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Geographic Differences in Potentially Preventable Readmission Rates in Rural and Urban Hospitals

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Executive Summary

Introduction and Purpose of the Study

Potentially preventable hospital readmissions (PPRs) among Medicare patients are examples of inefficiencies in the health care system. Policymakers are considering efforts to measure and publicly report preventable readmission rates and target hospitals with high rates for improvement by means of payment policy and technical assistance. To help inform the policy debate about readmissions of rural patients, this study estimated PPRs in three types of acute care hospitals: urban prospective payment system (PPS) hospitals, rural PPS hospitals and Critical Access Hospitals (CAHs). The study sought to answer two specific questions:

- Are the adjusted-PPR rates of rural PPS hospitals and CAHs significantly different from the rates of urban PPS hospitals?
- Do differences in demographics or severity of patients in these hospitals affect the PPR rates?

Methods

This study estimates Medicare readmission rates in rural and urban U.S. acute-care hospitals for each of four common health conditions. Medicare Provider Analysis and Review (MedPAR) data from the years 2004–2007 were analyzed. We used 3M Potentially Preventable Readmission (PPR) software to exclude readmissions for reasons unrelated to patients' initial admissions.

The initial hospitals where patients were admitted were grouped into three categories: urban Prospective Payment System (PPS) hospitals, rural PPS hospitals, and Critical Access Hospitals (CAHs), and by U.S. census divisions. Readmission rates, adjusted for illness severity, were calculated at 30-, 60-, and 90-day periods for each of the four most common diseases treated in rural hospitals: congestive heart failure (CHF), bacterial pneumonia, chronic obstructive pulmonary disease (COPD), and kidney or urinary tract infection (KI/UTI).

Results

Significant differences in readmission rates were found between PPS hospitals, CAHs, and urban PPS hospitals, both nationwide and within census divisions. However, these differences varied by disease and division. Moreover, in instances where rural PPS hospitals had significantly higher or lower rates than urban hospitals within a census division, CAHs often did not have similar differences. Overall, adjusted CAH rates were significantly lower than urban rates for three of the four diseases (for KI/UTI, the exception, CAH rates were significantly higher). National rural PPS rates did not differ significantly from urban PPS rates at 30 days, although differences in pneumonia and KI/UTI appeared with longer time frames.

Both national and regional (census division) disease-specific PPRs vary. National CHF and COPD readmission rates are consistently higher than pneumonia and KI/UTI rates. The variation within a disease across census division is remarkable. For example, the South Atlantic PPR rate for COPD readmissions exceeds 200 per 1,000; in contrast, the Pacific rate is under 120 (both 30-day, severity-adjusted). Nationally, rural PPS hospital rates varied little from urban rates; however, every census division had at least one disease-specific rural PPS rate that varied significantly from urban rates. National readmission rates for CAHs were lower than rural or urban PPS hospital rates for CHF, pneumonia, and COPD. CAHs displayed considerable regional variation by disease: more than half of the census divisions had statistically significant variation (high or low) in CAH readmissions for pneumonia, COPD, and KI/UTI.

The absolute differences in PPR rates between urban hospitals, rural PPS hospitals, and CAHs became more pronounced as the discharge-to-readmission time interval increased from 30 days to 90 days. However, the pattern of differences was usually the same for diseases and divisions regardless of the time to readmission.

Our major finding was that location clearly influences readmission rates among hospital types and across diseases. In the New England, Middle Atlantic, East North Central and Pacific divisions, rural PPS hospitals and CAHs usually had significantly *lower* readmission rates than urban hospitals. In contrast, most rural PPS and CAH readmission rates were significantly *higher* than urban rates in the southern areas of the country (i.e., East South Central and West South Central divisions) and in the Mountain Division. Only the West North Central Division had rural readmission rates that were consistently similar to urban rates.

Conclusions

Though we found that analyzing potentially preventable readmission rates across different lengths of time to readmission (30, 60, and 90 days) did not alter results greatly, separating rural PPS hospitals and CAHs from urban PPS hospitals and grouping hospitals by census division definitely contribute toward developing a more complete picture of Medicare readmissions for the four health conditions included in this study.

Our analyses demonstrated that grouping rural and urban hospitals together in readmission studies can mask important variations. Our study also documented the importance of looking separately at rural PPS hospitals and CAHs, since their PPR rates can vary significantly from each other by disease and region. A more useful approach would be to examine severity-adjusted rates by type of hospital and by region (census division, state, or other geographic area). That combination will provide the fullest picture and, potentially, a baseline against which the impact of future PPR improvement efforts can be assessed.

The health disparities among southern Medicare patients (especially in the East South Central and West South Central divisions) merit additional research to examine how the relatively high readmission rates for rural PPS hospitals and CAHs can be improved. Likewise, it could also be beneficial to examine rural PPS hospitals and CAHs in the northeastern areas (Mid-Atlantic and New England) and in the west (Pacific), to determine whether in-hospital care, out-of-hospital care, or other controllable factors may contribute to the relatively low readmission rates in those areas.

Introduction

Current health care reform efforts seek to decrease the costs of care and increase efficiencies (White House, 2009). These goals can be achieved in part through removing waste and improving quality and efficiency in the health care system, including Medicare. Potentially preventable hospital readmissions among Medicare patients are examples of such inefficiencies and are currently targeted for closer examination and scrutiny across the country (Benbassat and Taragin, 2000; Goldfield et al., 2008).

Hospital readmissions may indicate one or a combination of factors: poor in-hospital care, insufficient discharge planning, uncoordinated transition care or inadequate post-discharge and follow-up care or both (Marcantonio et al., 1999; McAlister, Lawson, Teo, and Armstrong, 2001; Hunt, Baker, Chin, et al., 2002; Medicare Payment Advisory Commission [MedPAC], 2007). A national 30-day Medicare hospital readmission rate of 17.6% was reported in 2007, using 2005 data; 76% of those readmissions were identified as potentially preventable (MedPAC 2007). Thus potentially preventable readmissions (PPRs) represent a major opportunity for improving quality and decreasing costs. Health care spending associated with PPRs has been estimated between $12 billion and $17.4 billion per year (MedPAC, 2007; Jencks, Williams, and Coleman, 2009).

Policymakers are considering efforts to (a) measure and publicly report preventable readmission rates and (b) target hospitals with high rates for improvement by means of payment policy and technical assistance. Florida has begun to report hospital-level potentially preventable readmission rates for all patients for acute myocardial infarction (AMI), heart failure, and pneumonia (Goldfield et al., 2008). In June 2009, CMS added 30-day, risk-adjusted, all-cause readmission rates for the same three medical conditions to the publicly reported quality indicators on the Hospital Compare website (CMS, 2009).

Given that rural hospitals have disproportionately high Medicare patient volumes, future policies related to preventable-readmission reporting and payment could have a substantial impact on the rural health care system. Currently, little or no information is available on the prevalence of potentially preventable readmissions among rural Medicare patients. Examining such information could help policymakers develop and implement appropriate readmission-based policies. Policies that take into account germane local and regional factors are more likely to achieve their desired outcomes in both rural and urban areas (e.g., improved quality, reduced costs, and greater efficiency).

Purpose of this Study

To help inform the policy debate about readmissions of rural patients, this study estimated potentially preventable readmissions in three types of acute-care hospitals: urban PPS hospitals, rural PPS hospitals, and Critical Access Hospitals (CAHs). The study sought to answer two specific questions:

- Are the adjusted PPR rates of rural PPS hospitals and CAHs significantly different from the rates of urban PPS hospitals?

- Do differences in demographics or severity of patients in these hospitals affect the PPR rates?

We chose to examine readmission rates for the four diseases with the highest prevalence of rural admissions: congestive heart failure (CHF), bacterial pneumonia, chronic obstructive pulmonary disease (COPD), and kidney infection/urinary tract infection (KI/UTI).

- CHF is the most common diagnosis among hospitalized Medicare patients (CMS, 2006) and has been associated with six-month hospital all-cause readmission rates of more than 40 percent (Krumholz et al., 1997).

- Pneumonia was the second most common reason for hospitalization among Medicare patients in 2007 (HCUPnet, 2009). It is a designated ambulatory care sensitive condition (i.e., a health condition for which timely access to outpatient primary care can decrease the need for inpatient hospitalizations; Agency for Healthcare Research and Quality [AHRQ], 2001).

- COPD is one of the leading causes of morbidity and mortality worldwide (World Health Organization, 2009). National health survey data have indicated that about 24 million Americans have COPD (Centers for Disease Control and Prevention, 2009).

- UTIs are the second most common type of infection in the body (National Kidney and Urologic Diseases Information Clearinghouse, 2005). Risk factors include aging and having diabetes, kidney stones, or other chronic illnesses (Mayo Clinic, 2009a). Kidney infection is a specific type of UTI that generally begins in the urethra or bladder and travels up into the kidneys (Mayo Clinic, 2009b).

Methods

This study employed the 3M Health Information Systems' Potentially Preventable Readmissions (PPR) software model. This model identifies potentially preventable readmissions using state- and federal-level hospital data sets. Based on an extensive review of the existing permutations of diagnoses for index hospitalizations and readmissions, the 3M analytic model determines the likelihood that a given readmission diagnosis is related to the index hospitalization and thus potentially preventable (MedPAC, 2007). (See Appendix A for additional information regarding the 3M PPR software.)

In 2007, the 3M model was used to calculate preventable readmission rates in the Medicare population for MedPAC. This method was also used by the State of Florida to calculate preventable readmissions rates within its hospitals across all payers (Florida Center for Health Information, 2007).

We used four years of Medicare Provider and Analysis Review (MedPAR) data (2004 through 2007) to estimate PPRs at 30-, 60-, and 90-day intervals using the 3M PPR program, and SAS v9.2. MedPAR data were matched with corresponding Medicare denominator files to obtain demographic information. The Medicare beneficiaries in the study included older adults (age 65 and older) and disabled beneficiaries under the age of 65. Patients with inpatient visits in each state were combined with out-of-state inpatient visits to identify all visits by patients to hospitals in all states. The 3M program was used on this combined data to generate files that identified PPRs for patients.

The 3M generated PPR data was also combined with files containing information on rurality (defined by linking hospital zip codes to rural-urban commuting area codes) and Critical Access Hospital (CAH) status of each hospital used by patients. Dates of when a hospital became or ceased to be a CAH were used to signify CAH status at date of admission for the patient. Hospitals were grouped into three cohorts: urban prospective payment system (PPS), rural PPS, and CAH.

Initial hospitals were defined as ones where a patient had an admission for a defined disease (CHF, pneumonia, COPD, or KI/UTI) that may have led to a readmission for reasons that were clinically related to that disease. These diseases were the four most common inpatient diagnoses for rural hospitals. CHF, pneumonia, and COPD were also the three most common diagnoses for urban hospitals, while KI/UTI was sixth most common for urban hospitals.

