Journal of Patient Experience
2020, Vol. 7(4) 607-614

DOI: 10.1177/2374373519862933
journals.sagepub.com/home/jpx
SAGE

Rural Disparities in Hospital Patient Satisfaction: Multilevel Analysis of the Massachusetts AHA, SID, and HCAHPS Data

Yu (Sunny) Kang, PhD, MS, MPP, MPA[1], Huey-Ming Tzeng, PhD, RN, FAAN[2], and Ting Zhang, PhD[3]

Abstract

Introduction: Hospital patient satisfaction has been a salient policy concern. We examined rurality's impact on patient satisfaction measures. **Methodology:** We examined patients (age 50 and up) from 65 rural and urban hospitals in Massachusetts, using the merged data from 2007 American Hospital Association Annual Survey, State Inpatient Database and Survey of Patients' Hospital Experiences, utilizing Hierarchical binary logistic regression analyses to examine the rural disparities in patient satisfaction measures. **Results:** Relative to the urban location, rurality reduced the likelihood of cleanliness of environment (odds ratio = 0.66, 95% confidence interval: [0.63-0.70]); but increased the likelihood of staff responsiveness and quietness. Compared to Caucasian counterparts, Hispanic patients were less likely to reside in a quiet hospital. Compared to other payments, Medicare or Medicaid coverage each reduced the likelihood of staff responsiveness and cleanliness. Compared to other diagnoses, depressive or psychosis disorders predicted smaller odds in responsiveness and cleanliness. Anxiety diagnosis reduced the likelihood of cleanness and quietness. At the facility level, higher registered nurse full-time equivalent (FTE)s or being a teaching hospital increased the likelihood of all measures. **Conclusion:** Relative to the urban counterparts, rural patients experienced lower likelihood of staff responsiveness after adjusting for other factors. Compared to Caucasian patients, Hispanic patients were less likely to reside in quiet hospital environment. Research is needed to further explore the basis of these disparities. Mental health diagnoses in depressive and psychosis disorders also called upon further studies in special care needs.

Keywords

hospital quality of care, patients' satisfaction, rural–urban disparity, AHA data, HCAHPS data

Introduction

Aiming to increase the US health-care quality, from fiscal year (FY) 2006, the Centers for Medicare & Medicaid Services (CMS) developed a national survey: Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). This survey reports patients' assessment of health-care providers and plans by assessing 32 items (1). In addition to the public reporting of the HCAHPS scores in 2008; CMS started to associate the HCAHPS scores with hospital payment through the Hospital Value-Based Purchasing Program since 2012 (1).

According to the 2016 National Healthcare Quality and Disparities Report, excluding "age, sex, disability status, sexual orientation" and gender, the quality of health has varied by several factors, including the residential location (2, p. 9). Current studies have examined the rural–urban disparities in hospitals' quality of care. In general, rural health care is facing several barriers, including lack of reimbursement, limited

[1] School of Health and Human Services, College of Public Affairs, University of Baltimore, Liberal Arts and Policy Building, Baltimore, MD, USA
[2] The University of Texas Medical Branch, School of Nursing, Galveston, TX, USA
[3] Department of Finance and Economics, Merrick School of Business, Jacob France Institute, University of Baltimore, Baltimore, MD, USA

Corresponding Author:
Yu (Sunny) Kang, School of Health and Human Services, College of Public Affairs, University of Baltimore, Liberal Arts and Policy Building, 10W. Preston St. Baltimore, MD 21201, USA.
Emails: kangumf@gmail.com; ykang@ubalt.edu

population base to attract specialized services, and limited transportation (3). Particularly, compared to the nonrural patients, rural patients were 14% more likely to die after traumatic injuries (4). Additionally, patients in different locales (metropolitan versus nonmetropolitan) are varied by adherence, proximity to high-volume or accredited hospitals, and hospital type (5). According to a cross-sectional study in 2005, rural patients showed less adherence to care guidelines for myocardial infarction (MI) and heart failure (HF) (6). On the other hand, compared to smaller urban or rural/remote residents, urban residents were prone to have 24 or more physician visits in the past year (7). According to a study examining 10 108 coronary artery bypass surgery patients, urban or higher income patients were more likely to be treated by providers with better performance (8). Compared to the nonaccredited rural hospitals, accredited rural hospitals scored higher in 4 out of 16 quality indicators, including MI, HF, pneumonia, and surgical infections (9).

