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Preventable Hospitalizations: Does Rurality or Non-Physician Clinician Supply Matter?

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Abstract This study examines the relationship between rurality as well as the proportion of non-physician clinicians and county rates of ambulatory care sensitive hospitalizations (ACSHs) for pediatric, adult and elderly populations in Nebraska. The study design was a cross-sectional observational study of county level factors that affect the county level rates of ACSHs using Poisson regression models. Rural (non-metro) counties have significantly higher ACSHs for both pediatric and adult population, but not for the elderly. Frontier counties have significantly higher adult ACSHs. The proportion of primary care providers who are non-physician clinicians does not have a significant association with ACSHs for any of the age groups. The results indicate that rurality may have a greater impact on pediatric and adult ACSHs and the proportion of NPCs in the primary care provider workforce does not significantly impact ACSH rates.

Keywords Ambulatory care sensitive hospitalizations · Rurality · Non-physician clinician supply · Access to care

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Introduction

In 1993, the Institute of Medicine (IOM) tasked a 17 member expert committee to develop a list of indicators to monitor access to health care services. The rate of ambulatory care sensitive conditions hospitalizations (ACSHs) was identified as one of these indicators [1]. The Agency for Healthcare Research and Quality (AHRQ) defines ambulatory care sensitive conditions (ACSCs) as those conditions "for which good outpatient care can potentially prevent the need for hospitalization or for which early intervention can prevent complications or more severe disease" [2]. Prior studies have found that impoverished rural areas and sprawling suburban areas have similar rates of hospitalization for ACSCs. Greater prevalence of non-physician clinicians and international medical graduates (IMGs) were also found to be associated with lower rates of ACSCs especially in poor rural areas [3]. However, others have found that physician supply is not associated with hospitalizations for ACSCs in rural areas [4]. Isolated rural or frontier communities may be at a higher risk of preventable hospitalizations due to worse access to primary care. In frontier areas that have difficulty in recruiting and retaining primary care physicians, physician extenders or non-physician clinicians (NPCs) could be addressing a vital need in the provision of primary care. The purpose of this study is to examine the association of rurality and the supply of non-physician clinicians (physician assistants and nurse practitioners practicing in primary care) and the rates of hospitalization for Ambulatory Care Sensitive Conditions (ACSCs) in Nebraska counties.

According to the premise underlying the use of ACSH as a measure of the adequacy of primary care, lower rates of ACSH should indicate better access to primary health care [4–6]. The use of rates of ASCHs in assessing the

effectiveness, efficiency and accessibility of primary health care systems has been validated in studies conducted in different countries and regions, such as Australia [6], Europe [7, 8], North America [9–12], and South America [13].

Ansari et al. [6] suggest that the association between ACSHs and primary care access may be confounded by three sets of factors, all of which are known determinants of health care access. The three sets of factors are healthcare access and health factors, social determinants and behavioral risk factors. Past studies have explored the association between these sets of factors and ACSH. Health and healthcare access factors such as disease, specifically ACSC prevalence [5, 7]; insurance status [6, 14]; having a regular source of care and continuity of care [15] have all been shown to be independent predictors of ACSH. Associations between ACSHs and demographic factors such as gender [8, 13, 16]; age; race [14, 17]; place of residence (rural/urban) [18] and socioeconomic factors such as level of education and income [5, 9, 14, 19, 20] have also been reported. Behavioral risk factors such as smoking rates have also been found to be associated with ACSHs, with evidence linking higher ACSH rates in areas with greater proportions of current smokers [6]. The managed care penetration rate in a community has also been found to be associated with ACSH rate [21] and enrollment in a Medicaid managed care program has been found to be associated with a reduced probability of ACSH in a pediatric population [22]. ACSH rates may also vary with access to hospital care [23]. All of these findings shed some light on the complexity of primary care and primary care access [6, 24]. Researchers and policy makers often use ACSCs to better understand health inequities and the impact of health care policy across population groups and levels of geography [3, 10, 12, 25]. Ansari et al. [6] found that the negative association between self-rated access to care and ACSHs holds in both urban and rural areas, validating the use of ACSHs as a measure of access.