The observations used were patient visits to an initial hospital that did or did not lead to a readmission within the designated time span (i.e. 30, 60, or 90 days). Readmissions to hospitals that were different than the initial hospitals (regardless of state) were included. Readmissions for reasons not related to the patients' principal diagnoses or conditions during their initial admissions were excluded. Patients who died were also excluded. Transfers were not considered as separate visits. Further details on the algorithm used by the 3M program to determine PPRs can be found in Goldfield et al. (2008). The number of valid visits to an initial hospital that *did* result in a readmission relative to the number of valid visits that *did not* result in a readmission was used to estimate PPR rates.

States were grouped into nine census divisions for analysis. Hospitals were categorized into divisions using the initial hospital's state. Hospitals where the readmission occurred may or may not have been located in the same division. The U.S. Census (2009) definitions for region and division were used to categorize states into nine census divisions and four census regions (see Table 1).

Table 1. Census Divisions Used for PPR Analysis

Northeast Region New England Division: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut Middle Atlantic Division: New York, New Jersey, Pennsylvania
Midwest Region East North Central Division: Ohio, Indiana, Illinois, Michigan, Wisconsin West North Central Division: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
South Region South Atlantic Division: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida East South Central Division: Kentucky, Tennessee, Alabama, Mississippi West South Central Division: Arkansas, Louisiana, Oklahoma, Texas
West Region Mountain Division: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada Pacific Division: Washington, Oregon, California, Alaska, Hawaii

Severity Variables

A health condition severity score was calculated for each Medicare patient based on information from the patient's initial hospitalization, including age, gender, race, comorbidity score (a scale unique to each disease created from odds ratios of Elixhauser-defined comorbidities), emergency room visit (yes or no), intensive care unit visit (yes or no), length of stay (LOS), total charges per day, surgical procedure performed (yes or no), and discharge destination (home/regular or other), using logistic regressions. Severity scores were estimated uniquely for each disease and days-to-readmission combination.

The data were aggregated by hospital. For each hospital the PPR rate was estimated. Individual data about each hospital included average demographics and severity (average percentage under 65 years old, over 74 years old, male, white, destination home, destination home health care, destination skilled nursing facility, destination swing bed, average age, comorbidity score, severity score, LOS, and cost per day). Cohorts of hospitals were based on census division and type of hospital (urban PPS, rural PPS, or CAH) for each of the four diseases and three time periods.

Statistical Analysis

Average severity scores of hospitals for each disease/division/time were compared between hospital types using one-way ANOVA with Tukey's multiple comparison tests. Average PPR rates for each hospital were adjusted by breaking the severity score into five levels and adjusting rural PPS and CAH rates according to the distribution they would have had if their severity would have matched urban rates. The distribution of the severity score for adjusting was done separately for each disease, time to readmission, and division. Both unadjusted and adjusted average PPR rates of rural hospitals were compared to rates of the urban hospitals, using independent *t*-tests.

As the validity of the 3M PPR algorithm has been established by MedPAC (2008) and Goldfield et al. (2008), only PPRs in urban, rural PPS, and rural CAH hospitals for the four diseases were studied. This allowed for a direct comparison of readmissions among these three hospital types, disregarding readmissions not related to initial admissions.

Results

This section presents the major findings from our statistical analyses. To provide context for these findings, we first summarize potentially preventable readmissions of Medicare patients for each diagnosis in the three types of hospitals in the 2004–2007 period. Second, the PPR results related to patient attributes (gender, race, and age) are presented. Finally, we describe and interpret the potential hospital attributes that could explain variation among PPR statistics for these four diagnoses.

Hospitals Used by Medicare Patients for Potentially Preventable Readmissions

Table 2 shows the nationwide distribution of inpatient facilities used by Medicare patients with congestive heart failure (CHF), pneumonia, chronic obstructive pulmonary disease (COPD), or kidney infection/urinary tract infection (KI/UTI) who had potentially preventable readmissions at 30, 60, and 90 days.

The distribution of hospitals in which PPRs occurred was fairly consistent across these four diseases: Urban PPS hospitals accounted for about 47% of all hospitals with PPRs among Medicare patients. Rural hospitals accounted for 53%, with rural PPS hospitals composing 31% and CAHs composing the remaining 22% of hospitals. Hospital usage by type of hospital varied slightly but not significantly across these diseases.

The variation in volume of readmissions for these four diseases merits attention. CHF and pneumonia both account for about six million readmissions in this four-year data set. That is approximately double the volume of patients readmitted for COPD (three million). Rehospitalizations for KI/UTI are least frequent (slightly more than two million patients).

Table 2. Number, Percentage and Type of Hospitals Used by Medicare Patients with CHF, Pneumonia, COPD, and KI/UTI for 30-, 60-, and 90-Day Potentially Preventable Readmissions

	Patients	Hospitals	Urban PPS		Rural PPS		CAH	
	N	*N*	*N*	(%)	*N*	(%)	*N*	(%)
CHF								
30 Day	2,300,332	5,854	2,745	(46.89)	1,817	(31.03)	1,292	(22.07)
60 Day	1,993,936	5,821	2,735	(46.98)	1,795	(30.83)	1,291	(22.17)
90 Day	1,803,001	5,798	2,725	(46.99)	1,783	(30.75)	1,290	(22.24)
Pneumonia								
30 Day	2,149,464	6,018	2,778	(46.16)	1,940	(32.23)	1,300	(21.60)
60 Day	1,966,404	5,999	2,772	(46.20)	1,927	(32.12)	1,300	(21.67)
90 Day	1,838,628	5,981	2,766	(46.24)	1,915	(32.01)	1,300	(21.73)
COPD								
30 Day	1,154,920	5,823	2,794	(47.98)	1,736	(29.81)	1,293	(22.20)
60 Day	1,017,998	5,805	2,786	(47.99)	1,727	(29.75)	1,292	(22.25)
90 Day	925,732	5,796	2,778	(47.92)	1,726	(29.77)	1,292	(22.29)
KI/UTI								
30 Day	838,129	5,557	2,598	(46.75)	1,669	(30.03)	1,290	(23.21)
60 Day	748,180	5,535	2,588	(46.75)	1,657	(29.93)	1,290	(23.30)
90 Day	689,300	5,515	2,850	(46.78)	1,648	(29.88)	1,287	(23.33)

Patient Demographics

Figures 1 to 3 show the distribution of gender, race, and age, respectively, for 30-day PPRs for each disease. Males represent slightly less than 50% of Medicare patients with 30-day PPRs for three of the four diseases: CHF, pneumonia, and COPD (Figure 1). The most striking urban–rural disparity involves COPD: urban PPS hospitals had a significantly lower percentage of males admitted than did rural PPS hospitals, and PPS hospitals had a significantly lower percentage of males readmitted than CAHs did. This contrasts with the CHF profile, in which urban PPS hospitals had a significantly higher percentage of males than in either type of rural hospital.

The male and female percentages readmitted for pneumonia varied only slightly across the three hospital types. Females make up approximately three quarters of the patients readmitted for kidney infection/urinary tract infection. The percentage of males readmitted for KI/UTI at CAHs was significantly higher than the percentage readmitted at either urban or rural PPS hospitals.

Figure 2 summarizes the racial and ethnic makeup of Medicare patients who had PPRs for the four diseases. The current Medicare population is predominantly white, and the readmission data show a high percentage of white patients across all four diseases and all three hospital settings. Average percentages range from about 80 percent (urban PPS hospitals) to 90 percent (CAHs), regardless of disease. Urban PPS hospitals had the most diverse populations, regardless of disease. As Figure 2 documents, all pairs of urban PPS hospitals, rural PPS hospitals, and rural CAHs are significantly different for all diseases.

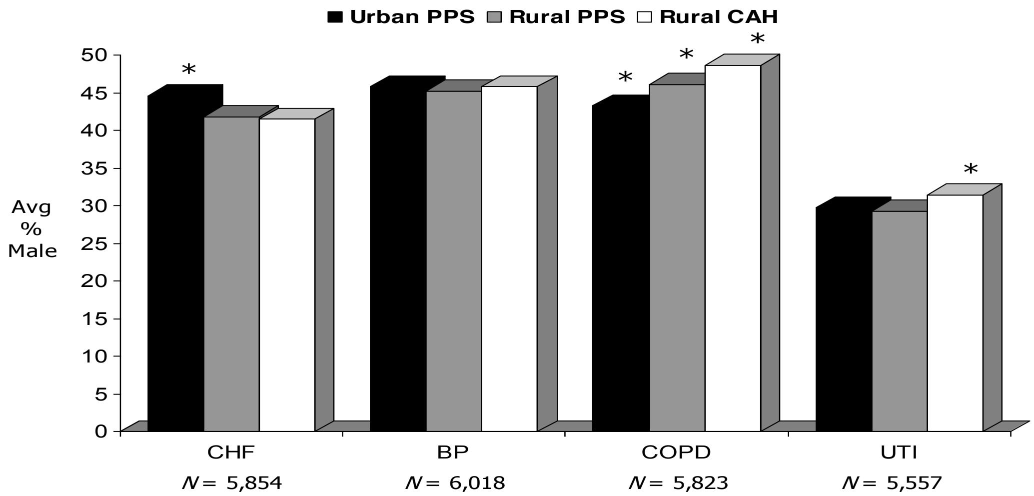
Average age, displayed in Figure 3, shows numerous significant differences. All pairs of urban PPS hospitals, rural PPS hospitals, and CAHs vary significantly for three of the four diseases: CHF, pneumonia, and KI/UTI. For each of those diagnoses, the urban PPS hospitals have the youngest patients, and the CAHs have the oldest patients, on average.

COPD shows a distinct pattern. It has a markedly lower average age compared to the other three diseases, and that low age persists across all three hospital types. The average age among COPD patients did not differ significantly between urban and rural PPS hospitals. However, the CAH patients readmitted for COPD were significantly older, on average.

Nearly identical patterns were found for 60- and 90-day PPRs for the four diseases, thus those data are not shown.

Figure 1

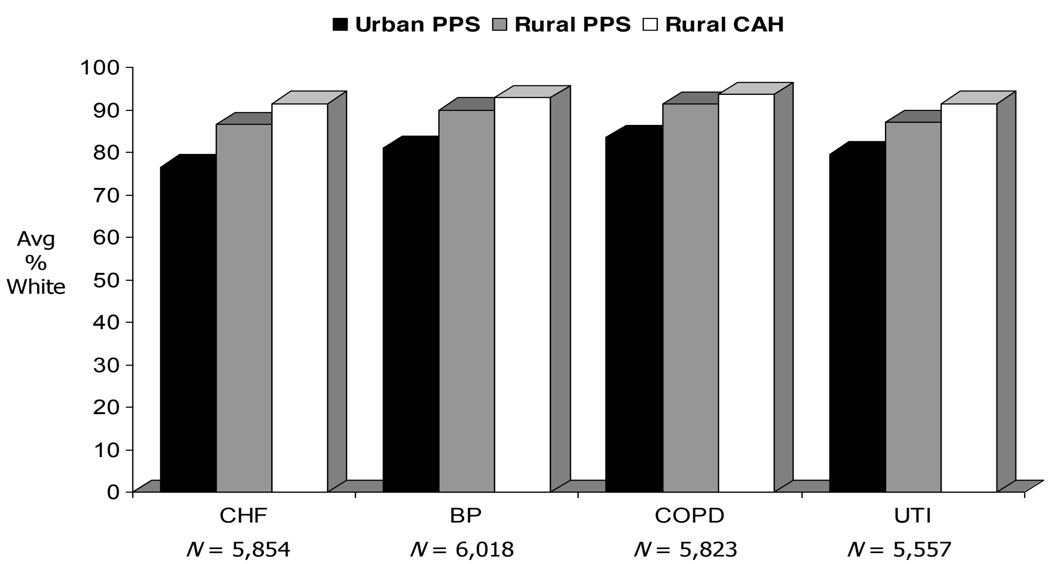
Average Percentage Male in Urban PPS, Rural PPS, and Rural CAH Hospitals with Patients who had 30-Day PPR for CHF, BP, COPD, and UTI



* Significantly different from other rurality designations within the disease.