A growing body of research has been targeting the predictors for hospital patients' satisfaction. The weight of the evidence reveals several predictors, with the preponderance of this work directed to patient satisfaction results in hospital care. One study using California hospital data found that a higher level of registered nurses per bed was associated with increased patients' satisfaction rate, whereas a higher portion of contract nurses predicted lower patient satisfaction rate (10). Another study indicated that being a teaching hospital or the introduction of medical students was positively associated with patients' perceptions of care quality (11).

In recent studies, patient satisfaction has increasingly been utilized as an indicator for the overall quality of care (12). However, prior studies have limited discussions regarding the patient's satisfaction as the quality measures when examining the rural–urban disparities. Particularly, measures such as the staff responsiveness, cleanliness, or quietness were not frequently used in prior studies to measure quality of care in a hospital setting. In this study, we examine the possible explanations for the rural and urban disparities in hospital quality of care, utilizing 3 patient assessment items from the HCAHPS survey.

Data and Methods

Data Source

This study utilized merged data from 3 major sources. The first data source was the State Inpatient Database (SID). The SID data are part of the Healthcare Cost and Utilization Project by Agency for Healthcare Research and Quality (AHRQ) that provides patient-level variables. The SID is a state-specific data that contains more than 95% of hospital discharge information in the United States (AHRQ, SID Documentation, 2017). The second data source came from the American Hospital Association (AHA) Annual Survey Database, which provides hospital-level variables (13,14). The AHA annual survey is an ongoing survey providing information about hospitals' organizational structure, facilities, and services, as well as the staffing information. The third data source is the CMS-HCAHPS. The HCAHPS survey provides 21 patient-rated items about care, these hospital-level variables are classified by 9 major topics (1).

The score in HCAHPS measures are reported in percentiles, with both "top box" (most positive) and "bottom box"(least positive) values, which are presented in the HCAHPS Percentiles Table, at the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles (15). The CMS conducted a large-scale experiment on the mode effects, according to which, patients' response may vary based on the mode of survey types. In general, compared to patients who were randomly chosen for "mail only or mixed modes," patients surveyed through "telephone only and active IVR" were more likely to provide positive feedback. Hence, "mode adjustment" was utilized to modify these effects (16).

Study Variables

Dependent variable. This study utilized 3 patient satisfaction measures from the CMS-HCAHPS survey. They are patient-rated measures, including: the responsiveness of hospital staff, the cleanliness of hospital environment, and the quietness of hospital environment (1). They have been selected among other measures in the CMS Hospital Compare site to inform the quality of hospital practice and the patients' selections of services (17,18). Particularly in this study, cleanliness and quietness are indications of the health-care environment; whereas the responsiveness is an indication of the quality of care from the medical staff's perspective. The CMS Hospital Compare included 7 categorizations of the measures, the selected 3 measures are under the category of "patient experience" (19).

Independent variables. The primary variables of interest in the study were the facility locations that were categorized into rural–urban areas. This study defined rural–urban areas according to the 2006 National Center for Health Statistics urban–rural classification, according to which, urban areas include large central metro, large fringe metro, medium metro, and small metro areas; while rural areas include the micropolitan and noncore areas (20).

This study utilized the Andersen's behavioral model to organize the predictors for the 3 patient's satisfaction measures. Based on the Andersen Model, the health behaviors are categorized by 3 factors: predisposing, enabling, and need (21). In the Emerging Model (phase 4 of the Andersen model), consumer satisfaction is categorized under the outcomes, while the external environment will impose influence on said outcomes (21).

In this study, the predisposing factors include demographic characteristics, such as age, gender, and race. The enabling factors include income level and sources of payment (ie, Medicare, Medicaid, and other types insurance). The need factors include residents' primary diagnosis at

admission (ie, cancer, anxiety, depression, fatigue, syncope, epilepsy, hypertension, diabetes, psychosis, Parkinson, stroke, and cognitive disorders). Other need factors include whether the patient was a surgical patient or experienced radiochemotherapy, the total number of chronic conditions per person, and the total length of stay (LOS) measured by days.

Besides the predisposing, enabling, and need factors, we also included the facility characteristics as a forth category in the model. The facility characteristics include the facility locations categorized by urban or rural (as the primary variable of interest), facility size measure by number of beds, whether the facility was a teaching hospital, the registered nurse full-time equivalents (RN FTEs), and whether the facility provided any drug allergy alerts.

