preparation and Cleaning

Data wrangling was performed using R (R Core Team, 2023) with dplyr and tidyr packages. We removed irrelevant columns, converted character variables to numeric types, handled missing values through domain-specific filtering, and aggregated hospital-level responses into state-level statistics. Missing data totaled 722,478 values (10.9% of all data cells), primarily reflecting structural missingness from non-applicable survey items. Three US territories (American Samoa, Guam, Northern Mariana Islands) were excluded due to absent survey responses.

Statistical Analysis

Descriptive Statistics. We calculated national and state-level summary statistics (mean, median, standard deviation, minimum, maximum) for all HCAHPS domains. State-level mean star ratings were mapped using interactive geographic visualization.

Correlation Analysis. Pearson correlation coefficients were computed among all 13 key HCAHPS domains using pairwise complete observations. We examined correlation magnitudes to identify which patient experience dimensions were most highly interrelated.

Multiple Regression Modeling. We constructed a multiple linear regression model predicting the outcome variable (percentage of patients who would "definitely recommend" the hospital) from 13 HCAHPS predictors, hospital survey response rate, number of completed surveys, and state fixed effects with DC as the reference category.

Cluster-Robust Inference. Because hospitals cluster within states and may share unmeasured state-level characteristics (policy environment, regional culture, resource availability), we estimated cluster-robust standard errors at the state level using the sandwich and lmtest packages. This adjustment prevents underestimation of standard errors and avoids inflated statistical significance.

Results

National-Level Findings

Descriptive statistics for HCAHPS measures at the national level are presented in Table 1. The mean patient survey star rating was 3.22 (SD = 0.77), with ratings ranging from 1 to 5. This indicates that, on average, US hospitals receive ratings in the middle-to-upper portion of the satisfaction spectrum, though substantial variation exists. Mean HCAHPS answer percent (reflecting positive responses to survey items) was 34.71% (SD = 25.82), with an interquartile range of 10% to 61%. Survey response rates varied considerably, with a median of 21% (range: 4% to 70%), suggesting substantial heterogeneity in patient engagement across hospitals.

Measure	N	Min	Q1	Median	Q3	Max	M	SD
Patient Survey Star Rating	35,264	1.0	3.0	3.0	4.0	5.0	3.22	0.77
HCAHPS Answer Percent	271,348	0.0	10.0	23.0	61.0	100.0	34.71	25.82
Survey Response Rate Percent	370,747	4.0	16.0	21.0	27.0	70.0	22.48	13.41

Table 1: Descriptive Statistics for HCAHPS Measures at National Level. Q1 = first quartile; Q3 = third quartile; M = mean; SD = standard deviation.

Geographic Variation

State-level analysis revealed significant geographic disparities. Midwest states—Wisconsin (M = 3.89), Nebraska (M = 3.86), and Minnesota (M = 3.84) achieved the highest satisfaction ratings, while California (M = 2.80), New York (M = 2.66), and Washington DC (M = 2.32) showed lower performance. This 1.5-star differential persisted even after statistical adjustment for patient experience domains, indicating that state-level factors (policy environment, healthcare culture, resource distribution) meaningfully influence satisfaction beyond individual hospital efforts.

Correlation Analysis

Table 2 presents selected Pearson correlations among core patient experience domains. Strong intercorrelations ($r \geq .90$) were observed among communication and respect-related domains: nurse communication with nurse respect (r = 0.95), and doctor communication with doctor respect (r = 0.95). Call button responsiveness and bath/personal care assistance demonstrated high correlation (r = 0.88), suggesting that staff responsiveness in acute situations reflects broader organizational patterns of patient-centered care. Hospital cleanliness and quietness showed moderate correlations with communication domains ($r \approx .54$ to .64), indicating that while environmental factors contribute to overall satisfaction, they operate somewhat independently from interpersonal care quality.

Domain	1	2	3	4	5
Nurse Communication	—	0.95*	0.82*	0.79*	0.64*
Nurse Respect	0.95*	—	0.76*	0.79*	0.67*
Doctor Communication	0.82*	0.76*	—	0.95*	0.55*
Doctor Respect	0.79*	0.79*	0.95*	—	0.51*
Hospital Cleanliness	0.64*	0.67*	0.55*	0.51*	—

Table 2: Intercorrelations Among Select HCAHPS Domains. p* < .001 for all correlations.*

Regression Analysis and Prediction of Patient Recommendations

A multiple linear regression model was estimated predicting the percentage of patients who would "definitely recommend" their hospital. Results are presented in Table 3. The overall model was highly significant, $F(65, 3558) = 119.96$, $p < .001$, with $R^2 = 0.687$, indicating that the specified predictors explained 68.7% of variance in recommendation rates.

