Access to Primary Care and Quality of Care in Rural America

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Executive Summary

Objective

We conducted a population-based study to determine how the availability of health care resources in rural areas affects rates of hospitalization for ambulatory care sensitive conditions (ACSCs), often referred to as "potentially avoidable" hospitalizations. This study attempts to address some of the shortcomings of previous research on this issue by (1) incorporating multi-state data; (2) including both elderly and non-elderly populations in the analysis; (3) examining the impact of a broad range of primary care providers, including physicians, physician extenders, and community clinics; (4) controlling for differences in health status and regional differences in practice patterns.

Methods

Bivariate and multivariate methods were used to examine the relationship between primary care supply, rural location and ACSC hospitalization rates. We used multivariate regression techniques to examine the extent to which, controlling for community characteristics, access to primary care is related to ACSC hospitalizations. Independent variables in this model included the state, socio-economic characteristics of the population, the health status of county residents, rural or urban location, and the supply of primary care and acute hospital providers.

County-level analyses were conducted separately for persons between the ages of 18 and 64 and for persons over the age of 64. Data to conduct this study were obtained from the Healthcare Cost and Utilization Project State Inpatient Database (SID) system, and included all payer discharge records in nine states – Arizona, Colorado, Iowa, Kentucky, Michigan, North Carolina, South Carolina, Washington, and West Virginia.

Rates of hospitalizations for 16 ACSCs, as defined in the AHRQ Prevention Quality Indicator (PQI) set were used to draw inferences concerning the quality of primary care in each county. The total number of ACSC discharges in each county was summed and rates of potentially avoidable hospitalizations for persons between the age of 18 and 64 and for persons over the age of 64 were computed. Because preliminary analyses indicated that admission rates for other medical conditions were highly correlated with admission rates for non-ambulatory care sensitive conditions we standardized county avoidable hospitalizations by total admissions. The dependent variable in these analyses was an estimate of the proportion of all hospitalizations in a county that were potentially avoidable.

Another PQI, the low birth weight rate in the county, was used as an alternative indicator of quality of care outcomes.

Rural counties were identified using the Department of Agriculture Rural/Urban Continuum Codes. To facilitate statistical analyses we collapsed the ten categories in this classification scheme into three broader groups that represent metropolitan counties, non-metropolitan counties with an urban population (referred to in this study as "other urban counties"), and completely rural counties.

Several measures were used to quantify the health care capacity of individual communities. County-level data on the total number of active, non-federal primary care physicians and physician extenders – nurse practitioners and physician assistants – was obtained from the Area Resource File. A composite measure of the supply of primary care providers was constructed by totaling the number of physicians and physician extenders, adjusted for differences in productivity.

Other measures of primary care supply were also examined. Counties were characterized on the basis of whether they are designated a primary care Health Professions Shortage Area (HPSA) as well as whether a Federally Qualified Health Center, Rural Health Clinic or other ambulatory care clinic operates in the community. Inpatient capacity was measured as the ratio of acute hospital beds to population. Because skilled nursing care may substitute for acute inpatient care, particularly where hospital capacity is limited, we included the ratio of the number of skilled nursing beds to population as an independent variable in this model.

Results

A total of 620 counties were represented in our analyses. The proportion of hospital admissions that were potentially avoidable varied widely across counties in these states. Approximately 11.9 percent of non-elderly admissions in rural counties were potentially avoidable compared to 11.1 percent of non-elderly admissions in other urban counties, and an average of 9.5 percent of non-elderly admissions in metropolitan counties. Analyses of elderly populations indicated that an average of 21.1 percent of admissions in rural counties were potentially avoidable compared to 18.8 percent of admissions in other urban counties and an average of 14.1 percent in metropolitan counties

The relationship between rurality, primary care supply and quality was found to vary depending on the specification of quality that was used:

- Avoidable hospitalizations in non-elderly: In the non-elderly population the effect of provider supply was found to vary by location. Increasing primary care supply was estimated to reduce the proportion of hospitalizations that are potentially avoidable in metropolitan counties and other urban counties, but to increase the proportion of hospitalizations that are potentially avoidable in rural counties. The magnitude of these effects was small.

- Avoidable hospitalizations in the elderly: In the elderly population both rural/urban location and primary care supply were each found to have a unique effect on ACSC hospitalization rates. Not only was the proportion of hospitalizations that are potentially avoidable significantly higher in rural areas but also, in both rural and urban counties, increasing primary care provider supply was found to result in lower rates of hospitalization for ACSCs.

- Low-weight birth rates: In analyses of county low-weight birth rates neither location in a rural or urban area nor health care supply were significant determinants of county low-weight births.

Discussion

Relative to state effects and the effect of poverty status (in the non-elderly population), rural/urban location and primary care supply are minor determinants of hospitalizations for ACSCs. Interestingly, the nature of the relationship between rurality, primary care supply and avoidable hospitalizations was found to vary depending on the population considered. Analyses of potentially avoidable hospitalizations among elderly adults suggest that strengthening primary care capacity could lead to lower rates of admission for ACSC conditions, even if by only a very slight amount. Analyses of non-elderly county residents showed a modest inverse relationship between primary care supply and avoidable hospitalization rates in metropolitan counties, but a small positive relationship between supply and avoidable hospitalizations in rural counties.

Why results conducted with elderly and non-elderly populations differed so dramatically are not entirely clear. One reason for the observed discrepancy is the manner in which primary care markets were measured. Markets defined on the basis of a county may overstate a service area in highly urbanized locations and understate a service area in rural locations. To the extent that rural residents are more likely than their urban counterparts to travel outside their county of residence for care, county-based estimates may not accurately represent the primary care resources that are available to them. Misrepresentation of rural primary care markets may be more of a problem in analyses of the under-65 population since previous studies have shown that rural seniors are less likely than their younger counterparts to travel outside a county for care.

Among the major findings from this study is that states vary substantially in the rate of hospitalizations for ACSCs and that the proportion of hospitalizations that could potentially be avoidable is, in fact, quite large. Across the study states about one in ten hospitalizations of non-elderly adults and almost one in six hospitalizations in the elderly population were estimated to be potentially avoidable. It is probable that some hospitalizations that were designated as avoidable could not, in fact, have been avoided even with appropriate use of ambulatory care services. Even with this caveat, the findings suggest that a substantial amount of the inpatient expenditures incurred by public and private payers as well as a large number of days of lost productivity experienced by rural residents could potentially be averted.