Findings on the relationship between ACSH and the supply of primary care physicians have been conflicting. While some studies suggest the importance of a strong primary care provider presence within or near local communities to maintain or lower rates of preventable hospitalizations [4, 6, 11, 26], others have found a positive association [24] or no association [3, 27] between ASCH rates and physician supply. Others report that the association is not as simple as expected. Krakauer et al. [28] found that at higher levels of physician supply, the expected relationship between supply and ACSH may not hold true. Laditka [11] in a study examining the relationship between physician supply and risk of ACSHs among US elderly population, reports that areas with high and low physician supply both have higher risk of ACSHs, relative to areas with adequate supply of physicians. Areas with higher physician supply may be having supplier-induced demand for hospitalizations that explains the higher risk of ACSHs. These apparently inconsistent findings relating primary care physician supply to ACSHs may be reflective of differences in study design and the populations studied.

Results from studies of the association between physician supply and ACSH rates in rural areas have also been conflicting. Ansari et al. [18] report a negative correlation between physician supply and ACSH rates, while Laditka et al. [4] and Mobley et al. [3] report no association between the two in rural areas. Mobley et al. [3] suggest that the greater reliance on non-physician clinicians and international medical graduates in rural areas could possibly explain the lack of association between physician supply and ACSH rates in rural areas. In fact, they report a negative association between the prevalence of non-physician clinicians and international medical graduates and ASCH rates.

This study examines the relationship between total primary care provider supply, non-physician clinician supply and ACSH rates in Nebraska's counties. By looking at total primary care provider supply and non-physician clinician supply instead of primary care physician supply alone, we get a better estimate of the capacity and composition of the primary care workforce of Nebraska's counties. We also examined the association between ACSH and the extent of rurality (urban/rural/frontier). The propensity of rural residents to seek care later in their illness due to higher travel costs has been put forth as an explanation for the higher rates of ASCHs in rural areas [11, 29, 30]. Studies that have explored the differences in ACSH rates between rural and urban areas have identified the degree of remoteness and rural/urban residence [6, 18] to be positively associated with ACSHs and population density to have a negative association with ACSH [12, 18, 24]. Chen et al. [31] report that small rural hospitals compared to medium and large rural hospitals, spend more of their financial resources on ACSCs. They further state that "because small rural hospitals are more likely to be located in more remote rural areas, this result is consistent with the conventional observation that residents of remote rural areas have less access to timely and effective primary care than do residents of other areas" [31]. Taken together, these findings generate our hypothesis that a positive association exists between rurality (urban/rural/frontier) and ACSH rates, with higher rates of ACSHs in rural and remote rural areas.

Methods

The study design was a cross-sectional observational study of county level factors that affect the county level rates of

hospitalization for ACSCs. The study sample includes all Nebraska counties. The independent variables of interest were rurality (metro/non-metro and frontier designation) and prevalence of NPCs as a proportion of total primary care provider supply. Data on primary care provider supply were obtained from the University of Nebraska Medical Center Health Professions Tracking Service (UNMC—HPTS) 2007 data. The HPTS annual surveys of health care providers are a robust source of data on the supply of health care professionals in Nebraska. The data contain information on actively practicing health professionals and their practice locations as well as work effort (number of hours worked) at primary and satellite practice locations, thus providing a better estimate of primary care provider supply than the American Medical Association (AMA) Master file, which may not include all actively practicing providers. Further, the address field in the AMA Master file does not always reflect the practice location.

