Characteristics of Rural Children Admitted to Pediatric Hospitals

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abstract

BACKGROUND AND OBJECTIVES: Delivering high-quality care to children living in rural areas can be challenging. Compared with nonrural children, rural children often experience worse health outcomes. We assessed characteristics and hospitalizations of rural children admitted to US children's hospitals in 2012.

METHODS: Retrospective cohort analysis of 672190 admissions between January 1, 2012, and December 31, 2012, to 41 children's hospitals in the Pediatric Health Information System database. ZIP codes were used to assess the patients' rurality (by using Rural-Urban Community Areas classification), residence in a Health Professional Shortage Area, and family income. Multivariable regression was used to compare patient characteristics and hospital utilization between rural and nonrural children.

RESULTS: Rural children accounted for 12% of all admissions ($n = 81\,360$) to the children's hospitals. Compared with nonrural children, rural children lived farther from the hospital (median [interquartile range]: 68 [48–104] vs 12 [6–24] miles) and more often resided in low-income ZIP codes (53% vs 24%) and Health Professional Shortage Areas (20% vs 4%) ($P < .001$ for all). Rural children had a higher prevalence of complex chronic conditions (44% vs 37%; $P < .001$) and medical technology assistance (15% vs 12%; $P < .001$). In multivariable analysis, rural children experienced higher inpatient costs (mean: \$8507 vs \$7814; $P < .001$) and higher odds of 30-day readmission (odds ratio: 1.1; 95% confidence interval: 1.0–1.1; $P < .001$).

CONCLUSIONS: Rural children hospitalized at children's hospitals have high rates of medical complexity and often reside in low-income and medically underserved areas. Compared with nonrural children, rural children experience more expensive hospitalizations and more frequent readmissions.

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WHAT'S KNOWN ON THIS SUBJECT: Some children living in rural areas travel a great distance for inpatient care in children's hospitals. Little is known about differences in children's hospital use between rural and nonrural children.

WHAT THIS STUDY ADDS: Rural children hospitalized at children's hospitals have high rates of medical complexity and often reside in low-income and medically underserved areas. Compared with nonrural children, rural children experience more expensive hospitalizations and more frequent readmissions.

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Nearly 1 in 5 children in the United States resides in a rural area.¹ Compared with nonrural children, children living in rural areas often experience worse health outcomes.^{1,2} Children living in rural areas have higher rates of obesity, tobacco exposure, and chronic medical conditions compared with urban children.^{1,3,4} Rural children are also more likely to live in poverty, have unmet medical needs, and rely on Medicaid for their health care.^{1,3,5} The White House Rural Council recently launched “Rural Impact,” a large initiative aimed at addressing rural child poverty and health disparities.⁶

Delivering high-quality health care to children living in rural areas, particularly children with special health care needs, can be challenging. In rural areas, fewer general practice and specialty pediatricians per capita are in practice^{7–9} and fewer home- and community-based services (eg, physical therapists and home nurses) may be available.^{10–12} Furthermore, children’s hospitals, often the leading site for pediatric medical and surgical specialty care in a region, are almost exclusively located in nonrural areas.^{13–16} As a result, rural children, particularly those with tertiary care medical needs, must often travel long distances to access health services, especially when hospitalization is necessary.^{7,17} Coordination and integration of health care services for some rural children may become fragmented because of the distance between tertiary care and local general pediatricians and family practice physicians who care for these children.

Little is known about the rural children who use children’s hospitals. Most health services studies in hospitalized children compared resource use and health outcomes of patients using rural versus nonrural hospitals.^{18,19} One population-based study reported that infants living in rural counties experienced less hospital use in

the first year of life than did infants living in urban counties.²⁰ The study did not assess whether this finding held for infants with special health care needs or medical complexity. Children’s hospitals are increasingly seeking opportunities to integrate with local health services for rural children, especially those with medical complexity. A better understanding of the characteristics of rural children who use children’s hospitals is necessary to optimize these integration opportunities, especially at hospital discharge. As children’s hospitals and community pediatric clinicians consider engaging in agreements of shared financial savings and risk (ie, Accountable Care Organizations), it will be important to identify which rural children may be at risk of poor health or high health care utilization.

The objectives of this study are as follows: (1) to describe the clinical, demographic, and inpatient health care services characteristics of rural children who use children’s hospitals and (2) to assess the relationship between children’s rural residence and their hospital resource use, controlling for indicators of medical complexity. We hypothesized that rural children would experience higher hospital utilization compared with nonrural children.