This analysis also found that county per capita admission rates for ACSCs parallel per capita admission rates for other medical conditions. Because of the strong positive relationship between per capita ACSC admissions and admissions for all medical conditions some researchers have contended that ACSCs are not "special case" conditions and that this indicator may not be a valid measure of the quality of ambulatory care. Although ACSCs are an imperfect measure of quality, few alternative measures for assessing the quality of care in local communities using administrative data are presently available. The advantage of using administrative data to study access and quality of care of populations is that these data are readily available and typically the health care experiences of a large population are represented. Administrative data are not, however, without limitations. These data are collected primarily for purposes of reimbursement and detailed information to adjust for disease severity, co-morbidities, functional status, and social characteristics (e.g., availability of a caregiver) – factors that may affect the decision to hospitalize a patient - are often not available. Policymakers, community leaders, researchers, and community leaders attempting to use the results of this and

other studies that employ rates of potentially avoidable hospitalizations to assess quality must recognize that ACSCs are merely an indicator or signal that quality problems may exist; they are not a definitive measure of quality. When drawing inferences about the quality of care in particular communities it is therefore important to employ a broad range of indicators, including both process and outcome measures. For the future, research that offers more direct and comprehensive insight into how rural primary care systems function and the effectiveness of these systems in managing care is of particular importance to advance our understanding of quality of care in rural communities.

Access to Primary Care Resources and Quality of Care In Rural America

Introduction

Despite the progress made by federal and state health manpower recruitment and retention programs, residents of many rural communities continue to experience problems accessing primary care services. Some areas of the country, particularly those that are marked by a sparse population, persistent poverty, a population composed largely of racial and ethnic minorities and a lack of physical and cultural amenities, suffer from chronic shortages of primary care providers (Rosenblatt and Hart, 1999). In 2001, approximately 72 percent of all counties in the United States were designated as a primary care Health Professions Shortage Area (HPSA) in whole or in part. According to the Health Resources and Services Administration, Bureau of Health Professions, approximately 20 percent of the U.S. population resides in an area that has been designated a primary care HPSA (HRSA, 2003).

In January 2001 The Project HOPE Center for Health Affairs, under contract to the Medicare Payment Assessment Commission, convened a panel of rural health and quality of care experts to gather information on barriers and opportunities in the provision of quality of care in rural areas (Project HOPE, 2001). Among the issues on which the panel expressed agreement was that poor access to health care resources, including the inability to attract and retain an adequate health care workforce, compromises the quality of care available to rural residents.

Several studies have attempted to quantify the nature of the relationship between the supply of health manpower, typically primary care physicians, and quality of care in rural and urban areas. However, disparate findings and methodological limitations render it difficult to draw inferences concerning the relationship between the supply of health manpower and quality of care from this body of work. For instance, many studies failed to control for factors that, independent of supply, could affect quality of care; these include disease prevalence or the health status of the population, and provider practice patterns. Furthermore, in estimating capacity, studies have failed to account for an integral member of the primary care team, the physician extender.

The objectives of this study are twofold. First, this study will determine whether quality of health care in rural communities differs from that in urban areas. Second, this study will examine how access to professional and institutional ambulatory care services, affects quality of care.

Background

Several studies aimed at understanding how quality of health care varies by geographic location have been conducted. Hogan (2001) used the Access to Care for the Elderly Project (ACE-PRO) indicators, which consists of 46 measures of preventive service use and potentially avoidable emergency care to examine quality of care in the Medicare aged population. Hogan found that with the exception of beneficiaries living in the most remote rural counties, quality of care did not differ substantially for rural and urban Medicare beneficiaries. In contrast, Casey et al. (2000) found that in the general population rural residence was negatively correlated with

several quality process measures that included rates of receipt of a cholesterol screening test and mammography.

One measure that was recommended by the Institute of Medicine (1993) and that is being increasingly used to monitor population-based access to health care services is the rate of hospitalization for ambulatory care sensitive conditions (ACSCs). ACSCs are acute and chronic conditions that should be treatable or managed on an outpatient basis. These conditions include diabetes, asthma, hypertension and pneumonia. In theory, if access to appropriate ambulatory care services is obtained on a timely basis, these conditions should not progress to the point where a hospitalization is required (McCall et al, 2001). Often referred to as "potentially avoidable hospitalizations," ACSC admission rates are considered to indicate areas where access to ambulatory care may be limited and quality improvement efforts may be required.

Research has consistently demonstrated that rates of hospitalizations for ACSCs are higher among aged, low-income, uninsured and minority populations (Culler et al, 1998, Billings 1996, Bindman 1995, Weissman et al 1992). Geographic location has also been linked to rates of avoidable hospitalizations but the nature of this relationship is more indefinite. Using data from a national survey of elderly Medicare beneficiaries, Culler et al (1998) found that persons residing in either a core standard metropolitan statistical area or a rural county were at higher risk to be hospitalized for an ambulatory care-sensitive condition. In another study, Silver et al, (1997) found that with the exception of persons residing in frontier areas, rates of hospitalization for ACSCs did not differ among rural and urban Medicare beneficiaries residing in Utah. Neither of these studies examined the relationship between the supply of health manpower and hospitalization for ACSCs. A few studies have explored this issue but also produced conflicting results.

In the New York State under-65 population, Schreiber and Zielinski (1997) found that the rate of potentially avoidable hospitalizations was positively associated with physician supply but unrelated to location in a primary care shortage area. In contrast, Parchman and Culler (1999) found that, among a national sample of Medicare beneficiaries in fair or poor health, the rate of hospitalization for ACSCs was significantly higher in those regions that were designated as primary care shortage areas. Krakauer et al (1996) noted that physician supply had a negligible effect on Medicare admissions for ACSCs. The one exception observed by Krakauer was that admission rates for ACSCs were elevated in areas in which physician supply was less than one-quarter of the national average.