Statistical Analysis

Descriptive analysis. First, we provided a frequency distribution (in percentage) of 3 patient satisfaction measures by rural–urban location. Second, a descriptive analysis was conducted to describe the characteristics of individuals and facilities. Individual- and facility-level characteristics are reported in percentages or means with standard deviations.

Multivariate analysis. We used a hierarchical binary logistic regression model to predict risk-adjusted odds ratios (OR) of rural–urban for 3 patient satisfaction measures, controlling for the individual- and facility-level characteristics. We also examined the effect of each covariate on the patient satisfaction measures in the model. The multinomial logistic regression model has been selected for multivariate analysis, because it properly accounts for the log-linear model effects as well as for the generalized logit modeling with categorical dependent variables (22, Appendix A: *Mathematical Model in Multivariate Analysis*). Particularly, in the hierarchical model, the first (individual) level of the multilevel logistic regression model is specified in Equation 1, and the second (facility) level model is specified in Equation (2) (Appendix A). Y_{ij} is the binary patient satisfaction measure for the ith individual in the jth facility (Appendix A). All statistical analyses were conducted using SAS, version 9.4 (SAS Institute, Inc, Cary, North Carolina) (Table 1).

Table 1. Frequency Distribution of 3 Patient Satisfaction Measures by Rural-Urban Location (Percentage).

Patient Satisfaction Measures	Total n = 462 397	Rural n = 15 491	Nonrural Area n = 446 906
Responsiveness	42.12	54.19	41.71
Cleanliness	43.38	59.62	42.82
Quietness	43.42	48.10	43.26

Results

Descriptive Analysis

The study sample consisted of older patients (age $\geq$ 50) from 65 rural (n = 15 491) and metropolitan hospitals (n = 446 906) in Massachusetts, using the merged data from 2007 AHA, SID, and HCAHPS Survey. In general, about 2 out of 5 sample patients were male. Nearly half of the sample were using Medicare as the primary insurance, about one-third were using private insurance, and about 1 out of 8 used Medicaid to cover services. About 4 out of 5 were white patients, while black and Hispanic patients account for 6.06% and 5.90% of the sample, respectively. The average LOS was slightly less than 5 days. Nearly one-third of the sample were surgical patients. The common diagnoses included cancer, anxiety, epilepsy, diabetes, cognitive or psychosis disorders, and stroke. At the facility level, about 3.08% facilities were located in rural areas. About 2 out of 5 facilities were teaching hospitals or offering drug allergy alerts (Table 2).

In addition, a higher percentage of individuals who reside in rural hospitals were male, white, older, surgical patients, and a higher share of rural hospital patients were diagnosed with depression or cancer, and use Medicare as the primary payment approach at admission. A lower share of rural patients were either black or Hispanic; in addition, a smaller portion of the rural patients were diagnosed with hypertension, diabetes, or cognitive disorders (Table 2).

At the facility level, patients residing in rural hospitals were more likely to experience higher RN FTEs. Whereas rural patients were less likely to reside in facilities that were teaching hospitals, of a large size (more than 300 beds), or offering a drug allergy alert system (Table 2).

Multivariate Analysis

After adjusting for other individual- and facility-level factors, compared to the urban location, rurality was associated with smaller odds of hospital environment cleanliness (OR = 0.66, 95% confidence interval [CI]: [0.63-0.70]); but increased the likelihood of responsiveness of hospital staff (OR = 3.43, 95% CI = [3.27-3.59]) and quietness of hospital environment (OR = 1.22, 95% CI = [1.17-1.28]) (Table 3).

Predisposing. Compared to their Caucasian counterpart, Hispanic patients were more likely to reside in a clean hospital (OR = 1.35, 95% CI = [1.28-1.43]), but they were less likely to reside in a quiet hospital (OR = 0.75, 95% CI = [0.71-0.78]). Black patients were more likely to be admitted to a hospital with better experience statistics in all 3 measures: responsiveness, cleanliness, and quietness. Compared to the female patients, male patients were slightly less likely to be satisfied in all 3 measures (Table 3).

Table 2. Predisposing, Enabling, Need and Facility Factors of Discharged Hospital Patients (Percentage, Mean, SD).