METHODS

Study Design and Setting

We conducted a retrospective cohort analysis of the Pediatric Health Information System (PHIS), an administrative database containing hospital claims data in 2012 from 41 freestanding, tertiary pediatric hospitals located in urban areas of 24 states and the District of Columbia.²¹ Freestanding means that the hospitals are stand-alone facilities that do not reside “inside” another hospital (eg, a hospital for adult patients). PHIS hospitals accounted for nearly one-fifth of

all pediatric admissions in 2012. For each admission, PHIS contains patient demographic characteristics (eg, race/ethnicity designated by the child’s family at admission) as well as *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM), diagnosis and procedure codes. We used unique patient identifiers, which permitted longitudinal measurement of repeated hospitalizations at the same PHIS hospital. Participating hospitals are all members of the Children’s Hospital Association (Overland Park, KS), a business alliance of children’s hospitals in the United States. The Children’s Hospital Association and Truven Health Analytics (New York, NY) maintain PHIS. The institutional review board at Boston Children’s Hospital approved this study by exemption.

Study Population

Inpatient and observation admissions to one of the PHIS children’s hospitals ≥ 1 times between January 1, 2012, and December 31, 2012, for any diagnosis were included in the analysis. Patients of all ages, including patients aged ≥ 18 years, were included in this analysis because many young adults, especially those with chronic conditions originating in childhood, continue to receive inpatient care at children’s hospitals.²²

Main Outcome Measures

The main outcome measures were hospital length of stay (LOS), hospital cost, and 30-day all-cause readmission. Hospital cost measured in PHIS is calculated from charges by using hospital-specific cost-to-charge ratios and represents the sum of the cost of all hospital care, which includes the cost of the room, inpatient medications, equipment, therapies, treatment, procedures, etc. Hospital cost in this study does not include professional (eg, physician)

services, because this information is not available in PHIS.

Main Independent Variable

The main independent variable was the rural or nonrural designation of the home residence for each patient, determined by linking each patient's home ZIP code to their modified Rural-Urban Commuting Area (RUCA) categorization. RUCA is a classification system based on the US Census Bureau that distinguishes urban and rural areas by using population density and commuting travel patterns.²³ We used the 4-tier consolidation (large urban area, small urban area, large rural town, small rural town/isolated rural area) of the original RUCA classification system, as described by the Washington State Department of Health.²⁴ For the bivariate and multivariable modeling, we defined "rural" as residence in a large rural town or small rural town/isolated rural area.

Patient Characteristics

We analyzed patients' demographic characteristics, including age at admission in years, gender, race/ethnicity, insurance, and median family income by ZIP code ($\leq \$33\,525$, $\$33\,526$ – $\$44\,700$, $\$44\,701$ – $\$67\,050$, and $\geq \$67\,051$). Median family income by ZIP code was obtained from US Census data. Income categories correspond to $\leq 150\%$ of the federal poverty level (FPL), 151% to 199% of the FPL, 200% to 299% of the FPL, and $\geq 300\%$ of the FPL, respectively, for a family of 4 based on the 2011 designations by the US Department of Health and Human Services.²⁵ We included this variable to approximate neighborhood-level poverty for each child.

We calculated the distance traveled to hospital as the miles between the geographic center of the hospitals and patients' home ZIP codes. We assessed access to health care near the patient's home residence using the Health Resources and Services

Administration's designation for a primary care Health Professional Shortage Area (HPSA). Areas may receive HPSA designation when the population to primary care physician ratio is >3500 to 1 or the primary care physicians in surrounding areas are unavailable to serve the designated population.²⁶ Although HPSAs may be located in both metropolitan and nonmetropolitan neighborhoods, many are located in rural areas. To allow for comparisons at the county level we used Federal Processing Standard codes to convert the patient's home ZIP code to the corresponding county code.