Grumbach et al (1995) observed a relationship between physician supply and ACSC hospitalizations in California; however, a geographic effect was noted. In urban areas of the state, physician supply had a small but inverse relationship to the ACSC hospitalization rate. No relationship between physician supply and hospitalizations for ACSCs was noted in rural areas.

The Dartmouth Atlas (Wennberg and Cooper, 1999) reports that physician supply has no bearing on rates of hospitalization for ACSCs in the Medicare population. Rather, as suggested by Roemer's law[1] and theories of supply induced demand, ACSC admission rates are highly correlated with inpatient capacity.

[1] A theory of demand creation, Roemer's law states that hospital utilization increases as the hospital beds or supply increases.

Inconsistencies in these studies' findings may be attributable to several factors, including differences in the characteristics of the population that were studied. For example, perhaps because of limitations in the availability of data, research on the relationship between physician supply and quality of care has tended to focus on selected subgroups of the population, typically Medicare beneficiaries or the non-elderly population in individual states. Results from the Medicare population may not be directly comparable to that of the general population due to their generally poorer health status and greater demand or need for inpatient services.

Methods of measuring primary care supply may also hinder our understanding of the determinants of ACSC admissions. Several studies measured access to primary care services using simple physician-to-population ratios or in terms of whether the geographic area has been designated a HPSA. Use of either approach is limited in that they fail to account for the supply of physician extenders – physician assistants and nurse practitioners – who play an important role in the primary care system and may fill a critical niche in ensuring access to care in rural communities and areas with primary care shortages (Baer and Smith, 1999). Schrieber and Zielinski reasoned that the lack of explanatory power of HPSA designation in models of ACSC hospitalization could be due to the fact that non-physician primary care providers are not counted in designations of primary care shortage areas. It is also possible that the absolute number of physicians may not be as important to understanding quality of care as the types of providers and the nature of the services that are available in a community. Falik et al, (2001), for example, found that Medicaid beneficiaries who predominantly received care from a Federally Qualified Health Center had significantly lower rates of avoidable hospitalizations than their counterparts who used other types of providers.

Finally, regional differences in practice style or hospital admitting decisions may also help explain the inconsistent findings noted in the scientific literature. Wennberg and Gittelsohn's (1973) now classic study demonstrated that even in closely located geographic areas the manner in which physicians practice medicine varies widely. Wennberg and Cooper (1999) noted a strong positive correlation between Medicare discharges for ACSCs and discharges for all other medical conditions, suggesting that there is an underlying factor that influences physician's decision to admit patients with ACSCs as well as physician's decision to admit patients with other medical conditions. In other words, providers in geographic areas with a low threshold for admitting patients with non-ambulatory care sensitive conditions appear to have a low threshold for admitting patients with ACSCs. Similarly, providers in geographic areas with a high admission threshold for non-ACSC conditions appear to have a high threshold for admitting patients with ACSCs. Previous studies using ACSC hospitalization rates as a measure of quality have failed to account for geographic differences in practice style. Findings from these studies may therefore be misleading since, instead of capturing differences in quality, analyses may be measuring differences in practice style.

Methods

We conducted a county-level study to determine how the availability of health care resources in rural areas is related to hospitalizations for ACSCs. This study attempted to address some of the shortcomings of previous research on this issue by (1) incorporating multi-state data; (2)

including both elderly and non-elderly populations in the analysis; (3) examining the impact of a broad range of primary care providers, including physicians, physician extenders, and community clinics; (4) controlling for differences in health status and regional differences in practice patterns.

Using data from the Healthcare Cost and Utilization Project State Inpatient Database (SID)we calculated the number of ACSC discharges in each of 620 counties in nine states[2] - Arizona, Colorado, Iowa, Kentucky, Michigan, North Carolina, South Carolina, Washington, and West Virginia. Although these states were selected largely because of the availability of data necessary to conduct this study these states are geographically diverse and, as noted in Table 1, vary in terms of the size of the rural population and primary care supply. Nearly one-quarter of the U.S. rural population resides in these states.

Table 1: Rural Population of States Represented in Study, Physician Supply and Primary Medical Care HPSA Designations

State	Population [a]	Rural† Population (%)[a]	Physicians Per 10,000 population[b]	HPSA Counties (%)[c]	
				Partial	Full
AZ	5,130,632	11.8	17.6	80.0	13.3
CO	4,301,261	15.5	20.1	50.8	28.6
IA	2,926,324	38.9	15.3	31.3	13.1
KY	4,041,769	44.2	16.8	30.0	37.5
MI	9,938,444	25.3	19.1	71.1	15.7
NC	8,049,313	39.8	17.6	35.0	22.0
SC	4,012,012	39.5	16.5	69.6	24.0
WA	5,894,121	18.0	19.3	82.1	12.8
WV	1,808,244	53.9	18.0	49.1	27.3
US	281,421,906	21.0	19.8	45.4	27.0

Sources: [a] U.S. Census Bureau, Census 2000, www.census.gov; [b] Bureau of Health Professions National Center for Health Workforce Information and Analysis (2000). State Health Workforce Profiles. Rockville, MD: HRSA; [c] Walsh Center analyses of Area Resource File, 2001. † Rural area defined per the U.S. Census Bureau.

Hospitalizations for 13 ACSCs defined in the AHRQ Prevention Quality Indicator (PQI) set were identified from the data. Indicators were limited to the subset developed for adult populations. ACSCs represented in this quality measurement tool consist of chronic conditions – diabetes, hypertension, asthma, chronic obstructive pulmonary disease, asthma, congestive heart failure – as well as acute conditions – pneumonia, gastroenteritis, and urinary tract infections. The ICD-9 diagnostic and procedure codes used to identify discharges as well as exclusion and inclusion criteria were applied as specified in the PQI documentation (AHRQ, 2001). These codes are summarized in Appendix A.