Figure 2

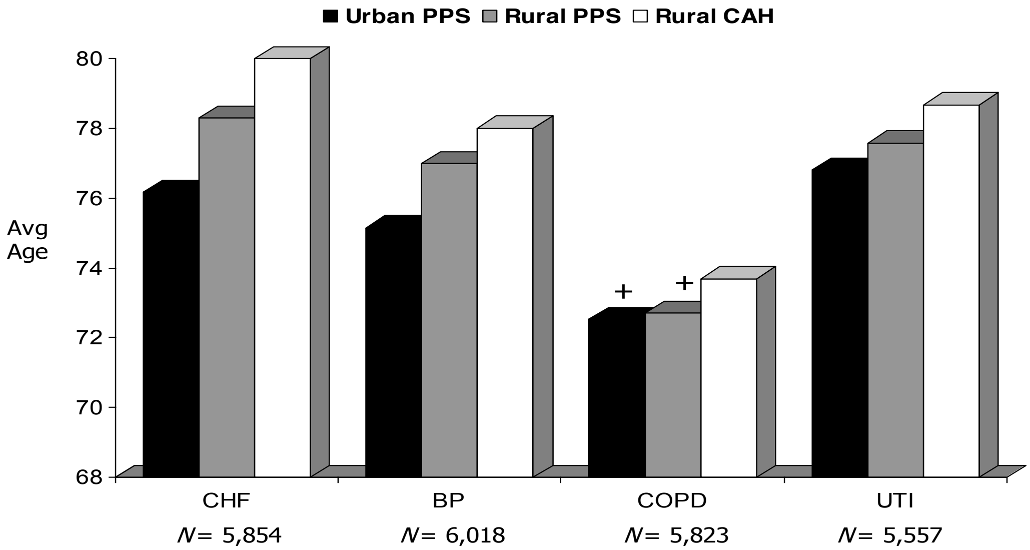
Average Percentage White in Urban PPS, Rural PPS, and Rural CAH Hospitals with Patients who had 30-Day PPR for CHF, BP, COPD, and UTI



* All pairs of Urban PPS, Rural PPS, and Rural CAH significantly different for all diseases.

Figure 3

Average Age in Urban PPS, Rural PPS, and Rural CAH Hospitals with Patients Who Had 30-Day PPR for CHF, BP, COPD, and UTI



+ All pairs of Urban PPS, Rural PPS, and Rural CAH significantly different for all diseases except for Urban and Rural PPS, COPD.

Patient Demographic Variations by Census Divisions

Our analyses of patient variables included an assessment by census division of the demographics of hospitals treating Medicare patients with potentially preventable readmissions for the four diseases being studied. Tables B-1 through B-4 in Appendix B show the demographic characteristics of Medicare patients at initial visit by census division and by PPR days for CHF, pneumonia, COPD, and KI/UTI respectively.

Geographic differences exist among the nine census divisions. Hospitals in the Mountain Division have a high average percentage of males most often for each disease, while the East South Central had the lowest percentage of males. Elsewhere, gender distributions vary. For all diseases, the West North Central, New England, and East North Central divisions have the highest average percentage of whites (fewest minorities), while the Pacific, West South Central, and South Atlantic have the lowest percentage of whites. Average age of patients in each hospital follows a similar pattern to race. The divisions with older or younger patients are also the divisions with more or less average percentages of white patients respectively. The average percentage under 65 or 75 and older varies more. For example, though the East South Central Division is not the youngest in terms of average age, it has the lowest average percentage of patients 75 and older for all four diseases.

Hospital Types and Severity

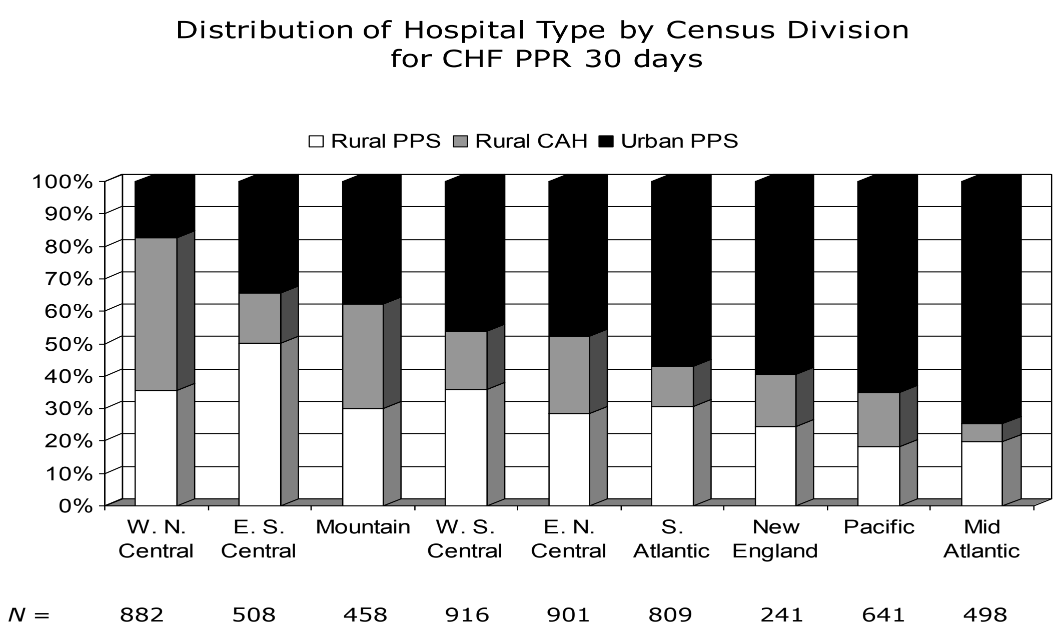
How do other hospital attributes affect PPRs for these four diseases? We examined the distribution of hospital types, unadjusted-severity scores by division and rurality, and nationwide severity-adjusted PPR rates for 30-, 60- and 90-day PPRs. Finally, we examined adjusted-PPR rates by disease, hospital type, and geographic division, using 30-, 60- and 90-day time frames. The remainder of this section presents findings from these analyses.

Distribution of Hospital Types by Census Division

Figure 4 shows the distribution of hospitals by type for 30-day congestive heart failure readmissions in each census division. Figure 4 starts on the left with the highest percentage of rural hospitals (rural PPS or CAHs) and orders the remaining divisions in decreasing order of rural hospital prevalence from left to right. Thus the West North Central Division (far left) has the highest percentage of rural hospitals (about 80%) and the Mid-Atlantic Division (far right) has the lowest percentage (about 25%).

The distribution of rural PPS hospitals and CAHs is not uniform across geographic regions. As Figure 4 depicts, most of the rural hospitals in the West North Central and Mountain divisions are CAHs. In contrast, the East South Central Division, which has the second highest percentage of rural hospitals, has one of the smallest percentages (about 12%) of CAHs. The percentage of rural PPS hospitals also varies greatly, from a low of less than 20% in the Pacific Division to a high of nearly 50% in the East South Central Division. The geographic distribution of the three types of hospitals is nearly identical for the other three diseases and other PPR days; thus those data are not shown.

Figure 4



Unadjusted Severity Scores by Division and Rurality

We found significant differences in unadjusted severity scores, both across census divisions and among hospital types within census divisions. The average severity scores for hospitals according to disease, division, PPR days, and hospital rurality are shown in Tables 1–4 in Appendix C. Each table displays results for one disease. Within each table, the census divisions are ordered in descending order of mean rural PPS severity score for 30-day PPRs.

The Mid-Atlantic and New England divisions consistently had the highest rural severity scores for all diseases, all PPR days. The Pacific, West North Central, and Mountain divisions had consistently low severity scores for three of the four diseases: CHF, pneumonia and KI/UTI. COPD presents a different picture: West North Central and Mountain divisions had low severity scores, but West South Central, East South Central, and South Atlantic rural PPS scores were all lower than Pacific scores.

For nearly all scores in CHF, pneumonia, and COPD, urban PPS hospitals had significantly higher severity of patients on average than rural PPS hospitals or CAHs. In a few instances, rural PPS hospitals and CAHs did not have significantly different severity scores. (This usually occurred for 60- and 90-day PPRs, and in the divisions of Mid-Atlantic and New England, which have the fewest CAHs.)

Kidney/urinary tract infection (Table 4, Appendix C) showed a more mixed picture. In East South Central and West North Central divisions, 60 and 90 days, the average urban PPS severity scores were not significantly different from rural PPS scores.

Severity-Adjusted PPR Rates, Nationwide

Average 30-, 60-, and 90-day PPRs per 1,000 patients for each hospital were estimated within each division for CHF, pneumonia, COPD, and KI/UTI. Average rates for rural PPS hospitals and CAHs were compared to urban hospitals. These rates were then adjusted for severity and again compared to urban rates. Figures 5–7 display the national results. Figure 5 shows the urban PPS hospital rates, unadjusted- and adjusted-rural-PPS rates, and unadjusted- and adjusted-CAH rates for 30-day PPRs, respectively. Figures 6 and 7 depict the comparable rates for 60-day and 90-day PPRs.

