

**Community Health Center and Rural Health Clinic Presence  
Associated with  
Lower County-Level Hospitalization Rates  
for  
Ambulatory Care Sensitive Conditions**



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# **Community Health Center and Rural Health Clinic Presence Associated with Lower County-Level Hospitalization Rates for Ambulatory Care Sensitive Conditions**

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## **Abstract**

We examined the effect of the presence of a federally qualified community health center (CHC) or rural health clinic (RHC) within a county on population rates of hospitalization for ambulatory care sensitive (ACS) conditions, using data from eight states. ACS conditions are diagnoses for which, in the judgment of medical experts, access to primary care should reduce the frequency of hospitalization. CHC or RHC availability did not affect ACS hospitalization rates among children, either for all children or among uninsured children alone. For working age adults, the presence of a CHC in the county of residence was associated with decreased rates for ACS hospitalizations, when compared to a county with neither facility. Among older adults, the presence of either a CHC or an RHC, or both, in the county reduced ACS admission rates, compared to counties in which neither provider was present. Results suggest that CHCs and RHCs may play a useful role in providing rural adults with access to primary health care and help to reduce rates of ambulatory care sensitive conditions. Further research is needed to understand the role of CHCs and RHCs in supporting access to care for children.



## Executive Summary

### Background and Study Objectives

#### *Access to Health Care in Rural Areas and Ambulatory Care Sensitive Hospitalization*

Access to primary care in non-metropolitan (hereafter, rural) counties, particularly those with high concentrations of minority residents, is handicapped by two factors: proportionately more poor and uninsured persons, served by fewer health care providers. In this environment, safety net providers can have marked effects on population health, as measured by rates of ambulatory care sensitive (ACS) hospitalization. ACS conditions are those for which, in the consensus of medical experts, access to primary care of acceptable quality can reduce the frequency of hospitalization among persons with these diagnoses. While not all hospitalizations can be prevented, at the population level ACS hospitalizations have been found to be lower where other measures of access to care, such as provider availability, are higher.

#### *Community Health Centers and Rural Health Clinics*

Two principal types of federally designated safety net providers are present in rural areas: federally qualified community health centers (CHCs) and rural health clinics (RHCs). Community health centers (CHCs), administered by the Bureau of Primary Care, HRSA, focus on providing primary and preventive care to underserved populations. The Rural Health Clinic (RHC) program is directed toward the retention of providers in rural areas.

#### *Study Objective*

To clarify the contribution that CHCs and RHCs make to access to care, as measured by rates of ACS hospitalization among children, working age adults and older adults.

### Results

#### Total Population

*Adjusted analyses:* The presence of a CHC or RHC in the county did not affect the ACS admission rate among children. For working age adults, the presence of a CHC in the county of residence was associated with decreased rates for ACS hospitalizations, when compared to a county with neither facility. Among older adults, the presence of either a CHC or RHC, or both, in the county reduced ACS admission rates, compared to counties in which neither provider was present.

#### Analyses Restricted to Uninsured Population for Children and Working Age Adults

*Adjusted analyses:* The presence of a CHC or RHC in the county did not affect the ACS admission rate among uninsured children or working age adults after adjusting for county-level demographic and health services availability characteristics.

### Implications

Results suggest that CHCs and RHCs may play a useful role in providing rural adults with access to primary health care and help to reduce rates of ambulatory care sensitive conditions. Further research is needed to understand the role of CHCs and RHCs in fostering access to care for children.



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## Introduction

### Rural Safety Net Providers

Access to primary care in non-metropolitan<sup>1</sup> (hereafter, rural) counties, particularly those with high concentrations of minority residents, is handicapped by two factors: proportionately more poor and uninsured persons, served by fewer health care providers (Economic Research Service, 2004; HUS 06 Table 135). In this environment, safety net providers can have marked effects on population health. Two principal types of federally designated safety net providers are present in rural areas: federally qualified community health centers (CHCs) and rural health clinics (RHCs). Each of these providers has a somewhat different organizational history and mission.

#### *Community Health Centers (CHCs)*

Community health centers (CHCs), administered by the Bureau of Primary Care, HRSA, focus on providing primary and preventive care to underserved populations. Underserved populations are present even within resource-rich urban communities, where private practitioners decline to accept or restrict Medicaid or uninsured patients. CHCs are nearly all private, non-profit community organizations. Most CHCs are funded under section 330 of the Public Health Service Act, which also funds migrant health centers, homeless health centers, and public housing health centers. In addition to being located in a medically underserved area, CHCs must have a community-based governing board, the majority of whom must be drawn from the center's patients (GAO 2005). Additional requirements include the willingness to care for all patients, with a sliding-fee scale for poor and uninsured patients. In return for meeting these requirements, CHCs receive core Federal funding to help them offset some costs. However, CHCs are expected to be "financially viable and cost-competitive;" thus, they are not required to provide free care to every patient (BPHC, 1998).