Our preliminary analyses confirmed that per capita admission rates for non-ambulatory care sensitive medical conditions were highly correlated with per capita admission rates for all

[2] A total of 29 states participated in the 2000 SID. However, because of concerns about patient confidentiality, several states have chosen not to report data on the location of patients' residence – zip code or county. Due to resource constraints and the need to classify patients' by residence, this analysis was limited to a subset of the states in the 2000 SID.

medical conditions. In the non-elderly population, the rate of admissions for other medical conditions was found to explain nearly 66 percent of the variation in the ACSC admission rate. To adjust for differences in physician admitting style we standardized the ACSC admission rate by the rate of admissions for all medical conditions, as follows:

$$\frac{\text{ACSC admissions}}{\text{1,000 population}} \div \frac{\text{All admissions}}{\text{1,000 population}} \times 100 = \text{Potentially avoidable admissions (\%)}$$

The resultant measure, the proportion of hospitalizations in each county that are potentially avoidable was used as the dependent variable in these analyses. Potentially avoidable admission rates are used as a surrogate for quality. Higher values on this measure suggest that a quality of care problem may exist. They are not, however, a definitive measure of quality.

Prevention Quality Indicators Used in Analyses

Acute

- *Bacterial pneumonia admission rate*
- *Dehydration admission rate*
- *Urinary Tract Infection admission rate*
- *Perforated appendix admission rate*

Chronic

- *Angina admission rate*
- *Congestive heart failure admission rate*
- *Hypertension admission rate*
- *Adult asthma admission rate*
- *Chronic obstructive pulmonary disease admission rate*
- *Uncontrolled diabetes admission rate*
- *Diabetes short-term complication admission rate*
- *Diabetes long-term complication admission rate*
- *Rate of lower-extremity amputation among patients with diabetes*

One measure in the PQI that was not used in our summary measure – low-weight births- was selected as an alternative specification of quality. The rationale for including this measure as a separate indicator is that low-weight births are unlikely to be affected by differences in physician admitting style. Rates of low-weight births were calculated as the proportion of all births occurring among county residents (in 1999) for which the reported birth weight was 2,500 grams or less. Data on the total number of births in a county and total number of low-weight births were obtained from the Area Resource File.

Analytic Approach

Using bivariate analyses we examined how the level of rurality and the availability of primary care providers were related to ACSC hospitalizations in the 620 study counties. To control for community characteristics that may have an independent effect on these admissions we used multivariate regression techniques to model the effect of rural and urban location and primary care supply on ACSC hospitalizations. Other independent variables in this model included the state, socio-economic characteristics of the population, the health status of county residents, rural or urban location, and the supply of primary care and acute hospital providers. Variables used throughout these analyses are described below:

Rural/Urban Location: Rural counties were defined using the Department of Agriculture 1995 Rural/Urban Continuum Codes. This classification scheme groups counties on the basis of size and adjacency to a metropolitan area. To facilitate statistical analyses we collapsed the ten categories in this classification scheme into three broader groups that represent (1) metropolitan

counties, (2) non-metropolitan counties with an urban population (referred to in this study as "other urban counties"), and (3) totally rural counties.

(1) Metropolitan Counties
- Central counties of metropolitan areas, with a population of 1 million or more;
- Fringe county of metropolitan area, with a population of 1 million or more;
- County in metropolitan area, population between 250,000 and 1 million;
- County in metropolitan area, population less than 250,000;

(2) Other urban counties
- Urban population of 20,000 or more, adjacent to metropolitan area;
- Urban population of 20,000 or more, not adjacent to metropolitan area;
- Urban population of 2,500 to 19,999, adjacent to metropolitan area;
- Urban population of 2,500 to 19,999, not adjacent to metropolitan area;

(3) Rural Counties
- Rural population of less than 2,500, adjacent to metropolitan area;
- Rural population of less than 2,500, not adjacent to metropolitan area.

Health care resources: Several measures were used to quantify the health care capacity of individual communities. County-level data on the total number of active, non-federal primary care physicians and physician extenders in 2000 – nurse practitioners and physician assistants – was obtained from data in the 2002 Area Resource File (ARF). A composite measure of the supply of primary care providers was constructed by totaling the number of physicians and physician extenders. Estimates of the total number of physician extenders in each county were adjusted to reflect the fact that services provided by nurse practitioners and physician assistants are not perfect substitutes for physician services. Productivity studies indicate that the physician substitution rate of nurse practitioners and physician assistants is between one half and three-quarters (IOM, 1996). We selected a conservative estimate of productivity and weighted the number of physician extenders by a factor of 0.50. Estimates were scaled by population size. To account for the possibility that the supply effect is not consistent across geographic locations we also included rural and urban interaction effects in our models.

Other measures of primary care supply were also examined. Counties were characterized on the basis of whether they are designated a primary care HPSA (either in full or in part) as well as whether a Federally Qualified Health Center, Rural Health Clinic or other ambulatory care clinic operates in the community. Inpatient capacity was measured as the ratio of acute hospital beds to population. Because skilled nursing care may substitute for acute inpatient care, particularly where hospital capacity is limited, we included the ratio of the number of skilled nursing beds to population as an independent variable in this model.

Comparable measures of primary care supply were incorporated in the model of county low-weight birth rates. Additionally, an estimate of the number of obstetricians and gynecologists per 10,000 women aged 15 to 44 in the county was included in the regression model.

Socio-economic Characteristics of the Population: As previously indicated, rates of hospitalization for ACSCs have been linked to socio-economic characteristics of the population. Two variables – the county-specific poverty rate and the proportion of persons in each county that are members of racial or ethnic minorities – were included in the model to control for the effects of these characteristics on ACSC admission rates. Measures of the distribution of county residents by age were also incorporated in these analyses.

Even though we were unable to control for behavioral risk factors associated with low-weight births (e.g., smoking) this model did control for several socio-economic risk factors by including measures of the county poverty rate, the teenage pregnancy rate (obtained from the 1999 County and Metro Area Data file) and the proportion of the population that are members of racial or ethnic minority groups.

Health Status of Community Residents: Data to assess the health status of community residents was not directly available. The three-year (1997-1999) average mortality rates from diabetes and heart disease, which were obtained from the ARF, were used as proxies for the health status of county residents. The five-year (1994-1998) infant mortality rate was used as a proxy for health status in analyses of county low-weight birth rates.

Data used in this study enable us to determine whether county residents were hospitalized, whether or not an admission occurred in the same county in which the person resides. Data do not enable us to determine whether residents were hospitalized outside the state. Admission rates may therefore understate actual admissions, particularly in counties that border a neighboring state. Data used in estimating the number of births and the low-weight birth rates were obtained from the Area Resource File and represent records compiled from the National Center for Health Statistics. These natality records are comprehensive and are not subject to the missing data bias that is present in the analysis of avoidable hospitalizations.