Figure 5

Unadjusted and Adjusted 30-Day PPR Rates for Urban, Rural PPS, and Rural CAH

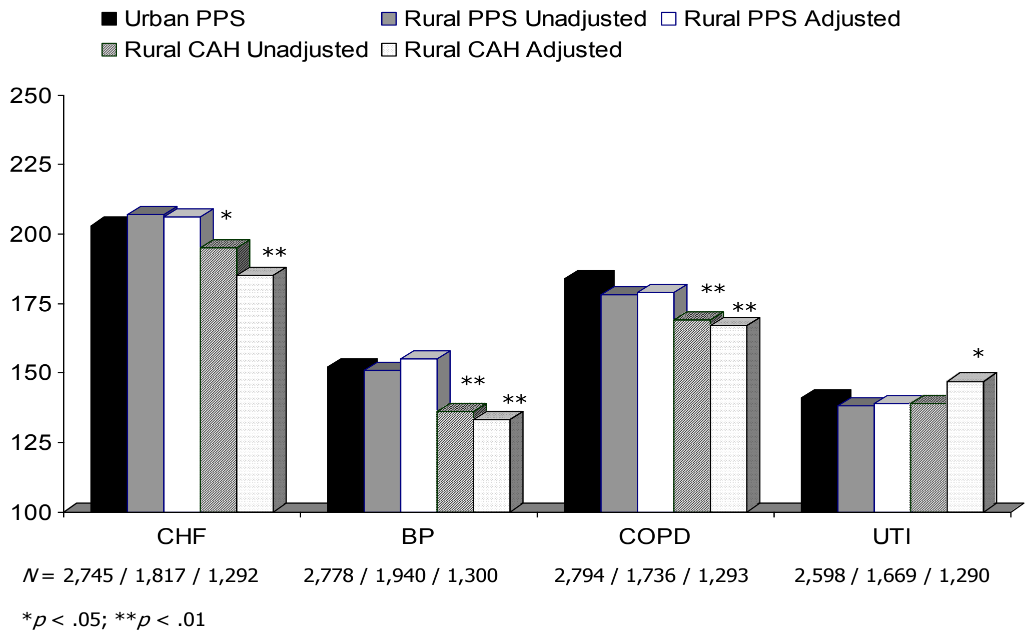


Figure 6

Unadjusted and Adjusted 60-Day PPR Rates for Urban, Rural PPS, and Rural CAH

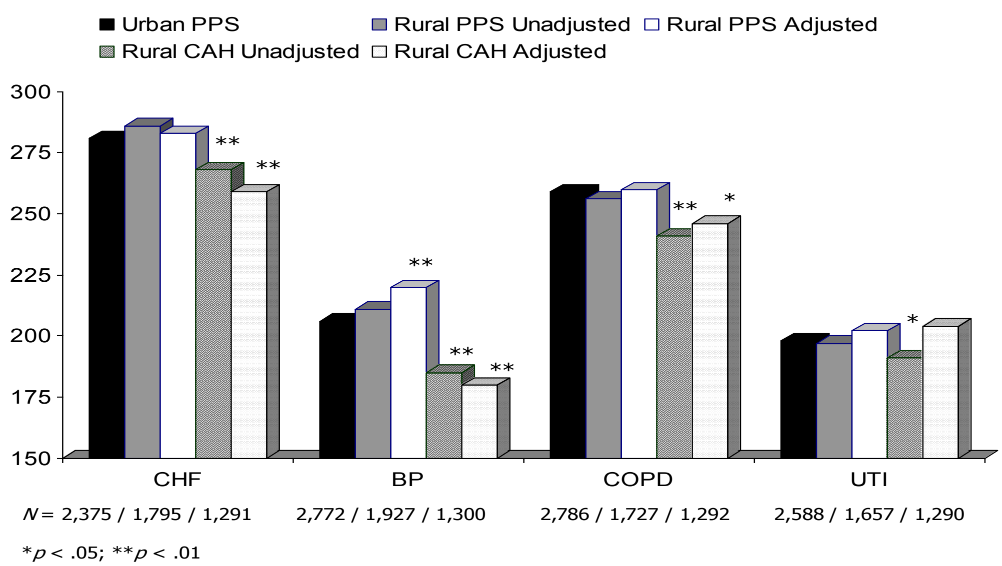
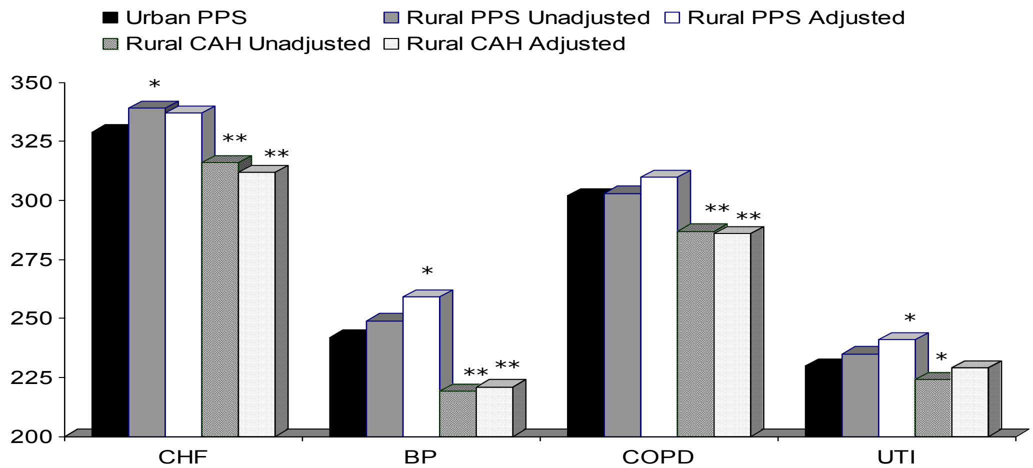


Figure 7

Unadjusted and Adjusted 90-Day PPR Rates for Urban, Rural PPS, and Rural CAH



N = 2,725 / 1,783 / 1,290 | 2,766 / 1,915 / 1,300 | 2,778 / 1,726 / 1,292 | 2,580 / 1,648 / 1,287

$*p < .05$; $**p < .01$

CHF and COPD have the highest rates of readmission across all three hospital types and for all three readmission time frames. For both CHF and COPD, rates increase by about 75 people per 1,000 between 30- and 60-day readmission, and by about 50 people per 1,000 between 60- and 90-day readmission. Pneumonia rates increase by about 50 people per 1,000 from 30-day to 60-day and between 60-day and 90-day readmissions. KI/UTI rates increase about 50 people per 1,000 between 30 and 60 days, and 25 people between 60 and 90 days.

In Figure 5, the 30-day rural PPS hospital adjusted rates (black) do not differ significantly from the urban PPS rates. However, the CAH adjusted rates (dark stripe) are significantly lower for all four diseases.

Figure 6 (60-day rates) shows that the adjusted rural PPS hospital rate for pneumonia is significantly *higher* than the urban PPS pneumonia rate. The adjusted rural PPS hospital rates for the other three diseases are very similar to urban PPS rates. Severity-adjusted CAH rates for KI/UTI are not significantly different from urban rates; however, the adjusted- CHF, pneumonia, and COPD rates for CAHs are significantly *lower* than the rates for their urban counterparts.

Figure 7 displays the 90-day rates. Once again, rurality makes a difference, but not always in the same direction. Adjusted 90-day rural PPS rates for both pneumonia and KI/UTI are significantly *higher* than urban PPS rates for those diseases. CAH rates mirror the pattern displayed in 60-day results: they are significantly lower for CHF, pneumonia, and COPD, although not for KI/UTI.

Severity-adjusted Rates, Geographic Variation by Disease

Congestive Heart Failure. Table 3 shows adjusted 30-day PPR rates for CHF, by census division.[1] The census divisions at the top have adjusted rural rates (rural PPS hospitals or CAHs or both) that are significantly *higher* than urban rates. The divisions in the middle do not differ significantly. The divisions at the bottom have adjusted rural rates that are significantly *lower* than urban rates. As the key to the table shows, statistical significance varies from $p < .05$ to $p < .01$, with several comparisons in the latter category.

Table 3. Congestive Heart Failure: Severity-Adjusted Average Hospital 30-Day PPR Rates per 1,000 Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division

Census Division	Urban PPS Hospitals	Rural PPS Hospitals	Critical Access Hospitals
East South Central	188	222**	218**
South Atlantic	211	239**	196
West South Central	202	223*	209
West North Central	186	209	174
New England	195	170	182
Mountain	185	156	172
Mid-Atlantic	209	209	196
Pacific	195	163*	148**
East North Central	216	173**	196*

* Differences with urban PPS hospitals are significant at $p < .05$
**Differences with urban PPS hospitals are significant at $p < .01$

When rural rates were adjusted for severity, both PPS and CAHs in the East South Central Division were significantly *higher* than urban rates. In the South Atlantic and West South Central, this same pattern was true for rural PPS hospitals, but not for CAHs.

Four geographic divisions of the country showed no significant difference between adjusted 30-day rural rates and urban rates: West North Central, New England, and Mountain, and Mid-Atlantic. (The Mountain and Mid-Atlantic CAHs did have significantly lower adjusted 60- or 90-day or both CAH rates, which are not shown.) Both the Pacific and the East North Central divisions had rural PPS and CAH rates that were significantly *lower* than urban rates after adjusting for severity.

Pneumonia. Table 4 presents the comparable severity-adjusted data for pneumonia. The adjusted pneumonia readmission rates are more mixed. The East South Central, West South Central, and Mountain divisions each have a significantly higher rural rate in one but not both rural hospital types. (Note that 90-day results showed statistical significance for both rural hospital types in both South Central divisions.)

[1] See Appendix D for comparable tables with 60- and 90-day severity-adjusted PPR rates by condition and census division

The bottom of Table 4 shows the most consistent results. The Pacific, Mid-Atlantic, and New England divisions all had 30-day rural PPS hospital and CAH rates that were significantly lower than urban PPS hospitals in those regions, when adjusted for severity.

Table 4. Pneumonia: Severity-Adjusted Average Hospital 30-Day PPR Rates per 1,000 Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division

Census Division	Urban PPS Hospitals	Rural PPS Hospitals	Critical Access Hospitals
West South Central	150	187**	144
East South Central	155	168	181*
Mountain	130	180**	139
West North Central	137	141	125
East North Central	153	155	184**
South Atlantic	148	159	155
Pacific	151	125*	107**
Mid-Atlantic	170	117**	152*
New England	158	107**	129**

* Differences with urban PPS hospitals are significant at $p < .05$
**Differences with urban PPS hospitals are significant at $p < .01$

COPD. Severity-adjusted PPR rates for COPD (Table 5) present a very different picture. Rural PPS hospital rates differed significantly from urban rates in only one division: Mid-Atlantic. In contrast, CAHs in six of the nine divisions had statistically significant differences when adjusted data were used. Adjusted CAH rates in the South Atlantic and Mountain divisions were significantly higher than urban PPS hospitals; CAH rates in Pacific, East North Central, New England, and Mid-Atlantic divisions were all significantly lower than urban rates.

Table 5. Chronic Obstructive Pulmonary Disease: Severity Adjusted Average Hospital 30-Day PPR Rates per 1,000 Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division

Census Division	Urban PPS Hospitals	Rural PPS Hospitals	Critical Access Hospitals
South Atlantic	183	204	213**
Mountain	148	147	213**
East South Central	182	180	183
West South Central	186	195	192
West North Central	167	174	156
Pacific	176	153	109**
East North Central	192	198	166**
New England	175	166	155*
Mid-Atlantic	211	175**	183*

* Differences with urban PPS hospitals are significant at $p < .05$
**Differences with urban PPS hospitals are significant at $p < .01$

Urinary Tract/Kidney Infection. Similar to CHF and pneumonia rates, the adjusted 30-day KI/UTI rates (Table 6) show a broad range of differences between rural and urban rates on both ends of the spectrum. Two divisions have significantly higher rural PPS and CAH rates when adjusted for severity. One division (Mountain) has higher CAH rates, but not rural PPS rates. On the other end, in New England and Mid-Atlantic divisions, both rural PPS and CAH rates are significantly lower when adjusted for severity.

Table 6. Kidney Infection/Urinary Tract Infection: Severity-Adjusted Average Hospital 30-Day PPR Rates per 1,000 Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division.