	Percentage		
	n = 462 397	Mean	Standard Deviation
Individual-level			
Age		59.15	20.90
Male	41.41		
Income			
Level 1	27.61		
Level 2	25.96		
Level 3	25.40		
Level 4	21.03		
Insurance			
Medicare	48.46		
Medicaid	12.15		
Private insurance	33.76		
Self-pay	1.18		
Black	6.06		
Hispanic	5.90		
White	80.38		
Asian	1.80		
LOS		4.84	5.94
Surgical	29.88		
Cancer	17.80		
Anxiety	6.76		
Fatigue	1.03		
Syncope	2.03		
Epilepsy	1.99		
Radiochemotherapy	0.46		
Diabetes	21.26		
Psychosis	2.95		
Parkinson' disease	0.99		
Stroke	3.21		
Cognitive	7.62		
Total chronic conditions			
0	27.84		
1	23.59		
2	20.72		
3	14.12		
4	8.09		
5+	5.64		
Facility-level			
Rural	3.08		
Teaching hospital	40.00		
Drug allergy alerts	41.67		
Drug interact	47.22		
RN FTE		37.49	24.85

Abbreviations: LOS, length of stay (days); SD, standard deviation; RN FTE, registered nurse full-time equivalents.

Enabling. Patients with higher incomes have shown greater odds of reporting better staff responsiveness (OR = 1.45, 95% CI = [1.44-1.46]) and cleanliness (OR = 1.02, 95% CI = [1.01-1.03]), while showing smaller odds in residing in quiet hospital environments. Compared to other insurance types, the Medicare or Medicaid coverage was each associated with a lower likelihood of staff responsiveness and hospital cleanliness. Additionally, compared to other insurance types, Medicare payment was associated with lower likelihood in quietness (Table 3).

Need. Compared to patients who were not receiving such treatment, the surgical patients were more likely to report satisfactions in all 3 quality measures. In addition, patients in radiochemotherapy were associated with greater likelihood of cleanliness and quietness, while they were less likely to be satisfied with staff responsiveness (Table 3).

Relative to patients without such diagnoses, patients with cancer were associated with greater odds among all 3 measures. Sample patients diagnosed with fatigue were less likely to report satisfaction in cleanliness or quietness. Diagnosis in epilepsy or hypertension was associated with smaller odds in staff responsiveness or quietness accordingly. Parkinson's disease or cognitive disorders each predicted lower odds in staff responsiveness. Concerning mental health diagnoses, patients diagnosed with depressive or psychosis disorders were less likely to experience higher responsiveness or cleanliness. An anxiety diagnosis predicted a lower likelihood of cleanliness and quietness. Sample patients' characteristics such as total chronic conditions per person predicted smaller odds in cleanliness and quietness; while the LOS measured by days predicted smaller odds in staff responsiveness (OR = 0.66, 95% CI = [0.63-0.70]) (Table 3).

Facility characteristics. After controlling for other individual- and facility-level covariates, the rural location was associated with greater odds of self-reported staff responsiveness and quietness (OR = 3.43, 95% CI = [3.27-3.59]; OR = 1.22, 95% CI = [1.17-1.28]); while the rural location was associated with smaller odds of cleanliness (OR = 0.66, 95%CI = [0.63-0.70]). In addition, facility size measured by number of beds predicted smaller chances in self-reported staff responsiveness (OR = 0.49, 95%CI = [0.49-0.49]) or cleanliness (OR = 0.52, 95%CI = [0.52-0.53]), but the facility size was related to greater chances of quietness (Table 3).

Residing in teaching hospitals or higher RN FTEs correlates with greater self-reported patient satisfactions in all 3 measures (OR = 1.05, 95%CI = [1.04-1.05]; OR = 1.17, 95%CI = [1.16-1.17]; OR = 1.05, 95%CI = [1.05-1.05]). Residence in facilities offering drug allergy alerts predicted smaller risks of all 3 patient satisfaction measures (Table 3).

Discussion

Prior studies suggested several risk factors contributing to the rural–urban disparities in hospital quality of care, including age, gender, race, cognitive impairment, mental health diagnoses, and several other diagnoses. Findings from this study suggested mixed effects of income level, minority race, and several diagnoses (such as anxiety, fatigue, epilepsy, hypertension, psychosis, radiochemotherapy) on 3 patient assessment items. The differences in demographic characteristics, diagnoses, functional limitations, and other conditions may contribute to the varying needs of hospital facilities. This difference, therefore, varied the impact on patient satisfaction results in different facilities.

Table 3. Multilevel Analysis of 3 Patient Satisfaction Measures.