We assessed patients' clinical characteristics, including the number and type of chronic conditions. We identified children assisted with medical technology with ICD-9-CM codes indicating the use of a medical device to manage and treat a chronic illness (eg, ventricular shunt to treat hydrocephalus) or to maintain basic body functions necessary for sustaining life (eg, a tracheostomy tube for breathing).^{27,28}

To assess whether patients had a chronic condition, we used the Agency for Health Care Research and Quality's Chronic Condition Indicator (CCI) classification system, which dichotomizes $\sim 14\,000$ ICD-9-CM diagnosis codes into chronic or nonchronic conditions and assigns each condition into 1 of 18 mutually exclusive clinical groups. Using the CCI, we counted the number of chronic conditions endured by each child. To identify children with a complex chronic condition (CCC), we used a previously established set of ICD-9-CM codes that represent child health conditions that are expected to last >12 months and that are associated with high rates of morbidity and/or mortality.²⁹ A chronic condition was identified if a corresponding ICD-9-CM code appeared for at least 1 hospitalization during the study period. Although the sensitivity and specificity of using

the Agency for Health Care Research and Quality's CCI system to count the number of chronic conditions remain unknown, the system has been validated for use in hospital claims, correlated with the risk of hospital readmission in children,³⁰ and used by nationally endorsed measures of hospital quality.

Statistical Analysis

In multivariable analysis, we used hierarchical linear regression (for log-transformed cost and LOS analyses) and logistic regression (for readmission analysis) with fixed effects for all of the patient characteristics described above (ie, age, race/ethnicity, payor, HPSA, distance to hospital, and type and number of chronic conditions) and a random effect for hospital to assess the relationship between a patient's rural location and their inpatient resource use. We used log-transformed cost and LOS variables for the regression analysis because these data were not normally distributed. All fixed effects aside from HPSA were included because they correlated with hospital resource use in previous studies. HPSA was included because, in our clinical experience, hospitalized children discharged to a medically underserved area tend to stay longer in the hospital. The random effect for hospital was included to limit the influence of 1 or a small group of outlier hospitals on the results. We also adjusted for clinical variables known to associate with utilization, including type and number of CCCs^{16,31,32} and technology assistance.³³ We derived a second set of multivariable models for each outcome with neonates (age <30 days at admission) removed from the cohort because their travel distances and hospital use may be different from older infants and children.³⁴ The threshold of statistical significance was set at $P < .05$. All statistical

analyses were performed by using SAS version 9.3 (SAS Institute, Cary, NC).

RESULTS

Study Population

There were 672 190 admissions in 2012 to the 41 children's hospitals in our cohort. The most common reasons for hospitalization were asthma (5.2%; $n = 34\,834$), bronchiolitis (4.4%; $n = 29\,353$), and seizure (4.1%; $n = 27\,635$).

Twelve percent ($n = 81\,360$) of admissions were for children who lived in a rural area. Of these rural children, 55.0% were from a large rural town and 45.0% were from a small rural town. Six percent ($n = 39\,079$) of admissions were for children who resided in an HPSA. The percentage of admissions attributable to rural patients varied significantly across hospitals (median: 10.1%; interquartile range [IQR]: 4.2%–20.5%; range: 0.3%–41.0%) as did the percentage of rural patients from an HPSA (median: 17.5%; IQR: 11.6%–24.8%; range: 0.3%–86.7%) (Fig 1). No single hospital accounted for a disproportionate share of total number of hospitalizations for rural patients. Rural children made up less than half (41.2%) of all patients residing in an HPSA. California and a band of states moving northeast from Texas to Ohio and western Pennsylvania had the most rural counties with high numbers of admissions to the children's hospitals in the cohort. Although the children's hospitals were present in only 24 states, rural children from all 50 states were admitted to those hospitals (Fig 2).

Demographic and Clinical Characteristics of Patients Living in Rural Versus Nonrural Areas

Rural children traveled a median of 68 miles (IQR: 48–104 miles) to their children's hospital compared with 12 miles (IQR: 6–24 miles) for nonrural

FIGURE 1

Percentage of discharges from children's hospitals to rural areas and rural HPSAs by hospital. The graph depicts the percentage of total discharges between January 1, 2012, through December 31, 2012, accounted for by rural children, for each of the children's hospitals, and the percentage of rural patients from an HPSA.

FIGURE 2

Hospital discharges from 41 children's hospitals of children residing in rural areas by US county in 2012. The figure depicts the number of admissions by rural county (as designated by RUCA-classified large rural town and/or small rural town/isolated rural areas) to any PHIS-affiliated children's hospitals in 2012. To convert from the patient's home ZIP code to the county we used Federal Processing Standard county codes. Black circles denote PHIS-affiliated children's hospitals.

patients. Compared with nonrural patients, a higher percentage of rural patients resided in ZIP codes with incomes $\leq 150\%$ of the FPL (52.8% vs 24.4%; $P < .001$) and in HPSAs (19.8% vs 3.9%; $P < .001$). A higher percentage of rural children were non-Hispanic white (73.1% vs 45.6%;

$P < .001$), and a lower percentage of rural children were non-Hispanic black (7.5% vs 20.5%; $P < .001$) and Hispanic (9.9% vs 17.4%; $P < .001$). A higher percentage of rural children had at least 1 chronic condition (71.4% vs 66.6%; $P < .001$), a CCC (44.0% vs 36.7%; $P < .001$), and

technology assistance (14.6% vs 11.7%; $P < .001$) (Table 1).