Census Division	Urban PPS Hospitals	Rural PPS Hospitals	Critical Access Hospitals
East South Central	136	164**	186**
West South Central	139	161*	177**
Mountain	110	119	166**
Pacific	135	114	138
South Atlantic	151	143	142
West North Central	139	118*	149
East North Central	142	134	133
New England	139	107**	110**
Mid-Atlantic	154	133*	135*

* Differences with urban PPS hospitals are significant at $p < .05$
**Differences with urban PPS hospitals are significant at $p < .01$

Summary of PPR Variation by Geography and Rurality

Table 7 summarizes the statistically significant differences in adjusted 30-day PPR rates by hospital type and census division for the four diseases. This table provides a visual synopsis of the marked differences in adjusted rates among census divisions. It also shows the considerable variation across census divisions for a specific disease. In addition, Table 14 enables comparisons of the rural PPS and CAH outcomes.

Differences among Census Divisions

Striking differences are evident. The Mid-Atlantic Division and East South Central Division represent opposite ends: Six of the eight 30-day rates are significantly lower in the Mid-Atlantic Division, and no rates are significantly higher. Conversely, the East South Central Division has no significantly lower 30-day rates and five rates that are significantly higher, as compared to urban hospitals.

It is also important to note the divisions with very little significant variation. Two of the nine divisions had fewer than three statistically significant results: the West North Central Division has one lower result and no higher results; and the South Atlantic Division has two higher results and no lower results. Even the divisions with multiple significant outcomes have at least two categories with no significant 30-day differences.

Differences among Diseases

Table 7 facilitates disease-specific comparisons across census divisions. In treating CHF, no statistically significant differences were evident in four of the nine census divisions. In two divisions, both rural PPS hospitals and CAHs had lower adjusted PPRs. Higher rural PPRs were found in three divisions.

The other three diseases all have significantly lower adjusted rural PPRs in three or four census divisions. Pneumonia PPRs are significantly lower for both rural hospital types in three divisions. COPD readmissions have the least variation: five lower rural rates and only two higher rural rates out of 18 possible (9 divisions × 2 rural hospital types = 18).

Rates for KI/UTI show the most dramatic variation. Two divisions have significantly lower adjusted rates for both rural hospital types; two divisions have significantly higher adjusted rates for both rural hospital types; and three divisions show no significant differences. The remaining two divisions each have one significant difference.

Table 7. Summary of Significant Differences in Severity-Adjusted 30-Day PPR Rates, by Hospital Type and Census Division

Census Division Summary of Significant Differences Compared to Urban PPS Rates	Congestive Heart Failure		Pneumonia		COPD		Kidney/Urinary Tract Infection	
	Rural PPS	CAH	Rural PPS	CAH	Rural PPS	CAH	Rural PPS	CAH
Mid-Atlantic: 6 Lower, 0 Higher			L	L	L	L	L	L
New England: 5 Lower, 0 Higher			L	L		L	L	L
Pacific: 5 Lower, 0 Higher	L	L	L	L		L		
East North Central: 3 Lower, 1 Higher	L	L		H		L		
West North Central: 1 Lower, 0 Higher							L	
South Atlantic: 0 Lower, 2 Higher	H					H		
Mountain: 0 Lower, 3 Higher			H			H		H
West South Central: 0 Lower, 4 Higher	H		H				H	H
East South Central: 0 Lower, 5 Higher	H	H		H			H	H
Totals	2 Lower; 3 Higher	2 Lower; 1 Higher	3 Lower; 2 Higher	3 Lower; 2 Higher	1 Lower; 0 Higher	4 Lower; 2 Higher	3 Lower; 2 Higher	2 Lower; 3 Higher

Comparisons between Rural PPS Hospitals and CAHs

Rural PPS hospital and CAH 30-day adjusted rates tended to be similar, especially for significantly low findings. The low findings for CHF, pneumonia, and KI/UTI are consistent across rural PPS hospitals and CAHs. The high findings are consistent for KI/UTI, but not at all for the other three diseases.

COPD shows the largest disparity among significant findings: Rural PPS hospital rates for COPD are significantly different in only one of nine census divisions. Critical Access Hospitals have significantly different COPD PPR rates in six of the nine divisions: In four divisions, CAH rates are significantly low, and in two divisions those rates are significantly high.

Overall Geographic Trends

To help discern broader geographic trends, 30-day adjusted PPR results are depicted graphically in Figures 8 to 11 for CHF, COPD, KI/UTI, and pneumonia, respectively. On each map, census regions are marked with an "H" where rural PPS hospitals or CAHs or both have *higher* 30-day adjusted PPR rates than urban PPS hospitals. Census regions are marked with an "L" where rural PPS hospitals or CAHs or both have *lower* adjusted PPR rates than urban PPS hospitals. In the unmarked census regions, PPR rates for rural PPS hospitals and CAHs were not significantly different than those of urban PPS hospitals.

Figure 8. Significant Differences in CHF 30-Day Adjusted PPR Rates for CAHs, Rural PPS, and Urban PPS Hospitals

Figure 9. Significant Differences in Pneumonia Adjusted 30-Day PPR Rates for CAHs, Rural PPS, and Urban PPS Hospitals

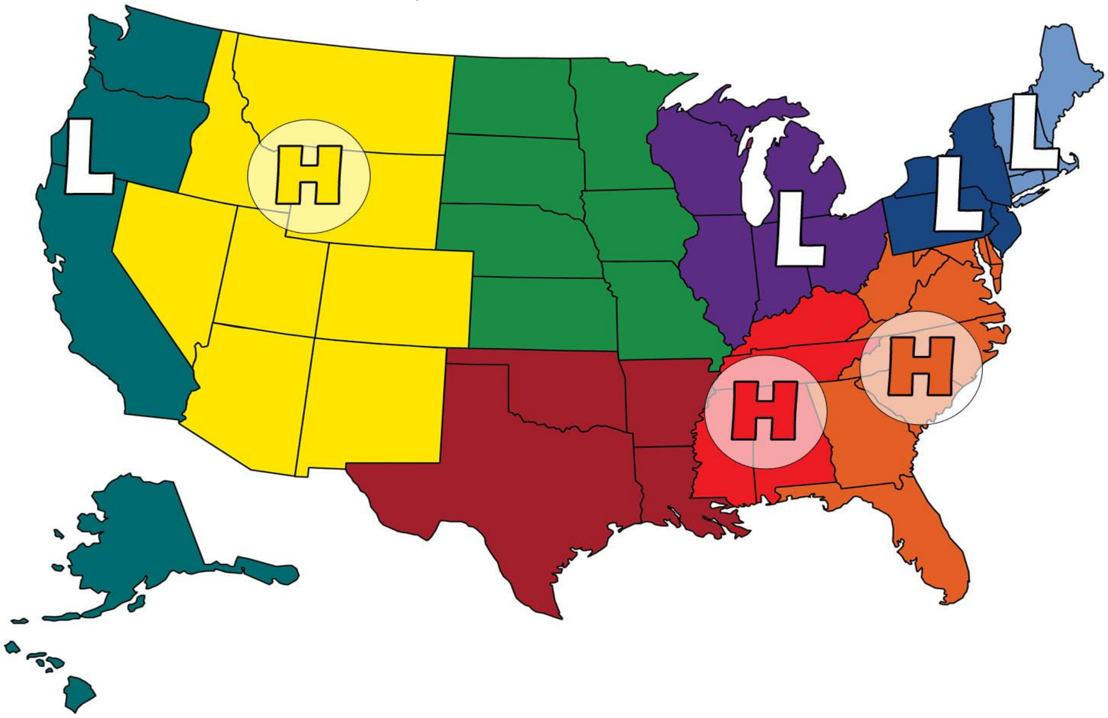


Figure 10. Significant Differences in COPD 30-Day Adjusted PPR Rates for CAHs, Rural PPS, and Urban PPS Hospitals

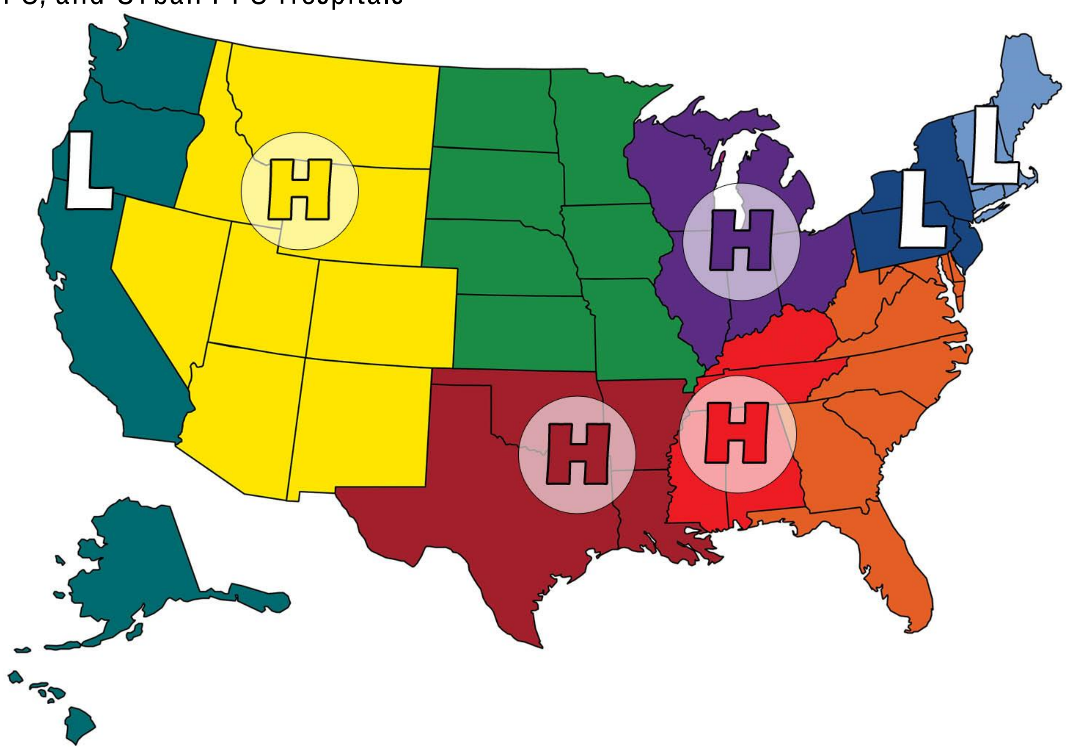
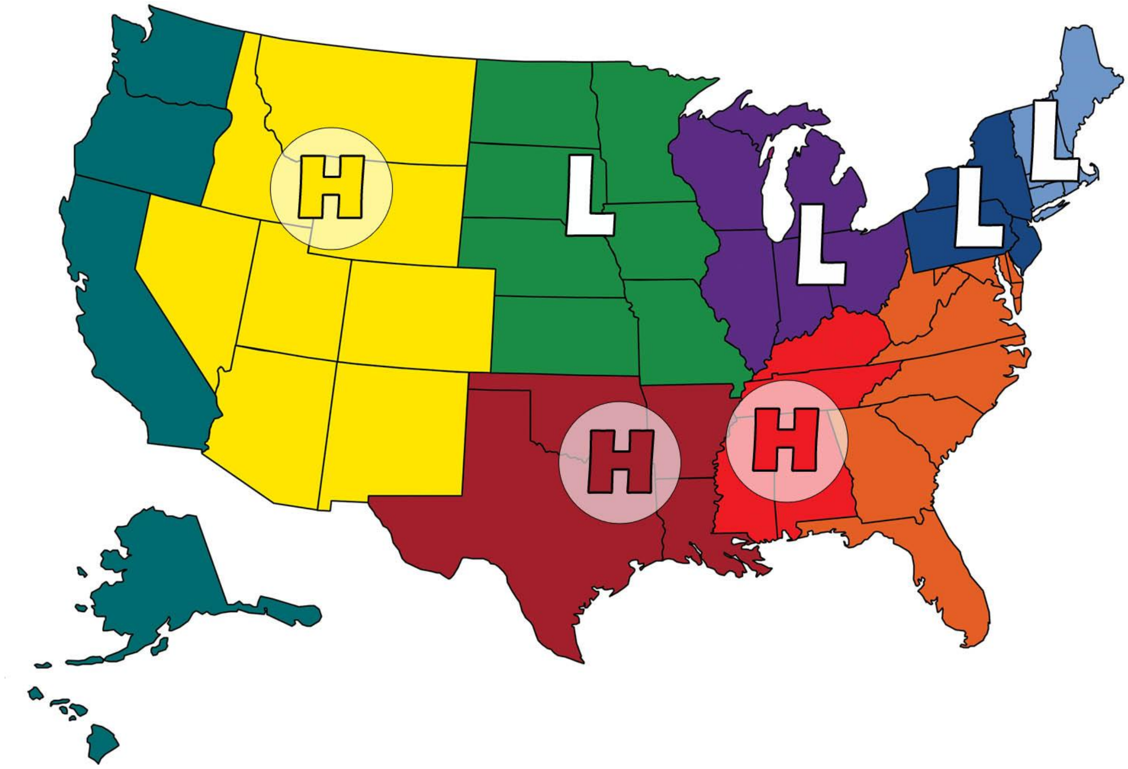