Among HCAHPS predictors, nurse communication demonstrated the strongest association with recommendations: for each one-point increase in the nurse communication score, the recommendation rate increased by 0.57 percentage points ($\beta = 0.572$, $p < .001$), holding other variables constant. Doctor respect contributed the second-largest effect ($\beta = 0.285$, $p < .001$), followed by discharge planning support ($\beta = 0.233$, $p < .001$) and medicine explanation ($\beta = 0.187$, $p < .001$). Environmental factors—hospital quietness ($\beta = 0.168$, $p < .001$) and cleanliness ($\beta = 0.097$, $p < .001$)—also independently predicted recommendations. Mean survey response rate exhibited a positive association with recommendations ($\beta = 0.175$, $p < .001$).

Predictor	b	SE	t	p	95% CI
Nurse Communication	0.572	0.082	6.99	<.001	[0.411, 0.732]
Doctor Respect	0.285	0.091	3.15	.002	[0.107, 0.463]
Discharge Planning	0.233	0.031	7.60	<.001	[0.173, 0.293]
Medicine Explanation	0.187	0.045	4.18	<.001	[0.099, 0.275]
Hospital Quietness	0.168	0.018	9.34	<.001	[0.133, 0.203]
Hospital Cleanliness	0.097	0.025	3.88	<.001	[0.048, 0.146]
Mean Response Rate	0.175	0.018	9.58	<.001	[0.140, 0.210]

Table 3: Multiple Regression Results Predicting Patient Recommendation Rates. Dependent variable = percentage of patients who would "definitely recommend" hospital. Model includes state fixed effects (DC = reference). n = 3,624 hospitals. $R^2 = 0.687$.

After application of cluster-robust standard errors, effect estimates remained statistically significant and similar in magnitude, confirming the validity of the findings. Diagnostic plots (Figure 3) verified model assumptions of linearity, normality, and homogeneity of variance, supporting the validity of our regression model.

Discussion and Conclusions

This comprehensive analysis of 442,215 HCAHPS survey records revealed that patient recommendations in US hospitals are driven primarily by interpersonal factors—specifically nurse and doctor communication rather than environmental or structural features alone. Nurse communication alone accounted for a coefficient of 0.572, representing approximately 5.9 times the effect size of environmental cleanliness ($\beta = 0.097$). This finding aligns with qualitative research emphasizing that patients prioritize respectful, clear communication from clinical staff as central to their care experience (Levinson et al., 2020).

Geographic variation in satisfaction ratings persists and may reflect differences in healthcare policy, local culture, resource availability, and regional approaches to patient-centered care. Hospital leadership seeking to improve patient recommendations should prioritize communication training for both nursing and physician staff, supported by environmental improvements and enhanced discharge planning processes.

Implications for Hospital Leadership.

These findings suggest hospitals should prioritize: Communication training for nurses and physicians, Systematic discharge planning protocols and Environmental improvements as supporting initiatives. The 5.9 times larger effect of communication vs. cleanliness indicates efficient resource allocation requires focusing on staff development first.

Geographic Disparities.

The 1.5-star differential between Midwest and coastal states warrants investigation into regional policy factors. High-performing states may offer models for national replication.

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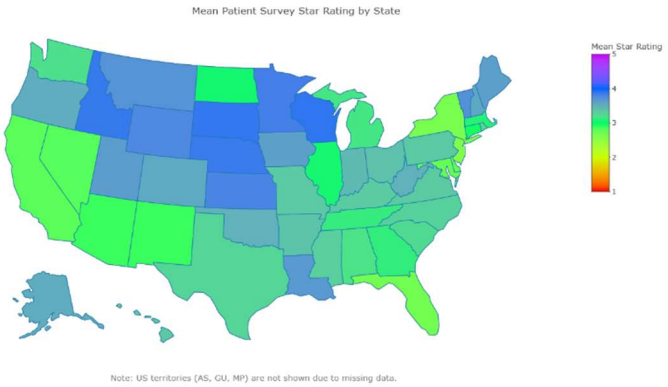
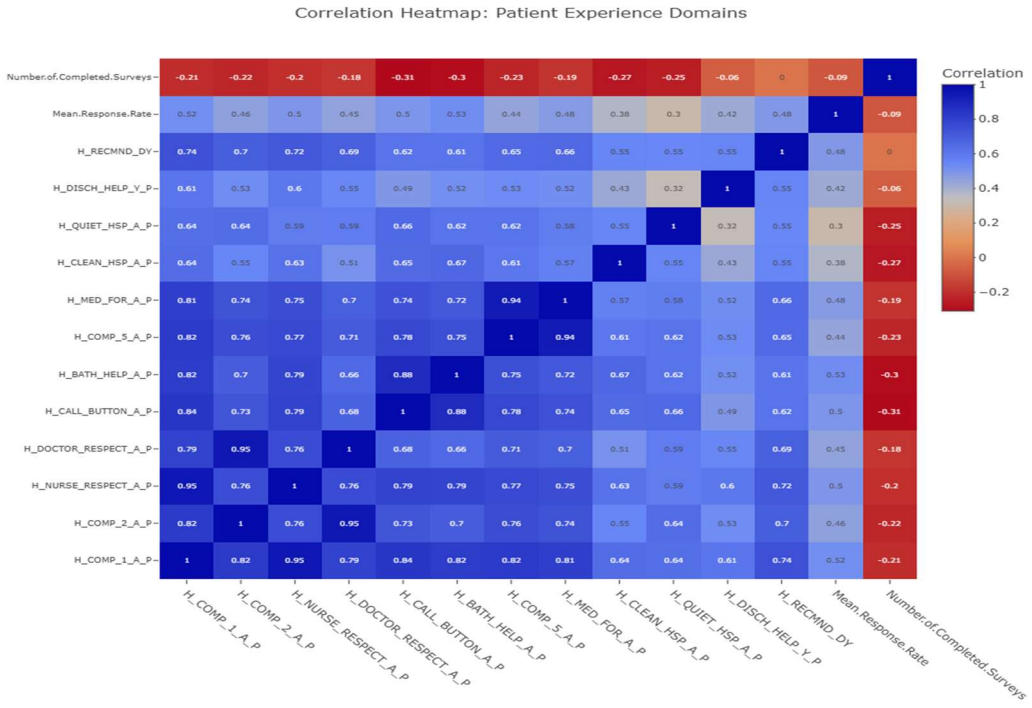
Figure 1: Mean Patient Survey Star Rating by State