	Responsiveness				Cleanliness				Quietness			
	OR	95% Confidence Limits		*P* Value	OR	95% Confidence Limits		*P* Value	OR	95% Confidence Limits		*P* Value
Individual-Level												
Age	1.00	1.00	1.00	<.0001	0.99	0.99	0.99	<.0001	1.00	1.00	1.00	.04
Female	Ref				Ref				Ref			
Male	0.94	0.93	0.96	<.0001	0.92	0.90	0.94	<.0001	0.94	0.92	0.95	<.0001
Income	1.45	1.44	1.46	<.0001	1.02	1.01	1.03	.00	0.83	0.83	0.84	<.0001
Other Insurance	Ref				Ref				Ref			
Medicare	0.99	0.96	1.01	.32	0.95	0.92	0.97	<.0001	0.89	0.87	0.91	<.0001
Medicaid	0.84	0.82	0.86	<.0001	0.91	0.89	0.93	<.0001	1.04	1.02	1.07	.00
Black	1.73	1.65	1.82	<.0001	1.85	1.76	1.95	<.0001	1.10	1.05	1.15	<.0001
Hispanic	0.96	0.91	1.02	.21	1.35	1.28	1.43	<.0001	0.75	0.71	0.78	<.0001
LOS	0.99	0.99	1.00	<.0001	1.00	1.00	1.01	.00	1.01	1.01	1.01	<.0001
Surgical	1.37	1.34	1.40	<.0001	1.10	1.08	1.13	<.0001	1.14	1.11	1.16	<.0001
Cancer	1.22	1.19	1.24	<.0001	1.17	1.14	1.19	<.0001	1.08	1.06	1.11	<.0001
Anxiety	1.07	1.03	1.11	.00	0.83	0.79	0.86	<.0001	0.92	0.89	0.95	<.0001
Depression	0.93	0.87	1.00	.05	0.78	0.73	0.84	<.0001	1.04	0.98	1.11	.24
Fatigue	1.55	1.44	1.67	<.0001	0.61	0.57	0.67	<.0001	0.85	0.80	0.92	<.0001
Syncope	1.08	1.03	1.14	.00	1.06	1.00	1.12	.04	0.96	0.91	1.01	.08
Epilepsy	0.75	0.69	0.80	<.0001	1.00	0.93	1.08	.98	1.17	1.10	1.26	<.0001
Radio-Chemotherapy	0.99	0.88	1.12	.86	1.72	1.47	2.00	<.0001	2.17	1.87	2.53	<.0001
Paralysis	0.92	0.82	1.04	.19	1.16	1.02	1.31	.02	0.93	0.83	1.03	.17
Hypertension	0.99	0.97	1.01	.33	1.06	1.04	1.08	<.0001	0.90	0.88	0.92	<.0001
Diabetes	0.97	0.95	1.00	.01	1.03	1.01	1.05	.01	0.97	0.95	0.99	.00
Psychosis	0.89	0.84	0.95	.00	0.74	0.70	0.79	<.0001	1.07	1.01	1.13	.02
Parkinson disease	0.92	0.86	1.00	.04	1.04	0.96	1.13	.31	1.10	1.03	1.18	.00
Stroke	0.99	0.95	1.03	.63	1.03	0.99	1.08	.19	1.06	1.02	1.11	.00
Cognitive	0.94	0.91	0.97	<.0001	1.05	1.02	1.09	.00	0.98	0.96	1.01	.26
Total chronic conditions	1.06	1.05	1.07	<.0001	0.99	0.99	1.00	.02	0.99	0.99	1.00	.02
Facility-level												
Urban	Ref				Ref				Ref			
Rural	3.43	3.27	3.59	<.0001	0.66	0.63	0.70	<.0001	1.22	1.17	1.28	<.0001
Bed size	0.49	0.49	0.49	<.0001	0.52	0.52	0.53	<.0001	1.07	1.06	1.07	<.0001
Teaching hospital	4.26	4.15	4.37	<.0001	1.07	1.04	1.09	<.0001	1.13	1.11	1.15	<.0001
RN FTE	1.05	1.04	1.05	<.0001	1.17	1.16	1.17	<.0001	1.05	1.05	1.05	<.0001
Drug allergy alerts	0.48	0.46	0.49	<.0001	0.13	0.13	0.14	<.0001	0.79	0.77	0.81	<.0001

Abbreviations: LOS, length of stay (days); OR, odds ratio; RN FTE, registered nurse full-time equivalents.

In the multivariate models, we found evidence of several facility factors that affect hospital patients' satisfaction ratings, while controlling for other individual- and facility-level characteristics. Specifically, the higher level of RN FTEs and being a teaching hospital predicted greater odds of patient satisfaction in all 3 measures. Unlike prior studies, large facility size (measured by number of beds) imposed a mixed effect in predicting hospital patient satisfaction: it was positively associated with responsiveness and cleanness but was negatively associated with quietness.