CHCs serve targeted vulnerable populations. Most patients are at or below poverty (69%) and a substantial minority are uninsured (39%; 2003 data; GAO 2005). Core grant funding provides resources CHCs can use for outreach programs, such as lay health workers to assist in management of patients with chronic disease (Thompson, Horton, Flores, 2007). Grant funding also allows CHCs to participate in programs aimed at improving care for chronic disease, such as the Health Disparities Collaborative (HDC), launched in 1998, or information and clinical technology grants, launched in 2003. HDC efforts, which focus on management of chronic disease, are particularly relevant to the reduction in ACS hospitalizations. Beginning with 88 funded CHCs, the HDC program has expanded to include approximately 800 centers (2006), participating in either HRSA sponsored collaboratives or parallel programs under other sponsorship (Health Disparities Collaborative, 2007). Funding through these initiatives allows for development of registries and other quality improvement efforts (Helfrich, Savitz, Swiger and Weiner, 2007).

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<sup>1</sup> Nonmetropolitan status is based on Office of Management and Budget definitions. Metropolitan counties are those with one or more urban areas, plus adjacent counties that are closely linked by work-related commuting (1,090 counties). Counties that do not meet this definition are classified as nonmetropolitan, or rural (2,052 counties).

Research suggests that quality of care provided at CHCs matches or exceeds that provided to similar patients in other venues, including the VA and commercial managed care (Hicks et al, 2006). A study comparing CHC user survey data to that from the 1994 National Health Interview Survey (NHIS) found that CHC patients were more likely to have a usual source of care, to receive preventive counseling, and if uninsured, to report multiple visits (Carlsion et al 2001). Similarly, CHC uninsured and Medicaid patients, when compared to uninsured and Medicaid insured persons reached by the 2002 NHIS, were more likely to have a usual source of care (Shi and Stevens, 2007). Early research suggested positive outcomes for the conditions addressed by CHCs participating in the Health Disparities Collaboratives (Wang et al 2004; Chin et al 2004). However, a more recent analysis found improvements in the processes of care, but not in intermediate outcomes, including emergency services for asthma, HgA1c values, or hypertension (Landon et al NEJM 2007). Reductions in ACS hospitalizations are also a possible intermediate outcome of HDC efforts.

### *Rural Health Clinics (RHCs)*

The Rural Health Clinic (RHC) program is directed toward the retention of providers in rural areas. Established in 1977, it allows clinics that qualify to receive higher reimbursement from Medicare and Medicaid, major payers among the rural populations (CMS, 2006). In a 1997 report, the Government Accountability Office (then, the General Accounting Office) found that RHCs are paid more than other practitioners for the same services (40% more by Medicare, and about 86% more by Medicaid; GAO, 1997). RHCs must be located in a rural Health Professional Shortage Area, either a geographic shortage area (whole county lacks providers) or population group shortage area (specific types of individual are underserved). The definition used for “rural” may follow Federal guidelines or may be designated by a state governor. At present, RHCs are handled with special funding mechanisms by both Medicare and Medicaid, receiving greater reimbursement than an equivalent practice in an urban area. RHCs may be owned by individual practitioners or by larger entities such as hospitals, and may have for-profit or non-profit status. Growth in the number of RHCs has tended to occur when providers convert to RHC status, rather than through in-migration of physicians; in 1991 – 1995, most growth occurred in communities that already had providers (GAO 1997).

The qualifications for RHC status are geographic; the facility must be in a rural area. RHCs are not required to provide a full spectrum of primary care services, nor are they required to see all patients regardless of need. As of September 2005, only 16 percent (590 / 3600) of RHCs stated they would take all patients regardless of ability to pay (GAO, 2006). Although not required to accept uninsured patients, RHCs actually derive a greater proportion of practice revenue from self-pay patients, that is, uninsured patients, than do CHCs (15% versus 7%; GAO 2001).

### **Ambulatory Care Sensitive Hospitalizations as a Measure of Access**

Rates of ambulatory care sensitive (ACS) hospitalization are frequently used as a measure of access to care at the population level. ACS conditions are those for which, in the consensus of medical experts, primary care of acceptable quality can reduce the frequency of hospitalization among persons with these diagnoses. While not all hospitalizations can be prevented, at the population level ACS hospitalizations have been found to be lower where other measures of access to care, such as provider availability, are higher. ACS hospitalization is both an epidemiological measure of the extent of serious and costly health events (hospitalizations)

and a health services research measure of the overall performance of the primary health care system. Previous research has found that hospitalization rates for ACS conditions are higher in rural areas (e.g. Ansari, Laditka, and Laditka, 2006; Silver, et al 1997; Culler, et al 1998, DeLia, 2003), and within rural areas, among nonwhites and individuals with low incomes (Laditka and Laditka, 1999, 2006; Laditka, Laditka, and Mastanduno, 2003; Laditka and Johnston, 1999; Shi, Samuels, et al, 1999; Shi and Lu, 2000).