Results – *Ambulatory Care Sensitive Conditions*

The states in our analyses included a combined total of 620 counties. As noted in Table 2, the proportion of hospital admissions that were potentially avoidable varied widely across counties in these states. An over two-fold difference in the proportion of counties' hospitalizations that were potentially avoidable was noted among non-elderly and elderly populations. When estimated with data for persons aged 18 to 64, the percentage of potentially avoidable hospitalizations ranged from an average of 6.4 percent of all hospital admissions in Colorado counties to an average of 13.3 percent of hospital admissions in West Virginia. When estimated with data on the over-65 population, the percentage of admissions in a county that were potentially avoidable ranged from an average low of 9.8 percent in Colorado counties to an average high of 22.7 percent for West Virginia counties.

Rates of potentially avoidable hospitalizations were calculated for metropolitan counties, other urban counties, and for rural counties. Across all states, an average of 11.9 percent of non-elderly admissions in rural counties were potentially avoidable compared to 11.1 percent of non-elderly admissions in other urban counties, and an average of 9.5 of non-elderly admissions in metropolitan counties. Analyses of elderly populations indicated that an average of 21.1 percent

of admissions in rural counties were potentially avoidable compared to 18.8 percent of admissions in other urban counties and an average of 14.1 percent in metropolitan counties.

Table 2: Percent of Hospitalizations that are Potentially Avoidable (%) Metropolitan, Other Urban and Rural Counties, 2000

	AZ	CO	IA	KY	MI	NC	SC	WA	WV	ALL
All State										
Age 18-64	7.6	6.4	8.4	12.4	12.8	10.2	10.9	7.0	13.3	10.0
Age 65 +	11.5	9.8	19.1	18.1	20.0	14.7	14.0	12.2	22.7	15.8
Metro Counties										
Age 18-64	7.5	6.3	8.1	10.6	13.1	9.5	10.1	6.8	12.4	9.5
Age 65 +	11.2	8.8	13.8	15.2	19.4	12.9	13.1	11.1	20.9	14.1
Other Urban										
Age 18-64	8.1	6.7	9.7	13.7	11.5	11.8	12.8	7.9	14.1	11.1
Age 65 +	13.1	12.8	21.6	20.3	22.3	17.3	15.8	16.0	23.7	18.8
All Rural										
Age 18-64	N/A	6.7	8.7	15.0	11.6	11.4	14.3	9.2	13.3	11.9
Age 65 +	N/A	14.8	25.3	20.9	22.2	18.0	13.6	17.4	25.0	21.1

The percentage of hospitalizations that were potentially avoidable was estimated for counties designated a primary care HPSA and those without this designation. Differences in the proportion of avoidable hospitalizations among persons aged 18 to 64 in a HPSA and non-HPSA counties were small; approximately 10.3 percent of hospitalizations in non-HPSA counties were potentially avoidable compared to 9.8 percent of hospitalizations in HPSA counties. For populations over the age of 64 the percentage of hospitalizations that were potentially avoidable averaged 15.3 percent in counties that were primary care HPSAs and 17.3 percent in counties that were not. (Refer to Table 3.)

Table 3: Percentage of Hospitalizations that are Potentially Avoidable by HPSA Designation, 2000
(Data weighted by county population)

	AZ	CO	IA	KY	MI	NC	SC	WA	WV	All
Non-shortage Counties										
Age 18-64	7.4	5.7	8.2	12.9	11.5	10.2	12.0	7.9	13.2	10.3
Age 65 +	12.0	10.0	18.8	19.5	18.7	15.2	15.8	17.9	23.0	17.3
Counties that are Partial or Complete Primary Care HPSAs										
Age 18-64	7.6	6.5	8.8	12.1	13.3	10.2	10.8	7.0	13.4	9.8
Age 65 +	11.5	9.7	19.5	17.2	20.4	14.3	13.9	12.2	22.6	15.3

Determinants of Avoidable Hospitalization: Persons Aged 18-64

The multivariate model shown in Table 4 explained a substantial (R^2=0.51) amount of variation in avoidable hospitalization rates among persons aged 18 to 64 residing in the study counties. Following is a description of the impact of selected factors on avoidable hospitalization rates.

State: Controlling for other factors, the proportion of hospitalizations that were potentially avoidable were found to vary markedly across states. As noted in Table 4, Arizona counties were estimated to have potentially avoidable hospitalization rates that were an average of over 5 percentage points lower than the reference state, West Virginia. Relative to West Virginia counties, avoidable hospitalization rates were nearly 4 percentage points lower in Colorado and Washington counties and 2.9 percentage points lower in Iowa counties. Avoidable hospitalizations rates in counties that comprise each of the Southern States (Kentucky, North Carolina, South Carolina) and Michigan were not statistically different from that of the reference group.

Socioeconomic and Health Characteristics: Poverty rate was the most important determinant of avoidable hospitalizations (ß = 0.39) in a county. An age effect was also noted; the percentage of hospitalizations that were potentially avoidable was lower in counties with a higher proportion of the youngest group of adults, those aged 18 to 24. Historical rates of mortality from heart disease, a proxy for the health status of the population, were directly related to avoidable hospitalizations.