Figure 11. Significant Differences in Kidney/Urinary Tract Infection 30-Day Adjusted PPR Rates for CAHs, Rural PPS, and Urban PPS Hospitals



Conclusions

This study addressed two main research questions: (1) Are the adjusted PPR rates of rural PPS hospitals and CAHs significantly different from the rates of urban PPS hospitals? and (2) Do differences in demographics or severity of patients in these hospitals affect the PPR rates?

Adjusted PPR Rate Differences among Hospital Types

Adjusted PPR rates vary among hospital types, both rural versus urban, and within the two rural hospital types (PPS and CAH). These variations are often at statistically significant levels, but are not all in one direction. Urban PPS rates can be higher or lower than rural PPS, depending on diagnosis and days to readmission. While CAH rates are typically lower than both urban and rural PPS hospitals, this is not uniformly the case.

Influence of Diagnosis on PPR Rate in Hospital Types

Each of the four diagnoses studied shows a distinct readmission pattern across the three hospital types. Readmission patterns were different not only between urban and rural PPS hospitals but also between rural PPS hospitals and CAHs. CAHs had significantly lower 30-day readmission rates for CHF, pneumonia, and COPD than did urban and rural PPS hospitals. However, adjusted 30-day KI/UTI readmissions were significantly higher for CAHs than for urban hospitals or rural

PPS hospitals. Given that UTI is the fourth most common diagnosis for rural hospital admissions, it is important to further research this difference.

Rural PPS hospitals tended to have readmission patterns similar to urban PPS hospitals, especially in the 30-day time period. Rural PPS hospitals have slightly higher readmission rates for CHF and pneumonia, although the differences in the 30-day results are not significant. Pneumonia readmissions at the 60-day and 90-day level are both significantly higher in rural PPS hospitals than in urban hospitals or CAHs. COPD results are very similar for urban and rural PPS hospitals across all three time frames. KI/UTI 30- and 60-day results are similar for rural and urban PPS hospitals; however the 90-day KI/UTI adjusted readmissions rate for rural PPS hospitals is significantly higher than either urban or CAH rates.

Influence of Differences in Demographics and Severity on PPR Rates

The adjustments for severity are important for two reasons. They change the results, sometimes at significant levels. Perhaps more germane, severity-adjusted data allow the results to be used with more confidence by hospital administrators, policymakers, and others.

Influence of Geography

In the process of answering the two primary research questions, we documented a third important factor in PPR rates. After adjusting for severity, it appears clear that geographic location interacts both with hospital types and diagnoses to create readmission patterns that vary markedly by census division. Overall, rural PPS hospitals and CAHs located in the New England, Mid-Atlantic, East North Central, and Pacific census divisions tended to have significantly *lower* readmission rates than urban hospitals. In contrast, several rural PPS and CAH readmission rates were significantly *higher* than urban rates in the three southern divisions of the country and in the Mountain Division.

Time Interval

This study employed three discharge-to-readmission time intervals (30-, 60- and 90-day). Recent studies have used the 30-day interval when measuring readmissions, presumably due to the belief among researchers and policymakers that readmissions within a shorter time frame are more easily avoidable, more closely linked to care provided during the patients' initial hospitalizations, and thus perhaps better represent indicators of potentially poor quality of care (Goldfield et al., 2008).

The results of our study indicate that, although readmission rates increased as time intervals increased, pneumonia was the only disease in which the patterns of readmission rates within divisions and hospital types varied significantly across the different time intervals. Thus, while 60- and 90-day data may be useful to specific hospitals or groups of hospitals, 30-day readmission rates can be considered useful proxies for 60- and 90-day PPR rates, at least from the standpoint of national and regional policy and planning.

Possible Causes of Geographic Variation in PPRs among Hospital Types

Some of the geographic differences may be caused by the prevalence of rural PPS hospitals and CAHs in these divisions. For example, the Northeast and Pacific areas have the lowest percentage of rural PPS hospitals and CAHs. The West North Central Division, which has the greatest percentage of CAHs, has rural readmission rates that are most similar to urban readmission rates.

Although the PPR rates were adjusted for demographics and severity, we may not have been able to adjust for all differences because of race and rurality. The higher rates of tobacco use in the southeastern states coupled with race and other rurality factors (Stevens et al., 2003) may have a long-term detrimental impact on the health of this population even after individuals have improved access to health care through Medicare. Other research links rurality and race to health outcomes (Hartley, 2004). Rural white older adults often experience better health than their non-white older adult counterparts owing to such factors as higher rates of health insurance coverage prior to Medicare eligibility, higher educational attainment, and increased income.

Limitations

This study is based on administrative data and on a limited number of diseases. Other factors beyond this study's scope need to be examined to get a better picture of what factors contribute to reduced readmissions. Such factors could include specific indicators of inpatient care quality, discharge planning, care coordination, home support, patient compliance, and patient self-care.

Directions for Future Research

Our analyses demonstrated that grouping rural and urban hospitals together in readmission studies can mask important variations. Our study also documented the importance of looking separately at rural PPS hospitals and CAHs since their PPR rates can vary significantly from each other by disease and region. A more useful approach is to examine severity-adjusted rates by type of hospital and by region (census division, state, or other geographic area). This combination provides the fullest picture and a baseline against which the impact of future PPR improvement efforts can be assessed.

The health disparities among southern Medicare patients (especially in the East South Central and West South Central divisions) merit additional research to examine how the relatively high readmission rates for rural PPS hospitals and CAHs can be improved. Likewise, it could also be beneficial to examine rural PPS hospitals and CAHs in the northeastern areas (Mid-Atlantic and New England) and in the far west (Pacific), to determine whether in-hospital care, out-of-hospital care, or other controllable factors may contribute to the relatively low readmission rates in those areas.

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Appendix A: 3M Potentially Preventable Readmission (PPR) software

The 3M Potentially Preventable Readmission (PPR) software offers specific advantages when estimating readmissions. First, it identifies clinically related readmissions using diagnoses and procedures performed to assign an APR-DRG for the admission. If the APR-DRG of an admission does not match that of the previous admission, it is not considered a clinically related readmission. This excludes admissions where a person may have first been hospitalized for a disease such as diabetes, but then was hospitalized for a car accident. They may still have diabetes as a secondary diagnosis, but the program identifies that diabetes is not the reason for admission and a different APR-DRG is assigned. The software can also identify if the admission is caused by an underlying disease even if another diagnosis or procedure is listed. Second, the PPR software identifies chains or a series of readmissions. If a patient is repeatedly readmitted to a hospital within a given time period, that is considered one event or a chain of admissions. For example, if a person is readmitted 10 days following an initial admission, then again 14 days later, then 19 days later, then 32 days later, these form a chain of three admissions with one initial admission with a 30-day PPR, two readmissions in the chain, and one lone admission. This avoids counting an extra readmission when it was still related to just one initial admission. If this were for a 60-day PPR, there would be one chain with four admissions. The third way the PPR software controls for readmissions is to exclude types of admissions that are not true readmissions. These include admissions for trauma, cancer, burns, obstetrics, where the person had left against medical advice, or admissions to non-acute care facilities. If the patient is transferred or dies, the admission is also excluded. This avoids counting preventable type admissions, such as accidents, or counting admissions twice, such as when a transfer occurs (only the receiving hospital is counted), or counting admissions where it is impossible for the person to be readmitted, such as when they died at initial admission.

The 3M PPR program is also versatile for the user. The number of days to readmission is selected by the programmer. The user can also specify types of hospitals to be excluded. Data files into the program and output files are easily formatted and useable. The 3M program also provides information about the admission in the output, including the type of admission, the placement in the readmission chain, and the number of chains per patient.