### **Assessments of CHC and RHC effects on ACS hospitalization rates**

Given the emphasis on care for chronic diseases that has typified CHCs over the past 10 years, it would be anticipated that admission rates for ACS diagnoses would be lower among patients served by such providers than among other patients. Analyses have documented that Medicaid patients receiving most of their care at a CHC, versus at another single provider, were less likely to be hospitalized or to visit an emergency room for ACS conditions (Falik, Needleman, Wells, Korb, 2001; Falik, Needleman, Herbert, Well, Politzer and Benedict, 2006). The presence of a CHC in a medical market area has been associated with lower ACS admission rates, while the presence of a free clinic has no effect (Epstein, 2001). The presence of a federally qualified community health center (CHC) in a county has been shown to reduce ACS hospitalization rates among children (Garg et al 2003). Given this previous research, we anticipate that hospitalization rates in counties served by a CHC will be lower than in counties lacking this provider.

Rural health clinics (RHCs) may serve as safety net providers, but research in this area is sparse at present. Evidence does show that RHCs can be beneficial to a sponsoring hospital (Schoenman et al 1999), conferring possible advantage on the community in which the hospital is located. An analysis limited to HPSA counties in Nebraska found that residents in HPSAs that contained an RHC were less likely to have an ACS hospitalization than those in counties without an RHC (Zhang, Mueller, Chen and Conway, 2006). This single Nebraska study constitutes the only previous research examining RHC effects on population health. Based on this research, we anticipate that hospitalization rates will be lower in counties with an RHC than in counties lacking this practitioner.

### *Study Purpose*

The present study sought to clarify the current understanding of the contribution that CHCs and RHCs make to access to care, as measured by rates of ACS hospitalization. We examined county-level admission rates for ACS conditions during 2002 across 8 states: Colorado, Florida, Kentucky, Michigan, New York, North Carolina, South Carolina, and Washington. Our research adds to present knowledge by examining the impact of RHC presence across multiple states and all county types. Similarly, the analysis of CHC effects is not restricted to a single patient type, but is assessed on a population basis. Finally, possible synergistic effects of both sources of primary care, CHCs and RHCs, are examined by calculating ACS admission rates separately among counties that include both types of practitioner.

## Findings

### ACS Discharge Rates across Total County Populations

#### *Unadjusted ACS Discharge Rates*

We first calculated raw ACS rates, not adjusting for the characteristics of county populations. In unadjusted analysis, the presence of an RHC in a county did not affect ACS admission rates, nor were counties having both CHCs and RHCs significantly different from counties that had neither provider. CHC-only counties had lower ACS admission rates for both working age adults and older adults than did counties with neither provider.

Table 1. ACS admissions per 1,000, by provider availability, eight states, 2002				
Age group (number of counties)	CHC Only (N=59)	RHC Only (N=139)	Both providers (N=27)	Neither provider (N=354)
Children (508)	4.62	4.98	5.56	5.01
Working age adults (575)	<b>9.02*</b>	11.49	13.31	11.05
Older Adults (567)	<b>66.26**</b>	78.22	78.75	79.56
* P > 0.01; ** P > 0.001				

Many CHCs, and a subgroup of RHCs, are located in urban counties. Thus, an unadjusted analysis does not fully control for differences between rural and urban counties, and across counties with different population and health resource characteristics. To account for these differences, we next examined ACS rates within the three age groups holding equal a range of characteristics of the county population, health care resources, and health status (Tables A-1 through A-3, Appendix.). Rates at counties with a CHC, an RHC or both providers were compared to those at counties with neither provider and rate ratios (rate at CHC or RHC counties compared to counties with neither provider) were calculated.

Even with county characteristics held equal, the presence of a CHC or RHC in the county did not affect the ACS admission rate among children (see Table 2, top of next page).

**Method summary:** Counties with CHCs, RHCs or both were compared to counties that had neither provider present. We analyzed admission rates for ambulatory care sensitive (ACS) conditions separately among children (age < 18 years), working age adults (ages 18 – 64) and older adults (age 65+). Admission rates differed markedly across age groups, making a single county-level analysis inappropriate. To assure stable rate estimates, we excluded counties that had fewer than 1,000 persons in the 0 – 17 and 18 – 64 age groups, and those that had fewer than 500 persons in the 65+ age group. See Appendix for a fuller description of methods.