Rural–urban disparities and racial disparities in hospital patient satisfaction. According to the multivariate analysis, after controlling for other covariates, nursing staff level—such as RN FTEs—was positively associated with patient satisfaction in all 3 measures. Staffing levels are included in the CMS 5-star rating system, and are 1 of 4 components being tested in the pay-for-performance initiative (23). Prior studies have also stated that a higher satisfaction in nursing teams, or a higher level of RNs per bed, was each associated with a higher rate of patient satisfaction (10,24). According to this study, the patients in rural hospitals are less likely to report cleanliness in their environment, which may indicate improper system management and the lack of cleaning staff in rural hospitals.

In addition, one study found that the urban areas predicted for dissatisfaction measures such as telephone consultations, which also indicated the lack of medical resources due to rural locations (25). Another study also found quality disparities among rural critical access hospitals and urban acute care hospitals, using quality indicators such as acute MI, HF, and pneumonia (26). All findings regarding the rural disparities have called upon policy initiatives to address this issue.

From the public policy perspective, CMS should provide rural hospitals with financial incentives to conduct

workshops or other training programs that better prepare nursing staff to care for patients residing in rural hospitals. Policy initiatives and financial incentives should be designed to improve nursing staff's knowledge on caring for rural patients, and hence to decrease the rural–urban disparities.

Patients with specific physical health or mental health diagnoses. Based on the multilevel analyses, compared to other diagnoses, mental health diagnoses such as depression and psychosis, each predicted for smaller odds of patient satisfaction measures such as responsiveness and cleanliness. Patients with anxiety disorders were less satisfied in hospital cleanliness and quietness. Similarly, diagnoses in fatigue were associated with less satisfaction in cleanliness and quietness; whereas diabetes, syncope, and cognitive disorders were each associated with smaller odds of quietness. In order to increase rural hospital quality of care measured by patient satisfaction surveys, medical and nursing staff should pay additional attention when caring for individuals with the conditions discussed above.

Public insurance programs versus patient satisfaction. According to the multivariate analysis, after controlling for other variables, patients paying through either the Medicare or Medicaid programs were less likely to be satisfied in staff responsiveness and the cleanliness of the hospital environment. Hence, further studies should investigate the structure of the current Medicaid and Medicare program, focusing on how to decrease the rural–urban disparities among the Medicare and Medicaid beneficiaries.

In FY 2017, CMS has linked the HCAHPS total performance score with value-based incentive payment percentage for all Medicare beneficiaries that are fee-for-service program participants. To better reflect patients' needs in assessing their experience in hospital care, from FY 2017, CMS has modified the patient assessment measures by adding one new measure in clinical care and 2 measures in safety domain (1).

The Medicaid program is the single most important source financing hospital care, especially with longer LOS. The level of Medicaid payment was especially important among the facilities with limited financial resources other than the public insurance programs (27). Policy innovations should also address the Medicaid beneficiaries' needs in hospital care, especially for those who reside in rural hospitals.

Limitations

A number of limitations should be considered when interpreting the results of this study. First, the cross-sectional design limited our ability to draw causal inferences from the findings because the structural and patient assessments were both obtained at the time of the survey. Future research should examine these measures using a longitudinal data set. Second, this study sample was limited to the state of Massachusetts. In the future, we will use the merged data sets of AHA, SID, and HCAHPS from various states to be able to generalize the study results.

Conclusions

In summary, this study examined the impact of rurality as well as other individual- and facility-level predictors on hospital quality of care, measured by patients' satisfaction. The findings remained statistically significant after adjusting for other individual- and facility-level covariates, such as the demographic characteristics, the payment sources, the diagnosis, and the facility characteristics. Policy efforts to enhance Medicaid and Medicare payment approaches and levels, nursing staff trained to care for patients with mental health conditions, as well as teaching hospitals will likely decrease the rural–urban disparities in hospital quality of care.