Table 4: Coefficients for a Model of Potentially Avoidable Hospitalizations, as a Percent of all Hospitalizations, County Residents Aged 18 – 64 (Model Adjusted R^2 = 0.51, N=620)			
	Estimate		**P**
	Parameter (*b*)	Standardized (ß)	
Intercept	7.14		
State			
Arizona	-4.69	-0.19	0.00
Colorado	-3.76	-0.31	0.00
Iowa	-2.87	-0.28	0.00
Kentucky	0.37	0.04	0.38
Michigan	-0.03	-0.00	0.95
North Carolina	-0.97	-0.10	0.07
South Carolina	-0.16	-0.01	0.81
Washington	-3.61	-0.24	0.00
West Virginia	Reference		
Socio-Economic			
Poverty rate (%)	0.22	0.39	0.00
Proportion minority (%)	0.00	0.01	0.83
Proportion young adults (%, age 18-24)	-0.06	-0.07	0.03
Health Status			
Heart disease mortality rate (1997-1999)	0.08	0.17	0.00
Diabetes mortality rate (1997-1999)	0.09	0.03	0.30
Rural / Urban Location			
Metropolitan	1.98	0.22	0.00
Other urban	0.98	0.13	0.06
Rural	Reference		
Health Care Infrastructure			
Primary care provider-to-population ratio	0.08	0.12	0.06
Acute beds-to-population ratio	0.01	0.10	0.00
Interaction Effects			
Metropolitan x primary care provider ratio	-0.17	-0.30	0.00
Other urban x primary care provider ratio	-0.11	-0.18	0.03
Rural x primary care provider ratio	Reference		

Rural/Urban Location and Health Care Infrastructure: Coefficients corresponding to the location, primary care supply, and the interaction terms suggested that location has a modifying effect on the relationship between primary care supply and avoidable hospitalizations. To better

understand the nature of this interaction, we estimated the percentage of avoidable hospitalizations in metro, other urban and rural counties in one state, West Virginia, when other continuous variables in the model were held constant at the mean and primary care supply was varied. In metropolitan counties, doubling the supply of primary care providers from 6/10,000 to 12/10,000 persons was predicted to reduce the percentage of hospitalizations that were considered to be potentially avoidable a minor amount, from 12.8 to 12.3 percent. In rural counties, a similar change in supply would be expected to increase the percentage of potentially avoidable hospitalizations also by a slight amount, from 11.9 to 12.4 percent (refer to Table 5.)

Other measures of primary care supply, including whether a county is designated a primary care HPSA and whether a community clinic, rural health clinic or federally qualified health center operates in the county, were tested for significance. These variables were not statistically significant and were subsequently removed from the final model.

The supply of acute hospital beds had a modest but significant (p=0.00) positive impact on county rates of avoidable hospitalization. A 10-bed increase in acute hospital bed supply would be expected to increase the percentage of avoidable hospitalizations; however, the magnitude of this increase is exceedingly small, 0.1 points. Availability of SNF beds was unrelated to avoidable hospitalizations and this variable was not retained in the final model.

Table 5: Percent of Hospitalizations that are Predicted* to be Potentially Avoidable Metropolitan, Urban, and Rural Counties, by Primary Care Provider Supply

	Age 18 – 64			Age 65 +		
	Metro	**Other Urban**	**Rural**	**Metro**	**Other Urban**	**Rural**
Primary care providers						
6 /10,000 pop	12.8	12.2	11.9	20.2	22.0	22.7
9 /10,000 pop	12.6	12.1	12.1	19.8	21.6	22.3
12 /10,000 pop	12.3	12.0	12.4	19.4	21.2	21.9

*Predicted values are based on the model specified in Tables 4 and 6. The model is estimated for counties in West Virginia when all other variables in the model are held constant at the mean.

Determinants of Avoidable Hospitalization: Persons over Age 64

The variables in the multivariate model shown in Table 6 explained approximately 53 percent of the variation across counties in avoidable hospitalization rates for elderly residents.

State: With the exception of Michigan counties, for which differences were not statistically significant, the proportion of hospitalizations that were potentially avoidable was, on average, higher for West Virginia counties than for counties in all other states. Avoidable hospitalization rates were 7 percentage points lower for Colorado counties, between 4 and 6 percentage points lower for Arizona, Iowa, South Carolina and Washington counties. Each of these differences was statistically significant at the 1 percent level or better.

Table 6: Coefficients for a Model of Potentially Avoidable Hospitalizations, as a Percent of all Hospitalizations, County Residents Aged 65 + (Model Adjusted R^2 = 0.53, N=620)			
	Estimate		**P**
	Parameter (*b*)	Standardized (ß)	
Intercept	11.3		
State			
Arizona	-5.42	-0.13	0.00
Colorado	-7.06	-0.32	0.00
Iowa	-4.64	-0.26	0.00
Kentucky	-3.65	-0.22	0.00
Michigan	-1.03	-0.05	0.25
North Carolina	-3.91	-0.22	0.00
South Carolina	-4.80	-0.19	0.00
Washington	-5.46	-0.20	0.00
West Virginia	Reference		
Socio-Economic			
Poverty rate	0.03	0.03	0.42
Proportion minority	-0.02	-0.06	0.22
Proportion oldest old (% age 84+)	0.55	0.22	0.00
Health Status			
Heart disease mortality rate (1997-1999)	0.21	0.25	0.00
Diabetes mortality rate (1997-1999)	0.31	0.06	0.05
Rural / Urban Location			
Metropolitan	-2.43	-0.16	0.00
Other urban	-0.66	-0.05	0.16
Rural	Reference		
Health Care Infrastructure			
Primary care provider-to-population ratio	-0.13	-0.11	0.00
Acute beds-to-population ratio	0.02	0.09	0.00
Skilled nursing beds-to-population ratio	0.01	0.09	0.01

Socio-economic and Health Status: Neither poverty rate nor the proportion of minorities in a county had a statistically significant effect on the percentage of avoidable hospitalizations. Not surprising given their generally poorer health status, higher proportions of very elderly persons (those over the age of 84) in the county tended to increase the proportion of avoidable hospitalizations. Another measure of health status, the historical heart disease mortality rate, was also positively correlated with avoidable hospitalizations

Health Care Infrastructure: Regression results indicated that in contrast to analyses conducted with data from the non-elderly populations, the supply of primary care providers was negatively and significantly associated with avoidable hospitalizations in seniors. Each unit increase in the provider-to-population ratio was estimated to result in a small (0.13 percentage point) decline in potentially avoidable hospitalizations. Although other measures of primary care capacity (e.g., designation as a primary care HPSA, availability of FQHC or RHC) were not statistically significant and were subsequently eliminated from the model, the supply of acute hospital and SNF beds were both found to have a small positive effect on avoidable hospitalizations.