Table 2. Rate Ratios for ACS Hospitalizations among Children, Eight States, 2002. Comparisons to counties with neither provider				
Children (ages 0 – 17)				
	Rate Ratio	95% confidence interval		P-value
		Lower	Upper	
CHC Only	1.00	0.85	1.18	0.9889
RHC Only	0.95	0.86	1.05	0.3132
RHC&CHC	0.95	0.80	1.14	0.6074
Adjusted for: physician supply; hospital bed supply; ED visit rates; hospitals with EDs, HMO penetration; rate of insurance; percent black, Hispanic, Asian, and American Indian; population change; education levels; population density; unemployment; death rates for heart disease, COPD, diabetes, and liver disease, and rural/urban location of county.				

Among working age adults, the presence of a CHC in the county of residence was associated with decreased rates for ACS hospitalizations, when compared to a county with neither facility (Table 3). The ACS hospitalization rate at counties having a CHC was 0.86 (95% CI 0.78-0.95; p = 0.0034) of the rate at counties with neither; rates at counties with an RHC only or with both facilities did not differ markedly from those at the comparison group.

Table 3. Rate Ratios for ACS Hospitalizations among Working Age Adults, Eight States, 2002. Comparisons to counties with neither provider				
	Rate Ratio	95% Confidence Interval		p-value
		Lower	Upper	
CHC Only	<b>0.86</b>	<b>0.78</b>	<b>0.95</b>	0.0034
RHC Only	1.00	0.94	1.07	0.8790
RHC&CHC	1.04	0.93	1.16	0.5105
Adjusted for: physician supply; hospital bed supply; ED visit rates; hospitals with EDs, HMO penetration; rate of insurance; percent black, Hispanic, Asian, and American Indian; population change; education levels; population density; unemployment; death rates for heart disease, COPD, diabetes, and liver disease, and rural/urban location of county.				

Among older adults, the presence of either safety net provider, or both, in the county reduced ACS admission rates, compared to counties in which neither provider was present (Table 4, next page).

Table 4. Rate Ratios for ACS Hospitalizations among Older Adults (65 years and above), Eight States, 2002. Comparisons to counties with neither provider				
	Rate Ratio	95% confidence interval		p-value
		LB	UB	
CHC Only	<b>0.84</b>	0.81	0.87	<.0001
RHC Only	<b>0.96</b>	0.94	0.99	0.0025
RHC&CHC	<b>0.88</b>	0.84	0.92	<.0001
Adjusted for: physician supply; hospital bed supply; ED visit rates; hospitals with EDs, HMO penetration; rate of insurance; percent black, Hispanic, Asian, and American Indian; population change; education levels; population density; unemployment; death rates for heart disease, COPD, diabetes, and liver disease, and rural/urban location of county.				

### ACS Discharge Rates among Uninsured County Populations

Community health centers have a specific mission to help underserved populations, including low-income and uninsured persons. Therefore, we conducted an additional analysis to estimate the effects of CHC and/or RHC presence on ACS admission rates among uninsured persons. To calculate ACS hospitalization rates, we used Census estimates for the number of uninsured adults within each county as the denominator. We made the assumption that nearly all such persons are younger than 65, as older individuals are almost universally covered by Medicare. The numerator in each county was the number of ACS admissions for which the payment source was identified as “self pay” in the discharge record. This value may not precisely equal the uninsured population, as some self-pay records may later have been converted to an insurer; however, we believe the number of cases in which this occurred would have been small. Such errors, if present, might have the greatest effect on admission rates among children, which are generally quite low and thus could be affected by small changes.

In unadjusted analysis, the presence of a CHC in the county was associated with lower ACS discharge rates for working age adults, but not for children (Table 5, below). Rates in counties having only an RHC, as well as counties with both facilities, did not differ significantly from rates at comparison counties.

Table 5. Estimated ACS admissions per 1,000 uninsured persons, by provider availability, eight states, 2002				
Age group (number of counties)	CHC Only (N=59)	RHC Only (N=139)	Both providers (N=27)	Neither provider (N=354)
Children (508)	1.66	1.17	1.40	1.20
Working age adults (575)	<b>8.44*</b>	11.20	13.20	10.27
* P > 0.01				

When demographic and health resource characteristics of the counties were held equal in multivariable analysis however, initial findings of CHC effects were not present. In adjusted analysis, there were no differences in the rates of ACS hospitalization among uninsured persons based on the presence of a CHC, RHC or both in the county (Table 6).