Appendix A

Mathematical Model in Multivariate Analysis

The first (individual) level of the multilevel logistic regression model is specified in Equation (1) below and the second (facility) level model is specified in Equation 2 below. Y_{ij} is the binary patient satisfaction measure for the ith individual in the jth facility. β_{1j} is the facility effect of location (1 = rural vs 0 = urban) on the log-odds of occurrence of the patient satisfaction measure (eg, $Y_{ij} = 1$ if resident i in facility j reported cleanliness in the environment; $Y_{ij} = 0$ if not). $\beta_{2j}^{t} X_{ij}$ represents the linear product of a vector of individual covariate characteristics and their corresponding β coefficients in the jth facility.

$$\begin{aligned} &\log\left(p_{ij}/(1-p_{ij})\right) = \beta_{oj} + \beta_{1j} RURAL_{ij} + \beta_{2j}^{t} X_{ij} \\ &\text{where, } p_{ij} = \text{Prob}(Y_{ij} = 1) \end{aligned} \tag{1}$$

In the second (facility level) of the model specified below, β_{oj}, the intercept in Equation 1 is assumed to be normally distributed (since random effect u_{oj} is) across facilities. Hence, each facility has its own intercept effecting overall probability of, for example, a resident reporting cleanliness. Z_{1j} and Z_{2j} are dummy variables serving to indicate the facility characteristics (eg, teaching hospital, drug allergy alerts). $\gamma_{03}^{t} Z_{3j}$ represents the linear product of a vector of facility-level covariate characteristics and their corresponding β coefficients in the jth facility. All of the various γ effects in Equation 2 are assumed fixed across the population of facilities.

$$\begin{aligned} \beta_{oj} &= \gamma_{00} + \gamma_{01} Z_{1j} + \gamma_{02} Z_{2j} + \gamma_{03}^{t} Z_{3j} + u_{oj} \\ \beta_{1j} &= \gamma_{10} \\ \beta_{2j}^{t} &= \gamma_{20}^{t} \end{aligned} \tag{2}$$

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Yu (Sunny) Kang, PhD, MS, MPP, MPA https://orcid.org/0000-0002-7038-2898

Supplemental Material

Supplemental material for this article is available online.