Rural and Urban Location: Net of other factors, the percentage of hospitalizations that are potentially avoidable was estimated to be nearly 2.4 percentage points lower in metropolitan counties than in rural counties. Metropolitan and rural county differences in avoidable hospitalizations were statistically significant at the level of $p < .001$. Differences in the percentage of avoidable hospitalizations were not statistically significant for other urban and rural counties. No interaction between rural/urban location and primary care supply was noted and variables specifying these effects were removed from the final model.

Results - *Low-weight Births*

Average rates of low-weight births varied nearly two-fold across states, from a low of 5.7 percent in Washington counties to a high of 9.5 percent in South Carolina counties. Low-weight birth rates were neither consistently higher nor consistently lower in metropolitan, other urban and rural counties or between counties that were and were not designated as a primary care HPSA within the same state or within. As noted in Tables 7 and 8, with few exceptions low-weight birth rates in a state differed only slightly by location.

Table 7: Percent of Births that are Low-weight in Metropolitan, Other Urban and Rural Counties, 1999
(Data weighted by county births)

	Metro Counties	Other Urban	Rural	All State
Arizona	6.8	7.4	N/A	6.9
Colorado	8.6	8.3	9.6	8.6
Iowa	6.5	6.1	6.0	6.3
Kentucky	8.1	8.0	8.1	8.0
Michigan	8.1	6.4	6.2	7.8
North Carolina	8.7	9.1	9.4	8.8
South Carolina	9.1	10.4	10.1	9.5
Washington	5.7	5.4	5.6	5.7
West Virginia	7.8	8.5	7.9	8.1

Table 8: Percent of Births in a County that are Low-weight, by State and Primary Care HPSA Designation, 1999
(Data weighted by county births)

	Counties not primary care HPSA	Primary care HPSA – full or partial
Arizona	7.0	6.9
Colorado	8.1	8.7
Iowa	6.2	6.4
Kentucky	7.8	8.2
Michigan	6.9	8.1
North Carolina	8.8	8.8
South Carolina	10.2	9.5
Washington	5.2	5.7
West Virginia	8.0	8.1

Determinants of County Low-weight Birth Rates

With an R^2 of 0.39, the multivariate model in Table 9 explained only a moderate amount of variation in county rates of low-weight births. Significant determinants of low-weight birth rates were found to include the state in which the community is located, socioeconomic characteristics of the population, and health status. Neither location in a rural or urban area nor health care supply were significant determinants of county low-weight births.

State: Counties in the states of Arizona, Iowa, Michigan, and Washington were each found to have rates of low-weight births that were significantly ($p < .05$), less than that of the reference group, West Virginia. Controlling for socioeconomic differences, location, and provider supply, rates of low-weight births in West Virginia were found to be nearly 3 percentage points higher than that of counties in Arizona and Washington, nearly 2 percentage points higher than that of counties in Iowa and 1.5 percentage points higher than that of counties in Michigan. Rates for other states included in this analysis were not significantly different from that of the reference group.

Socio-economic and Health Status: Not surprisingly, counties with higher poverty rates and a greater proportion of minorities were found to have higher rates of low-weight births. With a ß coefficient of 0.28, the proportion of county residents who were members of a racial or minority group was the most important determinant of low-weight births.

Health Status: As expected, a positive relationship was noted between counties' historical infant mortality rates and rates of low-weight births.

Health Care Infrastructure: As previously noted, primary care provider supply and the supply of acute care beds were unrelated to low-weight birth rates. Alternative specifications of health care supply, including measures of the availability of obstetricians and gynecologists, the presence of a hospital with an OB unit, and whether a county was designated a primary care

HPSA were tested. None of these variables either improved the model fit or were statistically significant. They were not retained in the model shown in Table 9.

Table 9: Coefficients for a Model of Low-weight Birth Rates, Metropolitan, Other Urban and Rural Counties, 1999
((Model Adjusted R^2 = 0.39, N=620)

	Estimate		
	Parameter (*b*)	Standardized (ß)	P
Intercept	7.24		
State			
Arizona	-2.83	-0.20	0.00
Colorado	0.14	0.02	0.72
Iowa	-1.68	-0.28	0.00
Kentucky	-0.18	-0.03	0.52
Michigan	-1.52	-0.24	0.00
North Carolina	-0.17	-0.03	0.63
South Carolina	0.64	0.08	0.15
Washington	-2.89	-0.32	0.00
West Virginia	Reference		
Socio-economic			
Poverty rate	0.03	0.10	0.04
Proportion minority	0.04	0.28	0.00
Teenage pregnancy rate	-0.02	-0.05	0.24
Health Status			
Average infant mortality rate 1994-1998	0.06	0.10	0.00
Rural / Urban Location			
Metropolitan	0.07	0.01	0.78
Other urban	0.08	0.02	0.67
Rural	Reference		
Health Care Infrastructure			
Primary care provider-to-population ratio	-0.00	-0.03	0.48
Acute beds-to-population ratio	-0.00	-0.01	0.70

Discussion

Rural/urban location and primary care provider supply were found to be minor determinants of quality of care, albeit the nature of the relationship was found to be complex and inconsistent across populations.

The main objective of this study was to determine whether rural and urban communities differ in rates of hospitalization for ACSCs and to better understand how admission rates are related to the availability of primary care resources. Relative to state effects and the effect of poverty status (in the non-elderly population), rural/urban location and primary care supply are relatively minor determinants of ACSC admissions. Findings from this study present a complex and somewhat inconsistent picture of the relationship between rurality, primary care supply and ACSC hospitalizations.

Analyses using low-weight birth rates as a proxy for quality suggest that neither primary care provider supply nor rural/urban location was a significant determinant of quality. Analyses that used ACSC hospitalization rates as a proxy for quality produced mixed results depending upon the population studied. In the elderly population both rural/urban location and primary care supply were each found to have a unique effect on ACSC hospitalization rates. Not only was the proportion of hospitalizations that are potentially avoidable significantly higher in rural areas but also, in both rural and urban counties, increasing primary care provider supply was found to result in lower rates of hospitalization for ACSCs. If we assume that lower rates of admission indicate better ambulatory care quality, then these findings support the conclusion that, at least for the senior population, strengthening primary care capacity will enhance quality of care, even if by only a very small amount. In the non-elderly population the effect of provider supply was found to vary by location. Increasing primary care supply was estimated to reduce the proportion of hospitalizations that are potentially avoidable in metropolitan counties and other urban counties, but to increase the proportion of hospitalizations that are potentially avoidable in rural counties. The magnitude of this effect was extremely small.