Data on county hospitalization rates for ACSCs were obtained from the 2007 Nebraska hospital discharge data, compiled by the Nebraska Hospital Association. County level variables were obtained from the US Census Bureau 2007 population estimates. The outcome of interest was the rate of hospitalizations for ACSCs. The list of ACSCs identified by the Institute of Medicine in 1993 was used. ACSC diagnoses include angina, asthma, cellulitis, chronic obstructive pulmonary disease, dehydration, gastroenteritis, urinary tract infection, pneumonia, severe ear-nose-throat infections, skin grafts, seizure disorders, congestive heart failure, diabetes, hypertension, and hypoglycemia. Health care needs and the type of ACSCs diagnoses differ by age group; therefore, the ACSHs were estimated separately for three age groups: pediatric (0–17 years), adult (18–64 years), and elderly (65 years and older). For the elderly population, consistent with other studies, pneumonia was excluded from the ACSC diagnoses, as pneumonia is often a terminal event in the elderly population [20, 32]. The younger than 65 population may experience greater barriers to care related to poverty, justifying the estimation of separate rates for the three population groups [9, 24]. The rate of ACSHs was calculated as the number of all ACSHs for year 2007 divided by the county population estimate for 2007, obtained from the US Census Bureau 2007 population estimates.

Metropolitan and non-metropolitan counties were designated according to the Office of Management and Budget 2003 definition of metropolitan and non-metropolitan counties. Nine of Nebraska's 93 counties were designated metropolitan. Frontier counties were designated using the conventional definition of frontier counties being counties having less than 7 persons per square mile. Of the 84 non-metropolitan counties, 38 Nebraska counties were designated frontier. Dummy variables were used for metro/non-metro and frontier designations.

Non-physician clinician supply in each county was defined as the prevalence of primary care mid-level providers, including nurse practitioners and physician assistants, as a proportion of total primary care provider supply. Primary care providers include actively practicing allopathic and osteopathic physicians, nurse practitioners, and physician assistants specialized in general practice, general family medicine, internal medicine, general pediatrics, or obstetrics. Specialties for primary care are consistent with those used for the federal primary care health professional shortage area (HPSA) designation by the Primary Care Office, Nebraska Department of Health and Human Services. In rural areas, nurse practitioners and physician assistants, have a significant role in providing primary care [3]. Therefore, they were included in the definition of primary care providers. Residents and house officers were excluded from the counts of allopathic and osteopathic physicians. Primary care supply was measured as provider count, weighted provider count, full-time equivalent (FTE) provider supply, and weighted FTE provider supply in each county and sensitivity analysis was performed using these different measures of provider supply. The provider count reflects the unduplicated number of primary care providers based on the primary practice location. The weighted provider supply is the provider count weighted by the scope of practice weight as follows: MDs and DOs weighted as 1 and PAs and NPs weighted as 0.5 [33]. The FTE provider supply weights the provider supply (counts of providers at primary and all satellite locations) with a weight of 1 for full time status (equivalent to 40 h per week or more work effort) and weight of 0.5 for part time status (less than 40 h per week effort). The weighted FTE provider supply is the FTE provider supply weighted by the scope of practice weights as described above. Unlike the AMA Master file, the HPTS survey database provides data on number of hours worked at each (primary and satellite) practice location, and also provides the practice location address for each provider in the database. For the AMA Master file, the address field could be either office or residential address. Therefore, the HPTS database allowed us to geo-locate the providers with a higher degree of accuracy than would have been possible with the AMA Master file.

The control variables in the model include county-level characteristics such as the percentage of persons in poverty, percentage of persons aged 65 or older, per capita income, percentage of non-white persons, county bed supply and unemployment rates. Population density was dropped from the regression model due to the high collinearity with the frontier dummy variable. The county level variables were obtained from the Area Resource File for year 2007. Low

income [9, 17, 20, 24] and unemployment [4, 34–36] and African American race [5, 17, 24] have all been identified in prior studies as risk factors for ACSHs. Racial minorities have problems with access to primary care because they find it difficult to have trusting relationships with primary care providers [11]. Following Laditka [11] African Americans and Hispanics are presumed to have similar ACSH risk. Therefore, the model controls for percentage of non-white persons in the county.