Table 6. Rate Ratios for ACS Hospitalizations among Uninsured Working Age Adults, Eight States, 2002. Comparisons to counties with neither provider.				
	Rate Ratio	95% Confidence interval		P
		Lower	Upper	
CHC Only	0.99	0.89	1.10	0.8469
RHC Only	0.98	0.92	1.04	0.4722
RHC&CHC	1.07	0.96	1.20	0.2128
Adjusted for: physician supply; hospital bed supply; ED visit rates; hospitals with EDs, HMO penetration; rate of insurance; percent black, Hispanic, Asian, and American Indian; population change; education levels; population density; unemployment; death rates for heart disease, COPD, diabetes, and liver disease, and rural/urban location of county.				



## Conclusions

### **CHC presence in a county is associated with lower ACS rates for adults, but the effect does not extend to uninsured populations**

The presence of a CHC in a county was associated with lower ACS admission rates among the county's working and older adult populations, when compared to counties that had neither a CHC nor an RHC available (Tables 3 and 4). This finding is consistent with previous research. CHC Medicaid and uninsured patients were more likely than similar patients not treated by CHCs to report a usual source of care in 2002 (Shi and Stevens, 2007), which should be associated with better continuity of care for chronic disease. Most ACS conditions are chronic diseases for which an established relationship with a primary care provider is recommended. Second, improved glycemic control has been reported for patients at CHCs participating in Health Disparities Collaboratives in North Carolina (Wang et al 2004) and in the Midwest (Chin et al 2004); improved control should be associated with reduced hospitalization for diabetes.

Much of the CHC effect for adult populations may be based on the provision of an access point for Medicaid and other low-income populations. Two studies have documented that Medicaid or uninsured patients who receive care from CHCs are more likely to have a usual provider and to receive preventive services, markers for effective access (Carlson et al 2001, Shi & Stephens, 2007). By the ACS measure, CHC availability provides improved access compared to counties in which such facilities are absent.

While CHC presence affected ACS rates at the population level, it did not have similar effects when the analysis was restricted to the uninsured population alone. Counties with CHCs had lower ACS rates among uninsured working age adults in unadjusted analysis (Table 5), but this effect was no longer significant when characteristics of the county population were taken into consideration (Table 6).

There are multiple reasons why CHCs might be less effective at reducing ACS hospitalizations among uninsured adults than among others. First, while CHCs charge a sliding fee scale for uninsured persons, that fee generally does not reach zero, but generally ranges from \$5 to \$20 (Gusmano et al, 2002). Even these relatively low rates may be sufficient to deter adults on a very restricted income. While CHC Directors rarely report turning away persons who cannot pay (Gusmano et al, 2002), uninsured individuals may never ask for special accommodations. Second, CHCs generally provide only primary care services; for some ACS conditions, periodic specialty consultations may be needed, and these are more difficult to obtain for uninsured individuals (Cook et al, 2007).

A third and more addressable reason for an absence of CHC effects among uninsured populations may lie in quality of care differences within CHC patients. Hicks and associates (2006) found that the quality of care provided to uninsured patients at CHCs in 1999-2000 was less than that among privately insured patients. Specifically, mean unadjusted quality scores for diabetes, hypertension and asthma, key ACS conditions, were lower among uninsured CHC patients than among those within any insured population. Adjusted mean quality scores (all diagnoses) were 40.7% for uninsured versus 44.4% among privately insured patients (p. 1720). Since receipt of appropriate care depends upon patient care-seeking as well as provider activities,

the fee barriers noted above may be one source of quality disparities experienced by uninsured populations. However, there may be barriers to uninsured patients within CHC services and procedures; these barriers can be addressed by these organizations through internal quality improvement projects.

Further research is needed to clarify patient and institutional barriers to the provision of quality care to uninsured populations. Since 2000, CHCs have been the centerpiece of Federal efforts to expand care available to uninsured persons. However, analysts have suggested that CHC expansion has not been sufficient to keep pace with the increasing number of uninsured persons caused by the steady erosion in private insurance (Hadley et al 2006). Further, since minorities are more likely than whites to lack insurance, addressing the problem of disparities among the uninsured is key to addressing racial/ethnic disparities in access (Hadley et al 2006). Finding measures that will counteract any barriers experienced by uninsured populations will thus contribute to the reduction of race based, as well as insurance based, differences in care.

### **RHC presence in a county is associated with lower ACS admission rates among older adults, but not among younger populations**

In unadjusted analysis, admission rates for ACS conditions among older adults (age 65+) at counties with an RHC did not differ markedly from those at counties lacking either a CHC or an RHC (78.22/1,000 at RHC counties versus 79.56/1000 among counties with neither; Table 1). However, when characteristics of the county population and county-level provider availability were considered in multivariable analysis, admission rates at counties having an RHC were 96% of rates at counties with neither a CHC nor an RHC, and counties with both an RHC and a CHC had rates that were 88% of the rates among “neither” counties (Table 4). The presence of an RHC in the county was not associated with lower ACS hospitalization rates among children or working age adults, whether across all county residents or estimated within the uninsured population.