The reasons why results differed so dramatically across populations are not apparent. One reason for the observed discrepancy could be the manner in which primary care markets were measured. Some states did not provide information on patients' residence at a level smaller than the county (e.g., zip code) and key data elements were unavailable for geographic regions other than the county (e.g., number of physician extenders). For this reason, patients' county of residence was used to define primary care markets. Markets defined on the basis of a county may overstate a service area in highly urbanized counties and understate a service area in rural counties. To the extent that rural residents are more likely than their urban counterparts to travel outside their county of residence for care, county-based estimates may not accurately represent the primary care resources that are available to them. Misrepresentation of rural primary care markets may be more of a problem in analyses of the under-65 population since previous studies (Basu and Cooper, 2000) have shown that even where provider shortages exist rural seniors are less likely than their younger counterparts to travel outside a county for care. As research on the relationship between primary care capacity and quality of care continues it will be important to consider actual patterns of travel for health care. Information from the HRSA-supported Primary Care Service Area (PCSA) project, particularly when further validated in non-elderly populations

could enable researchers to more accurately designate primary care markets and to overcome some of the limitations of this analysis.

Complicating the interpretation of results further is the fact that measures of primary care supply generated with administrative data sources only reflect access to care; they provide little insight into how the health care system is organized and operates. Merely because primary care provider supply is "adequate" does not imply that residents use these services as needed or that providers manage the care of their patients as appropriate or recommended in practice guidelines.

A large number of hospitalizations could be averted with appropriate access and use of ambulatory care services.

Among the major findings from this study is that states vary substantially in avoidable hospitalization rates and that the number of hospitalizations that could potentially be averted is, in fact, quite large. Across the study states an average of 12 percent of hospitalizations of non-elderly adults and one in five hospitalizations in the elderly population were classified as potentially avoidable. In the states of West Virginia and Iowa, about 1 in 4 hospitalizations among in rural county seniors could, in theory, have been avoided. A limited amount of clinical data was used to classify hospitalizations as avoidable and, for example, information on patient severity or functional status was not used to identify these cases. It is probable that some hospitalizations that were designated as avoidable could not, in fact, have been avoided even with appropriate use of ambulatory care services. Even with this caveat, the findings suggest that a substantial amount of the inpatient expenditures incurred by public and private payers as well as a large number of days of lost productivity experienced by rural residents could potentially be averted.

Admissions for ACSCs may be a poor indicator of quality and could produce misleading results if not standardized for practice patterns.

In conducting this analysis we confirmed Wennberg and Cooper's finding that county per capita admission rates for ACSCs parallel per capita admission rates for other medical conditions. Because of the strong positive relationship between per capita ACSC admissions and admissions for all medical conditions Wennberg and Cooper have contended that ACSCs are not "special case" conditions and that this indicator may not be a valid measure of the quality of ambulatory care. We standardized ACSC admissions by admissions for all other medical conditions to control for differences in practice patterns across counties and reduce the likelihood that our dependent variable was merely capturing regional differences in the threshold for admitting patients.

Although ACSC hospitalization rates are an imperfect measure of quality, few alternative measures for assessing the quality of care in local communities using administrative data are presently available. The advantage of using administrative data to study access and quality of care of populations is that these data are readily available and typically the health care experiences of a large population are represented. Administrative data are not, however, without limitations. These data are collected primarily for purposes of reimbursement and detailed information to adjust for disease severity, co-morbidities, functional status, and social

characteristics (e.g., availability of a caregiver) – factors that may affect the decision to hospitalize a patient - are often not available. Policymakers, community leaders, researchers, and community leaders attempting to use the results of this and other studies that employ rates of potentially avoidable hospitalizations to assess quality must recognize that ACSCs are merely an indicator or signal that quality problems may exist; they are not a definitive measure of quality. When drawing inferences about the quality of care in particular communities it is therefore important to employ a broad range of indicators, including both process and outcome measures. For the future, research that offers more direct and comprehensive insight into how rural primary care systems function and the effectiveness of these systems in managing care is of particular importance to advance our understanding of quality of care in rural communities.

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APPENDIX A

Specification of Potentially Avoidable Hospitalizations		
	Specifications (ICD-9)	**Exclusions* & Criteria**
Bacterial Pneumonia	481, 482.2, 482.9, 483.0, 483.1, 483.8, 482.30, 482.31, 482.32. 482.39	Excludes discharges with diagnosis of sickle cell
Dehydration	276.5	
Urinary Tract Infection	590.00, 590.01, 590.10, 590.11, 590.2, 590.3, 590.80, 590.81, 590.9, 595.0, 595.9, 599.0	
Perforated Appendix	540.0, 540.1	Population at risk includes persons receiving an appendectomy.
Angina	411.1, 411.81, 411.89, 413.0, 413.1, 413.9	Excludes discharges with a surgical procedure
Congestive Heart Failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.9	Excludes discharges with a cardiac procedure
Hypertension	401.0, 401.9, 402.00, 402.10, 402.90, 403.00, 403.10, 403.90, 404.00, 404.10, 404.90	Excludes discharges with a cardiac procedure
Adult Asthma	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.90, 493.91, 493.92	
Chronic Obstructive Pulmonary Disease	491.0, 491.1, 491.20, 491.21, 491.8, 491.9, 492.0, 492.8, 494.0, 494.1, 496	
Uncontrolled Diabetes & Short Term Complications of Diabetes	250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33	
Lower Extremity Amputation among Patients with Diabetes	841.0, 841.1, 841.2, 841.3, 841.4, 841.5, 841.6, 841.7, 841.8, 841.9	Population at risk includes persons with a diagnosis of diabetes. Excludes discharges for trauma.

*All indicators exclude newborns and children, transfers from other hospitals, pregnancy-related admissions.
Source: AHRQ Quality Indicators – Guide to Prevention Quality Indicators: Hospital Admission for Ambulatory Care Sensitive Conditions. Rockville, MD: Agency for Healthcare Research and Quality, 2001. AHRQ Pub. No. 02-R0203.