The data were analyzed using SAS software, version 9.2 (SAS Institute Inc., Cary, NC). Multivariate Poisson regression models with the log of the county specific population size of the age group as the offset, were used to examine the relationships between rurality and supply of non-physician clinicians and ACSHs, controlling for county-level characteristics, for all three age groups separately. For the Poisson regression models, the scale parameter is estimated by the square root of the deviance divided by degrees of freedom to allow for over-dispersion. Poisson regression was used because the dependent variable is a count variable and the use of OLS would result in biased estimates. The supply of primary care providers was included in the models respectively, using one of the four measures: number of primary care providers (PCP), weighted number of primary care providers (weighted PCP), number of full time equivalents (PCP FTEs), weighted number of FTEs (weighted PCP FTE). The selected models with the lowest Akaike's Information Criterion (AIC) values were the models for the county-level PCP FTEs for the adult ACSHs, and weighted PCP for the pediatric and elderly ACSHs. A significance level of $P < 0.05$ was considered significant for all tests.

Results

The mean rate of ACSHs per 1,000 population was 4.22 for the pediatric age group, 7.88 for the adult age group and 38.27 for the elderly age group (Table 1). Ninety percent of Nebraska's counties are rural (non-metro) and about 40% of the counties are isolated rural or frontier. On average, a third or so of primary care providers in Nebraska's counties are mid-level providers or non-physician clinicians. In four counties, they are the sole primary care provider and three of these counties are frontier, and one is rural. Selected county level characteristics such as, percent poverty, population density, unemployment rate, percent non-white population and percent elderly population are summarized in Table 1.

Rural (non-metro) counties have significantly higher ACSHs for both pediatric and adult population, but not for the elderly (Table 2). Frontier counties have significantly higher adult ACSHs. However, there is no significant association of frontier designation and ACSHs for either the pediatric or elderly population. The proportion of primary care providers who are non-physician clinicians does not have a significant association with ACSHs for any of the age groups. Counties with higher percent poverty have

Table 1 Selected characteristics of Nebraska counties (N = 93)

Characteristic	Mean	n (%)	SD	Min.	Max.
Pediatric ACSC rate (per 1,000)	4.22	–	3.37	0	19.32
Adult ACSC rate (per 1,000)	7.88	–	4.23	0.33	23.45
Elderly ACSC rate (per 1,000)	38.27	–	16.31	0	96.15
Non-metro	–	84 (90.3)	–	–	–
Metro	–	9 (9.7)	–	–	–
Non-frontier	–	55 (59.1)	–	–	–
Frontier	–	38 (40.1)	–	–	–
NPC supply (%)	32.87	–	25.95	0	100
PCP Supply					
County FTE PCPs	17.55	–	61.58	0	535.65
Weighted county FTE PCPs	15.16	–	55.02	0	481.49
Provider count	19.78	–	71.21	0	623
Weighted provider count	17.03	–	63.26	0	558
Poverty (%)	12.13	–	2.90	6.2	25.6
Non-white (%)	3.15	–	6.07	0.25	54.99
Population density	40.62	–	166.31	0.6	1472.1
Unemployment rate	2.94	–	0.57	2.0	6.2
Age 65 and older (%)	19.19	–	4.49	8	28.35
Hospital bed supply (per 1,000)	5.31	–	6.51	0	31.27

Table 2 Poisson regression analysis pediatric/adult/elderly ambulatory care sensitive hospitalizations