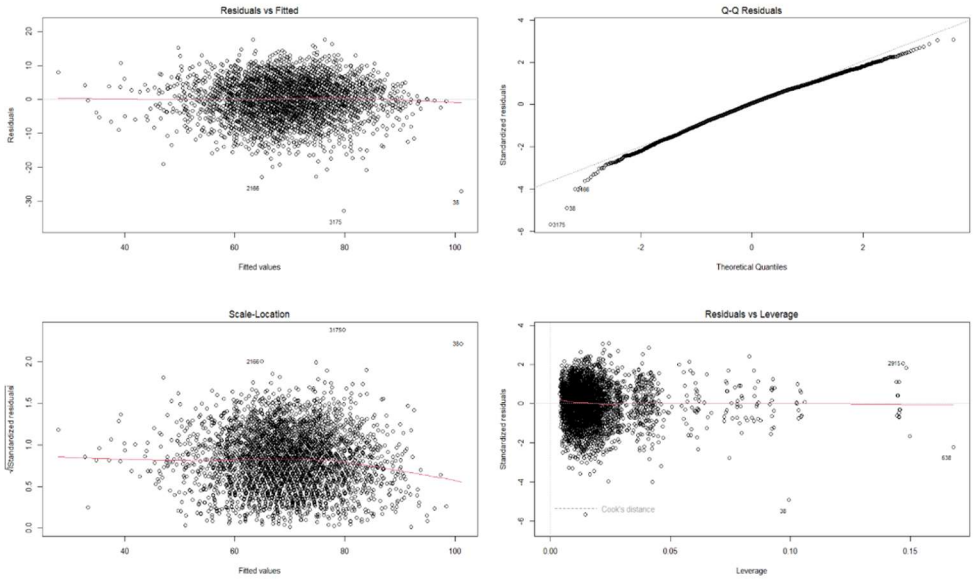
This choropleth map displays geographic variation in patient satisfaction ratings across US states. Midwest states (Wisconsin, Nebraska, Minnesota) colored in blue show the highest mean star ratings (≥ 3.84), while coastal urban centers (California, New York, Washington DC) colored in red show lower satisfaction ratings (≤ 2.80). The visualization clearly demonstrates that geographic location significantly influences patient satisfaction outcomes, with Midwest hospitals consistently outperforming coastal urban regions.

Figure 2: Correlation Heatmap—Patient Experience Domains



This matrix visualization shows intercorrelations among 13 HCAHPS measurement domains. Dark blue cells indicate strong positive correlations ($r > 0.80$), particularly among nurse communication, doctor communication, and respect-related domains ($r = 0.95$). Light blue cells show moderate correlations between communication domains and environmental factors (cleanliness, quietness), indicating that interpersonal and environmental care quality operate as partially independent dimensions requiring distinct improvement strategies.

Figure 3: Regression Diagnostic Plots—Model Validation



This four-panel diagnostic visualization validates the multiple regression model assumptions. The top-left plot (Residuals vs. Fitted Values) shows appropriate random scatter around zero, supporting linearity and homogeneity of variance. The top-right Q-Q plot demonstrates residuals closely following the normal distribution line, supporting normality. The bottom-left Scale-Location plot confirms consistent residual dispersion. The bottom-right Residuals vs. Leverage plot identifies potential influential observations with Cook's distance, showing three flagged outliers representing unusually high or low satisfaction values.