Appendix B: General Demographics of Hospitals Treating Patients with 30-Day PPRs

Table B-1. Demographics of Hospitals Treating Patients with 30-Day PPR for CHF by Division.*

	Hospitals *N*	Average % Male	Average % White	Average Age	Average % < 65	Average % ≥ 75
West North Central						
30 Day	882	43.21	95.58	80.53	6.37	76.17
New England						
30 Day	241	43.34	94.63	79.22	7.69	73.44
East North Central						
30 Day	901	42.24	89.12	78.09	10.33	68.20
Mountain						
30 Day	458	46.16	86.01	77.85	8.72	66.39
Mid-Atlantic						
30 Day	498	42.06	83.73	78.24	9.59	68.05
East South Central						
30 Day	508	40.53	77.76	75.99	15.11	59.85
Pacific						
30 Day	641	46.23	76.18	77.21	12.16	64.79
West South Central						
30 Day	916	42.16	75.90	76.41	13.42	60.72
South Atlantic						
30 Day	809	42.95	73.69	76.13	14.56	60.88

*Demographic characteristics for 60- and 90-day PPRs are very similar to 30-day PPR results

Table B-2. Demographics of Hospitals Treating Patients with 30-Day PPR for Pneumonia by Division.*

	Hospitals *N*	Average % Male	Average % White	Average Age	Average % < 65	Average % ≥ 75
West North Central						
30 Day	942	47.11	95.79	78.82	9.28	70.42
New England						
30 Day	249	46.95	96.07	77.36	11.39	65.73
East North Central						
30 Day	925	45.43	90.79	76.56	12.89	63.58
Mountain						
30 Day	476	50.15	86.39	75.89	13.56	59.73
Mid-Atlantic						
30 Day	502	45.26	85.73	76.84	12.88	64.61
East South Central						
30 Day	518	42.60	84.70	74.16	18.02	54.28
Pacific						
30 Day	658	47.42	78.29	76.22	14.42	62.48
West South Central						
30 Day	922	43.10	82.69	75.88	13.85	59.56
South Atlantic						
30 Day	826	44.87	80.88	75.07	16.21	58.49

*Demographic characteristics for 60- and 90-day PPRs are very similar to 30-day PPR results

Table B-3. Demographics of Hospitals Treating Patients with 30-Day PPR for COPD by Division.*

	Hospitals *N*	Average % Male	Average % White	Average Age	Average % < 65	Average % ≥ 75
West North Central						
30 Day	857	50.49	95.82	74.17	13.87	51.99
New England						
30 Day	241	42.13	96.81	73.47	16.69	49.05
East North Central						
30 Day	906	44.74	91.64	72.80	17.14	45.35
Mountain						
30 Day	452	46.21	89.12	73.13	15.96	46.36
Mid-Atlantic						
30 Day	511	42.70	86.09	74.04	15.59	51.55
East South Central						
30 Day	500	45.02	87.95	70.62	25.07	37.88
Pacific						
30 Day	632	45.20	80.23	73.37	16.57	48.84
West South Central						
30 Day	902	44.72	84.83	72.31	18.53	43.53
South Atlantic						
30 Day	822	43.84	84.18	71.93	20.61	42.15

*Demographic characteristics for 60- and 90-day PPRs are very similar to 30-day PPR results

Table B-4. Demographics of Hospitals Treating Patients with 30-Day PPR for UTI by Division.*

	Hospitals *N*	Average % Male	Average % White	Average Age	Average % < 65	Average % ≥ 75
West North Central						
30 Day	824	31.89	95.03	78.79	10.26	72.35
New England						
30 Day	227	32.64	96.47	78.56	11.12	72.37
East North Central						
30 Day	853	30.13	90.42	77.88	11.38	69.63
Mountain						
30 Day	425	31.31	85.34	76.43	12.60	64.88
Mid-Atlantic						
30 Day	472	30.97	84.85	78.09	11.56	70.49
East South Central						
30 Day	488	25.10	82.12	76.15	15.54	63.70
Pacific						
30 Day	618	31.00	77.95	76.59	14.22	65.75
West South Central						
30 Day	874	29.40	78.31	77.34	12.25	66.69
South Atlantic						
30 Day	776	28.63	77.77	77.23	12.66	67.23

*Demographic characteristics for 60- and 90-day PPRs are very similar to 30-day PPR results

Appendix C: Average Severity Scores of Urban PPS, Rural PPS, and CAH hospitals with 30-, 60-, and 90-Day PPRs by division.

Table C-1. Congestive Heart Failure: Average Severity Scores of Urban PPS, Rural PPS, and CAH Hospitals with 30-, 60-, and 90-Day PPR by Division.

Region	Urban PPS			Rural PPS			CAH		
Days	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)
New England									
30 Days	143	**.774**	(.090)	59	**.730**	(.102)	39	**.668**	(.073)
60 Days*	142	**.880**	(.198)	59	**.787**	(.099)	39	**.718**	(.072)
90 Days*	142	**.844**	(.213)	59	**.750**	(.096)	39	**.692**	(.066)
Mid-Atlantic									
30 Days	372	**.758**	(.087)	99	**.727**	(.070)	27	**.654**	(.082)
60 Days	372	**.888**	(.200)	99	**.784**	(.066)	27	**.700**	(.078)
90 Days*	371	**.852**	(.202)	99	**.746**	(.064)	27	**.671**	(.076)
South Atlantic									
30 Days	460	**.750**	(.102)	249	**.686**	(.117)	100	**.610**	(.095)
60 Days	457	**.875**	(.236)	245	**.778**	(.134)	100	**.690**	(.084)
90 Days	456	**.838**	(.239)	244	**.747**	(.139)	100	**.668**	(.081)
East South Central									
30 Days	174	**.717**	(.097)	255	**.681**	(.100)	79	**.628**	(.078)
60 Days	173	**.847**	(.188)	253	**.772**	(.145)	79	**.703**	(.068)
90 Days	173	**.811**	(.188)	252	**.739**	(.153)	79	**.677**	(.069)
East North Central									
30 Days	430	**.750**	(.108)	257	**.681**	(.103)	214	**.622**	(.070)
60 Days	430	**.870**	(.248)	255	**.746**	(.103)	214	**.688**	(.058)
90 Days	428	**.832**	(.249)	252	**.714**	(.097)	214	**.665**	(.055)
West South Central									
30 Days	423	**.724**	(.124)	330	**.673**	(.120)	163	**.599**	(.100)
60 Days	421	**.913**	(.266)	326	**.784**	(.221)	163	**.678**	(.084)
90 Days	419	**.882**	(.271)	324	**.749**	(.211)	163	**.656**	(.080)
Pacific									
30 Days	417	**.713**	(.120)	117	**.657**	(.122)	107	**.590**	(.089)
60 Days	416	**.812**	(.170)	115	**.739**	(.159)	107	**.661**	(.088)
90 Days	414	**.777**	(.165)	115	**.707**	(.159)	106	**.640**	(.092)
West North Central									
30 Days	153	**.709**	(.095)	314	**.634**	(.136)	415	**.590**	(.081)
60 Days	153	**.815**	(.224)	308	**.732**	(.152)	415	**.665**	(.072)
90 Days	152	**.775**	(.218)	305	**.706**	(.149)	415	**.644**	(.071)
Mountain									
30 Days	173	**.714**	(.118)	137	**.620**	(.112)	148	**.565**	(.090)
60 Days	171	**.850**	(.314)	135	**.696**	(.115)	147	**.635**	(.080)
90 Days	170	**.800**	(.266)	133	**.668**	(.114)	147	**.612**	(.079)

* Rural PPS and CAH mean severity scores not significantly different; all others different ($p < .05$)

Table C-2. Pneumonia: Average Severity Scores of Urban PPS, Rural PPS, and CAH Hospitals with 30-, 60-, and 90-Day PPR by Division.

Region	Urban PPS			Rural PPS			CAH		
Days	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)
Mid-Atlantic									
30 Days	371	**.932**	(.204)	104	**.810**	(.156)	27	**.687**	(.112)
60 Days	371	**1.013**	(.215)	104	**.897**	(.153)	27	**.775**	(.115)
90 Days	370	**1.003**	(.211)	102	**.894**	(.146)	27	**.778**	(.115)
New England									
30 Days	150	**.919**	(.164)	60	**.791**	(.149)	39	**.691**	(.083)
60 Days	150	**1.006**	(.176)	60	**.880**	(.163)	39	**.788**	(.083)
90 Days*	149	**.997**	(.175)	59	**.876**	(.159)	39	**.798**	(.086)
West South Central									
30 Days	422	**.953**	(.325)	336	**.759**	(.242)	164	**.648**	(.110)
60 Days	419	**1.042**	(.340)	334	**.840**	(.250)	164	**.732**	(.115)
90 Days	416	**1.032**	(.331)	334	**.841**	(.249)	164	**.740**	(.115)
East North Central									
30 Days	432	**.905**	(.251)	278	**.753**	(.155)	215	**.667**	(.084)
60 Days	432	**.992**	(.262)	276	**.841**	(.159)	215	**.759**	(.085)
90 Days	432	**.986**	(.263)	276	**.843**	(.160)	215	**.771**	(.084)
South Atlantic									
30 Days	468	**.890**	(.216)	257	**.753**	(.131)	101	**.633**	(.101)
60 Days	468	**.977**	(.237)	256	**.837**	(.135)	101	**.719**	(.108)
90 Days	468	**.971**	(.235)	253	**.833**	(.132)	101	**.726**	(.106)
East South Central									
30 Days	178	**.867**	(.253)	261	**.748**	(.167)	79	**.643**	(.089)
60 Days	177	**.953**	(.256)	259	**.836**	(.183)	79	**.727**	(.090)
90 Days	176	**.950**	(.258)	259	**.832**	(.183)	79	**.731**	(.089)
Pacific									
30 Days	423	**.877**	(.220)	126	**.706**	(.157)	109	**.599**	(.110)
60 Days	422	**.962**	(.225)	125	**.796**	(.149)	109	**.689**	(.114)
90 Days	422	**.959**	(.222)	125	**.798**	(.146)	109	**.704**	(.116)
West North Central									
30 Days	158	**.848**	(.245)	368	**.691**	(.182)	416	**.641**	(.093)
60 Days	158	**.932**	(.254)	365	**.782**	(.183)	416	**.735**	(.097)
90 Days	158	**.929**	(.250)	359	**.791**	(.184)	416	**.749**	(.097)
Mountain									
30 Days	176	**.860**	(.332)	150	**.656**	(.171)	150	**.579**	(.107)
60 Days	175	**.952**	(.347)	148	**.746**	(.175)	150	**.669**	(.113)
90 Days	175	**.947**	(.340)	148	**.750**	(.176)	150	**.680**	(.112)

* Rural PPS and CAH mean severity scores not significantly different; all others different ($p < .05$)

Table C-3. COPD: Average Severity Scores of Urban PPS, Rural PPS, and CAH Hospitals with 30-, 60-, and 90-Day PPR by Division.