A principal purpose of the RHC program has been the recruitment/retention of practitioners to rural counties. Lower ACS admission rates among older adults at counties with RHCs are consistent with previous research linking provider availability to reduced hospitalization among Medicare beneficiaries (Culler et al, 1998) and suggest that RHC presence benefits the Medicare population.

The present study cannot explain why RHC presence in a county did not have similar effects for children or working age adults. We speculate that children constitute a unique population, because ACS hospitalization is rare among this group. The small degree of variation may have inhibited RHC effects. Speculating on the absence of effects among working age adults, we note that relatively few such persons are covered by Medicaid, one of the funding mechanisms that is enhanced by RHC status. In general, adults can only obtain Medicaid for pregnancy-related care or as a result of disability. Thus, as was the case with children, the effect sizes may be too small to detect in the present analysis. Finally, we note that RHCs are not required to accept uninsured patients, and only a minority of RHCs report doing so (16%; GAO, 2006). Thus, it would not be anticipated, on the basis of stated purpose, RHCs would work to improve access to care for persons without insurance.

## **ACS admission rates among children are low and not influenced by provider type in county of residence**

Most ACS conditions are chronic diseases of adulthood; such diseases are generally uncommon among children and children's rates of admission for potentially preventable hospitalization are only a small fraction of rates among older adults (Table 1). Across all children, we found that the presence of a CHC or RHC in the county of residence did not affect ACS hospitalization rates, in unadjusted or adjusted analysis. Similarly, estimated rates among uninsured children were not associated with having a CHC or RHC in the county. These findings contradict previous research, restricted to Medicaid-insured children in a single state, suggesting that CHC presence reduced ACS admission rates among children (Garg et al, 2003). The study by Garg and associates was; however, restricted to a single state (South Carolina) and may not be typical of a broader geographic area. Present findings are consistent with other research finding little variation in ACS hospitalization rates among the pediatric population associated with provider availability (Laditka and Johnston, 1999; Laditka et al 2005). Among young children, the principal sources of ACS hospitalizations are rapid onset bacterial and viral conditions (Garg et al, 2003) for which parental recognition of and care for symptoms is important in avoiding hospitalization. Measures of provider availability, such as those used here, do not address the important issues of parental knowledge and behavior.

### **Implications**

Our results suggest that CHCs and RHCs play a useful role in providing rural residents with access to primary health care and help to reduce rates of ambulatory care sensitive conditions. Further research is needed to understand the role of CHCs and RHCs and access to care for children.

## Appendix

### Study Methods

#### *Study Design and Population*

We used a cross-sectional design to explore hospitalization rates for ambulatory care sensitive (ACS) conditions, to study whether the presence of specific types of safety-net providers within a county reduced these rates. Because no available national data set includes both patient county of residence and sufficient observations for analysis, we used the State Inpatient Databases (SID). The SID, maintained by the Agency for Healthcare Research and Quality, contain discharge records for each hospitalization within participating states. Fifteen states included residence information in 2002. We obtained the 2002 SID files for eight states: Colorado, Florida, Kentucky, Michigan, New York, North Carolina, South Carolina, and Washington. These states were chosen because they have a large number of counties with community health centers (CHCs), rural health clinics (RHCs), or both providers.

There were 579 counties in the eight studied states, as shown in the Table below. Across all counties, 59 (10.2%) had a CHC and not an RHC; 139 (24.0%) had an RHC but not a CHC; 27 had both providers (4.7%), and 354 (61.1%) counties had neither provider. To ensure stable rate estimation, we required that study counties have at least 1,000 persons each in the pediatric (0 – 17) and working age (18 – 64) population categories, and at least 500 in the 65+ age group. This reduced the total number of counties, leaving 508 counties for the study of children’s admissions, 575 counties for working age adults, and 567 counties for older adults. The same exclusion criteria were used for defining the counties used in analysis restricted to the uninsured population; the number of counties remained the same.

Table A-1. Presence of Safety Net Providers, Study States by county type, ARF 2002

(Rural)	Both CHC & RHC	Neither	CHC only	RHC only	All rural counties (n)	Urban, CHC or RHC	Total Counties	Percent of study counties
Colorado	1	45	9	8	47	7	63	10.9
Florida	4	29	8	25	29	16	66	11.4
Kentucky	2	102	2	14	85	2	120	20.7
Michigan	7	34	8	34	57	13	83	14.3
New York	1	45	14	2	26	13	62	10.7
North Carolina	3	64	7	26	60	13	100	17.3
South Carolina	5	15	7	19	25	12	46	7.9
Washington	4	20	4	11	22	6	39	6.7
Total	27	354	59	139	351	82	579	100.0

#### *Independent variable*

The presence of a CHC or RHC in a county was determined using Area Resource File data for the year 2002. Four mutually exclusive categories were created: CHC but no RHC, RHC but no CHC, both (CHC + RHC), and neither provider. The “neither” category served as the baseline against which other categories were compared.