	Pediatric ACSHs		Adult ACSHs		Elderly ACSHs	
	Parameter estimate	*P* value	Parameter estimate	*P* value	Parameter estimate	*P* value
Metropolitan	−0.413*	0.010	−0.508***	<0.001	−0.1308	0.275
Frontier	0.3185	0.053	0.304*	0.0299	0.1575	0.144
Non-physician clinician supply	−0.001	0.733	0.0017	0.555	0.002	0.342
Percentage of persons in poverty	0.083***	<0.001	−0.0231	0.262	−0.006	0.709
Percentage of persons aged 65 years or older	−0.063***	<0.001	0.0112	0.447	−0.001	0.921
Percentage of non-white persons	−0.065***	<0.001	−0.0281	0.0672	−0.007	0.547
Unemployment rate	0.218	0.096	0.2933*	0.011	−0.002	0.983
Hospital bed supply (per 1,000)	0.0231*	0.027	0.0022	0.817	0.0114	0.104
Primary care provider supply[a]	0.0008*	0.022	0.0015***	<0.001	0.0006*	0.034

[a] The model with the lowest Akaike's information criterion (AIC) is the county-level PCP FTEs for the adult group, and weighted provider count for the pediatric and elderly groups

* P value < 0.05

*** P value < 0.001

higher pediatric ACSHs, but not adult or elderly ACSHs. Counties with more diverse populations (percent non-white population) have lower pediatric ACSHs, but there is no significant association of the racial diversity of the counties with adult or elderly ACSHs. Counties with a higher percentage of elderly population have lower pediatric ACSHs. However, there is no association of the percent elderly population and adult and elderly ACSHs. Counties with higher unemployment rates have higher adult ACSHs, but there is no association of unemployment rates and pediatric and elderly ACSHs. Primary care provider supply was significantly positively associated with both pediatric and adult ACSHs, and also with elderly ACSHs. County level bed supply was positively associated with pediatric, but not adult or elderly ACSHs.

Discussion

Rural residence impacts access to primary care. This study like previous studies in Canada [12] finds that rural areas have significantly higher ACSHs compared to urban areas. However, this association only holds for pediatric and adult populations, but not for the elderly (65 and above) population. In the elderly population, who are covered by Medicare, geographical disparities in access to primary care may not be as significant as for the pediatric and adult populations. It appears that the non-elderly population in rural areas of Nebraska face more significant challenges in access to primary care, than the elderly.

In countries like Australia, that have a similar issue of geographically isolated populations like Nebraska, higher degree of remoteness within rural areas has been found to be associated with higher admissions for ACSCs [18]. In this study of rural and urban counties of Nebraska, the degree of remoteness (frontier status) was associated with higher adult ACSHs. However, there was no significant association of frontier designation and ACSHs for either the pediatric or elderly population.

We used a broader definition of primary care providers than are used for the HPSA designation which does not count NPCs. This is based on the fact that in rural counties NPCs have a significant role in the delivery of primary care. In fact, in four of Nebraska's rural counties, they are the sole primary care provider. This study found that the proportion of primary care providers who are non-physician clinicians, does not have a significant association with ACSHs for any of the age groups. This is contrary to the study by Mobley et al. [3] that found that greater prevalence of NPCs was associated with lower rates of ACSHs. This could be due to the fact that their study looked at all NPCs, rather than primary care NPCs as a proportion of the primary care provider workforce supply. In addition the count of total MDs used in that study included both generalists and specialists, whereas our count of physician supply includes primary care physicians and NPCs practicing primary care. Our study focused on the proportion of NPCs in the primary care provider supply, which is a better reflection of the actual supply, since not all NPCs focus on primary care. County level bed supply was positively associated with pediatric ACSHs. This finding is consistent with the finding from Folland et al. [37] that bed supply affects hospitalization.

Previous studies have found that socioeconomic factors impact ACSHs [19, 20] and this is corroborated by the findings of our study. Counties with higher percent poverty in Nebraska have higher pediatric ACSHs, but not adult or elderly ACSHs. Parker and Schoendorf [14] also found that

children living in poorer areas had higher ACSHs. Counties with higher unemployment rates have higher adult ACSHs, but there is no association of unemployment rates and pediatric and elderly ACSHs.