Region	Urban PPS			Rural PPS			CAH		
Days	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)
New England									
30 Days	148	**.559**	(.086)	54	**.507**	(.109)	39	**.424**	(.082)
60 Days	147	**.660**	(.192)	54	**.560**	(.106)	39	**.474**	(.070)
90 Days*	147	**.655**	(.212)	54	**.553**	(.109)	39	**.470**	(.072)
Mid-Atlantic									
30 Days	382	**.536**	(.108)	102	**.498**	(.077)	27	**.418**	(.102)
60 Days*	382	**.647**	(.241)	102	**.550**	(.101)	27	**.462**	(.081)
90 Days*	380	**.635**	(.248)	102	**.540**	(.108)	27	**.453**	(.078)
East North Central									
30 Days	440	**.525**	(.117)	251	**.449**	(.116)	215	**.373**	(.080)
60 Days	440	**.622**	(.253)	250	**.504**	(.137)	215	**.436**	(.074)
90 Days	439	**.612**	(.262)	250	**.495**	(.142)	215	**.434**	(.071)
Pacific									
30 Days	411	**.483**	(.092)	114	**.438**	(.138)	107	**.337**	(.095)
60 Days	410	**.546**	(.142)	114	**.484**	(.154)	107	**.391**	(.091)
90 Days	410	**.532**	(.148)	114	**.474**	(.159)	107	**.390**	(.091)
South Atlantic									
30 Days	477	**.504**	(.110)	244	**.430**	(.095)	101	**.342**	(.094)
60 Days	474	**.606**	(.196)	243	**.506**	(.097)	101	**.408**	(.079)
90 Days	473	**.599**	(.205)	243	**.498**	(.104)	101	**.404**	(.078)
East South Central									
30 Days	175	**.457**	(.117)	246	**.421**	(.092)	79	**.355**	(.079)
60 Days	175	**.578**	(.223)	245	**.489**	(.121)	79	**.418**	(.070)
90 Days	175	**.570**	(.230)	245	**.482**	(.127)	79	**.410**	(.073)
West North Central									
30 Days	158	**.490**	(.095)	285	**.414**	(.148)	414	**.352**	(.091)
60 Days	157	**.569**	(.196)	281	**.494**	(.160)	413	**.423**	(.082)
90 Days	157	**.558**	(.207)	280	**.486**	(.160)	413	**.423**	(.084)
West South Central									
30 Days	431	**.493**	(.138)	307	**.414**	(.113)	164	**.343**	(.099)
60 Days	430	**.662**	(.300)	306	**.495**	(.168)	164	**.411**	(.085)
90 Days	428	**.653**	(.306)	306	**.487**	(.171)	164	**.409**	(.084)
Mountain									
30 Days	172	**.485**	(.087)	133	**.403**	(.121)	147	**.337**	(.096)
60 Days	171	**.566**	(.187)	132	**.489**	(.291)	147	**.396**	(.091)
90 Days	169	**.555**	(.195)	132	**.485**	(.308)	147	**.393**	(.093)

* Rural PPS and CAH mean severity scores not significantly different; all others different ($p < .05$)

Table C-4. UTI: Average Severity Scores of Urban PPS, Rural PPS, and CAH Hospitals with 30-, 60-, and 90-Day PPR by Division.

Region	Urban PPS			Rural PPS			CAH		
Days	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)	*N*	Mean	(*SD*)
West South Central									
30 Days	402	**.871**	(.333)	308	**.749**	(.207)	164	**.642**	(.110)
60 Days	397	**.937**	(.365)	307	**.812**	(.223)	164	**.704**	(.132)
90 Days	394	**.905**	(.361)	305	**.792**	(.224)	163	**.710**	(.133)
Mid-Atlantic									
30 Days	348	**.806**	(.153)	97	**.735**	(.086)	27	**.661**	(.095)
60 Days*	348	**.869**	(.169)	95	**.788**	(.104)	27	**.711**	(.106)
90 Days*	348	**.835**	(.173)	95	**.758**	(.105)	27	**.714**	(.113)
East South Central									
30 Days	159	**.756**	(.117)	250	**.721**	(.149)	79	**.667**	(.075)
60 Days†	158	**.810**	(.125)	249	**.783**	(.162)	79	**.733**	(.092)
90 Days*†	157	**.783**	(.137)	246	**.757**	(.161)	79	**.735**	(.099)
South Atlantic									
30 Days	438	**.775**	(.153)	237	**.721**	(.105)	101	**.659**	(.088)
60 Days	437	**.835**	(.171)	237	**.778**	(.120)	101	**.723**	(.099)
90 Days*	434	**.803**	(.171)	237	**.755**	(.124)	101	**.728**	(.097)
New England									
30 Days*	138	**.800**	(.246)	50	**.707**	(.102)	39	**.654**	(.082)
60 Days*	138	**.872**	(.265)	50	**.772**	(.124)	39	**.711**	(.101)
90 Days*	138	**.853**	(.269)	50	**.751**	(.134)	39	**.739**	(.108)
East North Central									
30 Days	400	**.768**	(.166)	239	**.685**	(.121)	214	**.651**	(.079)
60 Days*	400	**.827**	(.180)	237	**.740**	(.136)	214	**.707**	(.086)
90 Days*	400	**.800**	(.196)	235	**.719**	(.137)	214	**.725**	(.090)
West North Central									
30 Days	148	**.714**	(.115)	263	**.659**	(.138)	413	**.599**	(.091)
60 Days	147	**.765**	(.116)	258	**.719**	(.165)	413	**.655**	(.106)
90 Days†	147	**.745**	(.120)	256	**.713**	(.168)	413	**.681**	(.113)
Pacific									
30 Days	408	**.744**	(.135)	103	**.640**	(.129)	107	**.588**	(.090)
60 Days	408	**.800**	(.153)	103	**.683**	(.141)	107	**.633**	(.107)
90 Days*	407	**.770**	(.154)	103	**.659**	(.142)	106	**.645**	(.103)
Mountain									
30 Days	157	**.695**	(.096)	122	**.593**	(.108)	146	**.560**	(.102)
60 Days*	155	**.747**	(.117)	121	**.632**	(.125)	146	**.601**	(.118)
90 Days*	155	**.719**	(.134)	121	**.613**	(.122)	145	**.602**	(.127)

*Rural PPS and CAH; †Urban PPS and Rural PPS scores not different; all others different ($p < .05$)

Appendix D: Severity-Adjusted Average Hospital 60- and 90-Day PPR Rates for Urban PPS, Rural PPS and CAH Hospitals by Division

Table D-1. Severity-Adjusted Average Hospital 60- and 90-Day PPR Rates per 1,000 CHF Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division

Census Division	Urban PPS	Rural PPS		CAHs	
Days		Adjusted	(Unadjusted)	Adjusted	(Unadjusted)
East South Central					
60 Days	**263**	319**	(309)**	307**	(302)**
90 Days	**323**	362**	(361)**	362**	(357)*
South Atlantic					
60 Days	**286**	330**	(293)	286	(297)
90 Days	**336**	397**	(358)*	333	(346)
West South Central					
60 Days	**288**	292	(310)	300	(300)
90 Days	**344**	371*	(373)*	330	(350)
West North Central					
60 Days	**260**	282	(291)*	263	(262)
90 Days	**305**	327	(335)*	315	(310)
New England					
60 Days	**277**	261	(274)	268	(258)
90 Days	**327**	305	(322)	308	(303)
Mountain					
60 Days	**254**	246	(252)	220*	(248)
90 Days	**284**	291	(290)	267	(289)
Mid-Atlantic					
60 Days	**299**	291	(288)	269*	(271)*
90 Days	**350**	335	(334)	307**	(309)**
Pacific					
60 Days	**268**	215**	(235)*	212**	(247)
90 Days	**309**	254**	(274)*	302	(302)
East North Central					
60 Days	**290**	254**	(262)*	260**	(260)**
90 Days	**335**	307*	(318)	305**	(304)**

*$p < .05$; **$p < .01$

Table D-2. Severity-Adjusted Average Hospital 60- and 90-Day PPR Rates per 1,000 Pneumonia Admissions for Rural PPS and CAHs Compared to Urban PPS Hospitals by Census Division

Region	Urban PPS	Rural PPS		CAH	
Days		Adjusted	(Unadjusted)	Adjusted	(Unadjusted)
West South Central					
60 Days	**209**	247**	(227)	198	(198)
90 Days	**243**	296**	(274)*	211**	(234)
East South Central					
60 Days	**201**	242**	(234)*	241**	(220)
90 Days	**245**	289**	(278)*	288**	(264)
Mountain					
60 Days	**187**	231*	(187)	193	(171)
90 Days	**212**	251*	(215)	206	(196)
West North Central					
60 Days	**193**	220*	(208)	173*	(180)
90 Days	**241**	261	(246)	212*	(215)*
East North Central					
60 Days	**206**	223	(206)	199	(183)*
90 Days	**240**	243	(238)	240	(218)**
South Atlantic					
60 Days	**198**	207	(211)	211	(210)
90 Days	**239**	231	(243)	255	(241)
Pacific					
60 Days	**203**	182	(184)	151**	(161)**
90 Days	**239**	219	(217)	196**	(186)**
Mid-Atlantic					
60 Days	**227**	197*	(211)	204*	(199)*
90 Days	**266**	268	(249)	248	(237)*
New England					
60 Days	**212**	151**	(165)*	181*	(182)*
90 Days	**235**	236	(223)	214*	(213)*

*$p < .05$; **$p < .01$

Table D-3. Severity-Adjusted Average Hospital 60- and 90-Day PPR Rates per 1,000 COPD Admissions for Rural PPS and CAH Compared to Urban PPS by Census Division

Census Division	Urban PPS	Rural PPS		CAH	
Days		Adjusted	(Unadjusted)	Adjusted	(Unadjusted)
South Atlantic					
60 Days	**251**	306**	(281)*	253	(247)
90 Days	**295**	353**	(325)*	297	(292)
Mountain					
60 Days	**212**	222	(227)	272**	(241)*
90 Days	**242**	265	(272)	302**	(278)*
East South Central					
60 Days	**257**	268	(261)	263	(257)
90 Days	**304**	317	(309)	312	(317)
West South Central					
60 Days	**263**	277	(261)	254	(249)
90 Days	**310**	324	(313)	297	(296)
West North Central					
60 Days	**246**	256	(252)	251	(240)
90 Days	**286**	314	(308)	286	(286)
Pacific					
60 Days	**250**	235	(241)	190**	(221)*
90 Days	**295**	286	(284)	246**	(271)
East North Central					
60 Days	**268**	258	(251)	234**	(238)**
90 Days	**311**	304	(295)	265**	(285)*
New England					
60 Days	**257**	226*	(220)*	225**	(223)**
90 Days	**308**	259**	(254)**	273**	(272)**
Mid-Atlantic					
60 Days	**289**	231**	(258)*	261*	(255)*
90 Days	**330**	280**	(304)*	300*	(291)*

*$p < .05$; **$p < .01$

Table D-4. Severity-Adjusted Average Hospital 60- and 90-Day PPR rates per 1,000 UTI Admissions for Rural PPS Hospitals and CAHs Compared to Urban PPS Hospitals by Census Division.

Census Division	Urban PPS	Rural PPS		CAH	
Days		Adjusted	(Unadjusted)	Adjusted	(Unadjusted)
East South Central					
60 Days	**193**	224**	(220)**	261**	(253)**
90 Days	**225**	258**	(255)**	293**	(289)**
West South Central					
60 Days	**214**	224	(223)	244**	(223)
90 Days	**242**	276**	(268)*	284**	(264)*
Mountain					
60 Days	**152**	168	(156)	197**	(182)*
90 Days	**187**	205	(187)	179	(200)
Pacific					
60 Days	**186**	160	(171)	177	(180)
90 Days	**221**	220	(206)	199	(204)
South Atlantic					
60 Days	**203**	207	(209)	184*	(200)
90 Days	**236**	242	(245)	228	(237)
West North Central					
60 Days	**192**	185	(177)	204	(175)*
90 Days	**217**	226	(220)	218	(208)
East North Central					
60 Days	**195**	206	(184)	202	(188)
90 Days	**229**	225	(218)	233	(222)
New England					
60 Days	**208**	209	(208)	150**	(174)*
90 Days	**247**	238	(246)	214*	(220)
Mid-Atlantic					
60 Days	**212**	183**	(188)**	130**	(185)*
90 Days	**243**	219**	(221)**	221	(212)*

*$p < .05$; **$p < .01$