References

1. Centers for Medicare & Medicaid Services, Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey. [Updated 2017]. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/HospitalHCAHPS.html.
2. Agency for Healthcare Research and Quality (AHRQ). National Healthcare Quality and Disparities Report and 5th Anniversary Update on the National Quality Strategy. July 2017. https://www.ahrq.gov/sites/default/files/wysiwyg/research/findings/nhqrdr/nhqdr16/2016qdr.pdf.
3. Jarman MP, Castillo RC, Carlini AR, Kodadek LM, Haider AH. Rural risk: geographic disparities in trauma mortality. Surgery. 2016;160:1551-9. doi:10.1016/j.surg.2016.06.020.
4. Short PF, Moran JR, Yang TC, Camacho F, Gusani NJ, Mackley HB, et al. Effects of hospital type and distance on lymph node assessment for colon cancer among metropolitan and nonmetropolitan patients in Appalachia. Med Care Res Rev. 2016;73:546-64. doi:10.1177/1077558715619052.
5. Caffrey RA. The rural community care gerontologic nurse entrepreneur: role development strategies. J Gerontol Nurs. 2005;31:11-6.
6. Goldman LE, Dudley RA. United States rural hospital quality in the Hospital Compare database-accounting for hospital characteristics. Health Policy. 2008;87:112-27. doi:10.1016/j.healthpol.2008.02.002.
7. Goodridge D, Lawson J, Rennie D, Marciniuk D. Rural/urban differences in health care utilization and place of death for persons with respiratory illness in the last year of life. Rural Remote Health. 2010;10:1349.
8. Yu TH, Chung KP, Wei CJ, Chien KL, Hou YC. Do the preferences of healthcare provider selection vary among rural and urban patients with different income and cause different outcome? PLoS One. 2016;11:e0152776. doi:10.1371/journal.pone.0152776.
9. Lutfiyya MN, Sikka A, Mehta S, Lipsky MS. Comparison of US accredited and non-accredited rural critical access hospitals. Int J Qual Health Care. 2009;21:112-8. doi:10.1093/intqhc/mzp003.
10. Hockenberry JM, Becker ER. How do hospital nurse staffing strategies affect patient satisfaction? ILR Review. 2016;69:890-910. 21p. 5. Charts. doi:10.1177/0019793916642760.
11. Esguerra R, Toro J, Ospina JM, Porras A, Díaz C, Reyes S. The transition to a teaching hospital: patient satisfaction before and after the introduction of medical students. Med Teach. 2014;36:710-4. doi:10.3109/0142159X.2014.907877.
12. Madan A, Fowler JC, Allen JG, Ellis TE, Hardesty S, Groat M, et al. Assessing and addressing patient satisfaction in a longer-term inpatient psychiatric hospital: preliminary findings on the Menninger quality of care measure and methodology. Qual Manag Health Care. 2017;23:178-87.
13. Agency for Healthcare Research and Quality, State Inpatient Database Documentation. [Updated 2018]. https://www.hcup-us.ahrq.gov/db/state/siddbdocumentation.jsp.
14. American Hospital Association (AHA). AHA Data and Directories. [Updated 2018]. https://www.aha.org/other-resources/2018-01-08-aha-data-and-directories.
15. Hospital Consumer Assessment of Healthcare Providers and Systems. [Updated 2018]. HCAHPS Tables on HCAHPS On-Line, Overview. https://www.hcahpsonline.org/en/summary-analyses/.
16. Centers for Medicare & Medicaid Services, Hospital Quality Initiatives, HCAHPS Fact Sheet. [Updated 2018]. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Downloads/HospitalHCAHPSFactSheet201007.pdf.
17. Tzeng HM, Hu HM, Yin CY. Understanding inpatient injurious fall rates using U.S. Medicare's Hospital Compare data. Med Surg Nursing. 2016;25:255-9, 69.
18. Odom-Maryon T, Hu HM, Tzeng HM. Associations between hospital-level patient satisfaction scores and hospital-acquired pressure ulcer occurrences among Medicare stroke patients. J Nurs Care Qual. 2019;34:364-69.
19. Centers for Medicare & Medicaid Services, Hospital Compare Measurement. https://www.medicare.gov/hospitalcompare/Data/Measure-groups.html.
20. National Center for Health Statistics (NCHS), NCHS Urban–Rural Classification Scheme for Counties. 2012. https://www.cdc.gov/nchs/data/series/sr_02/sr02_154.pdf. Vital and Health Statistics, Series 2, Number 154.
21. Andersen R. Revisiting the behavior model and access to care: does it matter? J Health Soc Behav. 1995;36:1-10.
22. Cherrie JA. Variable screening for multinomial logistic regression on very large data sets as applied to direct response modeling. 2002. http://www2.sas.com/proceedings/forum2007/081-2007.pdf. SAS Global Forum 2007, Paper 081-2007.
23. Centers for Medicare & Medicaid Services (CMS). Five-Star Quality Rating System. [Updated 2018]. https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/FSQRS.html.
24. McNicholas A, McCall A, Werner A, Wounderly R, Marinchak E, Jones P. Improving patient experience through nursing satisfaction. J Trauma Nurs. 2017;24:371-75.
25. Tranberg M, Vedsted P, Bech BH, Christensen MB, Birkeland S, Moth G. Factors associated with low patient satisfaction in out-of-hours primary care in Denmark—a population-based cross-sectional study. BMC Fam Pract. 2018;191-10. doi:10.1186/s12875-017-0681-6.
26. Nawal Lutfiyya M, Bhat DK, Gandhi SR, Nguyen C, Weidenbacher-Hoper VL, Lipsky MS. A comparison of quality of care indicators in urban acute care hospitals and rural critical access hospitals in the United States. Int J Qual Health Care. 2007;19:141-9.

27. Grabowski D, Angelelli J. The relationship of Medicaid payment rates, bed constraint policies, and risk-adjusted pressure ulcers. Health Serv Res. 2004;39:793-812.

Author Biographies

Yu (Sunny) Kang is an assistant professor at University of Baltimore, School of Health and Human Services. Her research interests center on health disparities in long-term care settings among underserved populations and how federal and state legislation, regulations, policies and programs can reduce or eliminate such disparities. Kang's previous works are published in journals such as The Gerontologist, Journal of Aging & Social Policy, and Medical Care Research and Review.

Huey-Ming Tzeng is a professor at the School of Nursing, The University of Texas Medical Branch, Galveston, Texas. Her research area is quality of care and patient safety for adults, with a focus on fall prevention and patient engagement towards self-care as well as their association with patient-centered outcomes. Her research interests include human resource management and leadership, quality of care and patient safety, patient engagement and adults' self-care needs, and teaching and research methodology.

Ting Zhang is an associate professor of Economics, Merrick School of Business, and an associate director of the Jacob France Institute, University of Baltimore. Dr Zhang's research interests include aging, human capital and occupational choice. As a published author, Dr Zhang has won multiple national and international research awards, has given invited talks to at the U.S. Congress, the US National Press Club, the US Department of Labor, universities and conferences, and has been quoted by Forbes, Time, Bloomberg Businessweek, etc.