### *Control variable:*

Community health centers (CHCs) and rural health clinics (RHCs) are located only in specific types of counties: counties with demonstrated high need for care among at risk populations (CHCs) or counties that have been designated as rural (RHCs). Thus, counties housing one or both of these types of provider can be expected to differ slightly from other US counties.

Across the US as a whole, CHCs tend to be located in highly urbanized counties, with high levels of physician and hospital resources (Table A-2, below) and high managed care penetration rates, compared to counties with neither provider. RHCs, being restricted to rural areas, are located in counties with fewer physician/population resources and lower managed care penetration. Similarly, median income at counties housing CHCs is slightly above that in counties with neither provider, while income is lower in counties with an RHC only. Both CHCs and RHCs, nationally, are located in counties in which the proportion of minority residents is greater than in counties with neither provider.

In the eight states studied, counties with CHCs only, RHCs only or both providers are more similar to counties with neither provider than is the case nationally. CHC-only counties differed from counties with neither provider in only one characteristic, a higher HMO penetration rate (25.32% at CHC only counties, 14.17% at counties with neither provider). Counties housing only an RHC had lower physician/population ratios, fewer hospitals with an emergency department, and lower managed care penetration rates than counties with neither provider. Estimated uninsured population rates were particularly high in RHC-only counties, and highest in counties that had both a CHC and an RHC (Table A-2).

To control for differences across county categories, we held multiple county characteristics statistically equal during analysis. Consistent with our previous research, the models for this study are based on a theory of health services need and use at the level of county populations (Laditka et al. 2005). Health systems use and characteristics variables included physician supply, bed supply, number of hospitals with an emergency department, emergency department visit rates, and managed care penetration rates. Population characteristics included racial/ethnic composition (proportions of the population that are non-Hispanic black, Hispanic, Asian American, and American Indian/Native American), population change 1990 – 2000, the percent of the population with less than a high school education, the unemployment rate, population per square mile, and whether the county was classified as metropolitan or non-metropolitan (rural). Resource characteristics included median household income and the percent of the population estimated to lack health insurance. Four variables pertaining to the health and behavior of the population were included: death rates from cardiovascular disease, chronic obstructive pulmonary disease, diabetes, and cirrhosis of the liver.

### *Analytic approach*

We examined unadjusted and adjusted rates for ACS hospitalization. We used county ACS admission rates as the dependent variable, calculated using definitions for ACS diagnoses from the Agency for Healthcare Research and Quality (AHRQ 2001). These definitions are substantially similar to those used in most related studies. The ACS conditions for adults include asthma, angina (without procedure), congestive heart failure (CHF), bacterial pneumonia,

chronic obstructive pulmonary disease (COPD), dehydration, diabetes long-term complication, diabetes short-term complication, hypertension, lower-extremity amputation for individuals with diabetes, perforated appendix, uncontrolled diabetes, and urinary tract infection. Consistent with the AHRQ definition and previous research, a hospitalization is in most instances attributed to an ACS only when the specific diagnosis for one of these conditions appears as the principal diagnosis, the primary cause of the hospitalization. For children, the AHRQ's ACS diagnosis list includes asthma, bacterial pneumonia, dehydration, perforated appendix, gastroenteritis, and urinary tract infection. The definitions exclude hospitalizations for which there is evidence of underlying severe disease. For children, for example, hospitalizations for asthma are excluded if there is evidence of cystic fibrosis or anomalies of the respiratory system.

Multivariate analysis was used to calculate rate ratios while holding other characteristics of the county equal, creating adjusted rate ratios. The rate ratio is the ratio of the mean value of ACS hospital admission rates across counties, for each age group, where the mean rate for a county type of interest (such as counties with both a CHC and an RHC) is the numerator. The denominator is the corresponding rate for counties having neither a CHC nor an RHC (the comparison category). Rate ratios less than 1.00 indicate that individuals in the county type of interest had a lower rate of ACS hospitalization than those in the comparison category. Factors held equal in multivariate analysis include characteristics of the county health system (physician population ratio; hospital bed/population ratio; number of hospitals with an emergency department; managed care penetration rate), demographic characteristics of the county population (percent of population that is African American, white Hispanic, Asian/Pacific Islander and American Indian / Alaska Native; percent population change, 1990-2000; percent with less than a high school education; percent unemployed; and population per square mile), and health characteristics of the county population (emergency department visits per 1,000 persons and death rates for cardiovascular disease, chronic obstructive pulmonary disease, diabetes, and cirrhosis of the liver).