In terms of the demographic profile of the county, counties with a higher percentage of elderly population have lower pediatric ACSHs. However, there is no association of the percent elderly population and adult and elderly ACSHs. Counties with more diverse populations (percent non-white population) have lower pediatric ACSHs, but there is no significant association of the racial diversity of the counties with adult or elderly ACSHs. This apparently contradictory finding could be explained by the fact that more diverse counties have increased bridging social capital (cross-cutting ties that cross racial-ethnic barriers). Greater potential for interracial and interethnic interaction appears to be associated with fewer ACSHs for pediatric populations, but not for the adult or non-elderly populations [38].

Primary care provider supply was significantly positively associated with pediatric and adult ACSHs, but not with elderly ACSH rates. This is consistent with Schreiber and Zielinski's finding [23] that the PCP ratio was positively related to ACSHs at all levels of the rural urban continuum. This study controlled for the degree of rurality in the same model and found the same finding. Grumbach et al. [39] found only a weak negative association between physician supply and ACSHs in urban areas and no association in rural areas. Ricketts et al. [27] found no association between PCP supply and ACSHs. However, Parchman and Culler [26] found a negative association between PCP supply and ACSHs, as did Basu et al. [40]. This suggests that access to primary care is not solely a function of the primary care provider supply in a community, but reflects a complex interplay of factors including health seeking behavior, patient preferences, disease prevalence and physician practice variation. All of these factors were not modeled in this study, as this study examined administrative data of county level characteristics that are associated with ACSHs.

Schreiber and Zielinski [24] found the effects of independent variables on ACSHs to be the same across rural and urban zip code groups justifying the use of rural and urban counties in the same analysis. Also zip codes with higher PCP to population ratios had higher ACSH rates, suggesting a non-linear relationship. We do not contend that ACSHs is an invalid measure of primary care need, but caution that the multi-factorial nature of the relationship be kept in mind while designing policy options. We also agree with Schreiber and Zielinski's conclusion [24] that ACSHs should not be used as a single measure of primary care need. Further research needs to address its inclusion into an index of need that addresses non health systems factors that impact the need for primary care.

Since this is a cross-sectional study we caution against drawing causal inferences based on ecological correlations. We would have liked to control for disease prevalence while estimating the rates of preventable hospitalizations. Data on county level prevalence rates of diseases were not available. However, Ansari et al. [6] did not find a significant association between propensity to seek care, disease burden and ACSHs. Further research would need longitudinal multilevel studies to model both county and patient level factors that impact access to primary care that may better address issues of causality. Finally, the issue of border crossing to obtain primary care may also impact access to primary care, which was not addressed in this study, since accurate data on health professional supply of counties bordering Nebraska were not available to enable us to examine this issue.

Conclusions

In summary, non-metro (rural) status was found to be positively associated with the rate of preventable hospitalizations, for both pediatric and adult ACSHs, but not for elderly ACSHs. The remoteness (frontier status) of the county was only positively associated with preventable hospitalizations for adult ACSHs, not for pediatric or elderly ACSHs. Contrary to the findings of a prior study of elderly ACSHs [3], the proportion of non-physician clinicians was not significantly associated with preventable hospitalizations for any of the three age groups.

State level datasets, such as the HPTS survey database can provide a robust source of data on health care provider supply both at the state and county levels. The results of this study indicate that rurality may have a greater impact on pediatric and adult ACSHs than elderly ACSHs and the proportion of NPCs in the primary care provider workforce does not significantly impact ACSH rates. These findings suggest that the pediatric and adult population face problems with access to primary care that are not solely explained by the supply or availability of primary care providers. The accessibility of providers, including travel impedance (distance and time to travel as well as availability of transportation) may be an issue affecting the access to primary care of pediatric and adult populations. The study also calls into question whether a greater reliance on non-physician clinician providers is a solution to the access problems that rural counties face considering that counties with higher proportions of NPCs did not have lower rates of ACSHs.

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