### *Limitations*

Our study has several methodological limitations. First, the analysis is ecological in nature. Although we can identify the county of residence of hospitalized persons in the State Inpatient Databases, we cannot identify their providers. Thus, we cannot state what proportion of persons in a county specifically received their care from a CHC or RHC, and cannot directly address the role of these institutions in reducing ACS admissions. Second, the study uses estimates of the number of uninsured persons present in each county when developing rate ratios for that population. Census estimates are believed to offer the most accurate assessment available. Nonetheless, Census data contain an unknown level of error, which may have influenced our findings for the uninsured population.

Table A-2. Characteristics of counties that house a Community Health Center (CHC), a Rural Health Clinic (RHC) or both facilities with counties that have neither, all US, 2002

<b>All US (n = 3,141 counties)</b>	CHC Only		RHC Only		BOTH		NEITHER	
Number of Counties:	263		741		103		2034	
Health care resources								
MD/DO per 10,000 population	20.77	***	8.46	***	14.08		12.23	
Beds per 10,000 population	3.78		3.72		3.14		4.06	
Number of hospitals with emergency department	3.52	***	1.02		2.12	***	1.03	
Health market characteristics								
HMO penetration rate	22.15	***	7.76	***	13.53		11.21	
ED visits per 1000	396		330		415		350	
Percent uninsured, aged 18-64	20.15	**	20.64	***	22.60	***	19.00	
Percent uninsured, age 17 or less	12.50		13.15	***	14.00	***	12.02	
Population characteristics								
Percent of population that is:								
African American (%)	14.50	***	9.89	*	10.91		8.62	
Hispanic white (%)	10.12	***	5.32	*	11.18	***	4.37	
Asian (%)	2.71	***	0.52	***	1.65	**	0.95	
American Indian / Native American (%)	2.29		1.54		1.44		1.93	
Population change, 1990 – 2000 (%)	8.48		7.52		7.80		8.21	
Less than a high school education (%)	22.22		24.46	***	26.57	***	21.81	
Population per square mile	1,227	***	50	***	110		173	
Unemployed (%)	8.12	***	7.52	***	9.41	***	6.62	
Median household income (\$)	37,592	*	32,767	***	33,014	***	36,141	
Death rate per 10,000 due to:								
Cardiovascular disease	17.59	***	22.89	***	20.88		20.32	
Chronic obstructive pulmonary disease	4.63	**	5.40	**	5.44		5.09	
Diabetes	2.71		3.03	***	2.90		2.67	
Cirrhosis of the liver	1.08	***	0.91	*	1.12	***	0.83	

\*P value compares the indicated category to counties that have neither facility. \*\*\*p<.001; \*\*p<.01; \*p<.05.

Table A-3. Characteristics of counties that house a Community Health Center (CHC), a Rural Health Clinic (RHC) or both facilities with counties that have neither, studied states, 2002

SID Sample, n=579	CHC Only		RHC Only		BOTH		NEITHER	
	Number of Counties:	59	139	27	354			
		P-value		P-value		P-value		
MD/DO per 10,000 population	12.85		10.29	*	14.32		12.33	
Beds per 10,000 population	3.46		3.19		3.90		3.16	
Number of hospitals with emergency department	1.73		0.97	*	1.41		1.59	
HMO penetration rate	25.32	***	9.38	**	10.60		14.17	
ED visits per 1000	337		372		382		330	
Percent of population that is:								
African American	20.28		17.48		16.21		16.41	
Hispanic white	6.37		6.57		7.70		6.43	
Asian	1.66		1.58		3.51		2.10	
American Indian / Native American	2.13		5.10	*	2.08		2.32	
Population change, 1990 - 2000, in percent	10.35		12.46		8.49		12.96	
Percent of population with less than a high school education	24.91		24.25		23.99		24.98	
Population per square mile	167		141		183		219	
Percent of population that is unemployed	7.34		6.76		6.28		7.03	
Percent uninsured, aged 18-64	18.98		20.81	***	22.05	**	18.89	
Percent uninsured, age 17 or less	11.96		12.87	***	13.31	*	11.41	
Median household income	35,595		35,179		36,835		35,844	
Death rate per 10,000 due to:								
Cardiovascular disease	18.32		15.63		17.08		16.96	
Chronic obstructive pulmonary disease	5.11		4.62		5.06		4.74	
Diabetes	2.56		2.19		2.17		2.24	
Cirrhosis of the liver	1.03		0.93		0.87		0.93	

\*P value compares the indicated category to counties that have neither facility. \*\*\*p<.001; \*\*p<.01; \*p<.05.



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