Inpatient Resource Utilization of Patients Living in Rural Versus Nonrural Areas

In multivariable analysis, when compared with nonrural patients, rural patients experienced a similar, although statistically significant, higher adjusted mean LOS [2.3 (95% confidence interval [CI]: 1.3–3.8) versus 2.2 (95% CI: 2.1–2.3) days; $P < .001$]; for every 10 hospitalized rural patients, the collective LOS was 1 day longer than for 10 nonrural children. Rural patients had a higher mean inpatient cost (\$8507 [95% CI: \$8101–\$8934] versus \$7814 [95% CI: \$7444–\$8203]; $P < .001$). Rural patients also experienced higher 30-day, all-cause readmissions (12.9% vs 11.5%; odds ratio: 1.1; 95% CI: 1.0–1.1; $P < .001$) compared with nonrural patients (Table 2). When excluding neonates (age <30 days), there was no longer a statistically significant difference ($P = .1$) in adjusted mean LOS between rural and nonrural children. Statistically significant differences remained in mean inpatient cost and odds of 30-day, all-cause-readmissions with the exclusion of neonates (age <30 days) (Table 2).

DISCUSSION

In this study, we found that rural children account for 1 of every 8 admissions to US children's hospitals. Rural children from all 50 US states were admitted to the US children's hospitals located in only 24 states. When hospitalized, rural children cost more and are readmitted more often than are nonrural children, even after controlling for indicators of medical complexity. Hospitalized children from a rural area have a higher prevalence of a chronic condition, a CCC, and need for technology assistance. Despite a higher prevalence of these characteristics, rural children

TABLE 1 Characteristics of Rural and Nonrural Patients Admitted in 2012 to Children's Hospitals

Characteristics	All Children	Home Residence	
		Rural	Nonrural
Admissions, <i>n</i> (%)	672 190	81 360 (12.1)	590 830 (87.9)
Total cost, %	—	14.3	85.7
Age at admission, <i>n</i> (%)			
<1 year	172 870 (25.7)	20 936 (25.7)	151 934 (25.7)
1–4 years	162 843 (24.2)	19 719 (24.2)	143 124 (24.2)
5–9 years	110 984 (16.5)	13 814 (17)	97 170 (16.4)
10–14 years	107 931 (16.1)	13 904 (17.1)	94 027 (15.9)
15–18 years	81 660 (12.1)	10 137 (12.5)	71 523 (12.1)
>18 years	35 902 (5.3)	2850 (3.5)	33 052 (5.6)
Male, <i>n</i> (%)	354 589 (52.8)	44 079 (54.2)	310 510 (52.6)
Public insurance, <i>n</i> (%)	379 440 (56.4)	47 082 (57.9)	332 358 (56.3)
Race/ethnicity, <i>n</i> (%)			
Non-Hispanic white	329 019 (48.9)	59 505 (73.1)	269 514 (45.6)
Non-Hispanic black	127 030 (18.9)	6126 (7.5)	120 904 (20.5)
Hispanic	110 823 (16.5)	8069 (9.9)	102 754 (17.4)
Asian	17 462 (2.6)	426 (0.5)	17 036 (2.9)
Other	87 856 (13.1)	7234 (8.9)	80 622 (13.6)
Median (IQR) distance to hospital, miles	14.4 (6.7–35)	68.3 (47.5–104.4)	12.2 (6.1–24.3)
Median household income, ^a <i>n</i> (%)			
≤150% of FPL	184 989 (27.8)	42 568 (52.8)	142 421 (24.4)
151%–199% of FPL	156 060 (23.5)	27 196 (33.7)	128 864 (22)
200%–299% of FPL	160 038 (24.1)	9756 (12.1)	150 282 (25.7)
≥300% of FPL	164 042 (24.7)	1110 (1.4)	162 932 (27.9)
HPSA, ^b <i>n</i> (%)	39 079 (5.9)	16 084 (19.8)	22 995 (3.9)
Chronic conditions, <i>n</i> (%)			
None	220 497 (32.8)	23 251 (28.6)	197 246 (33.4)
Chronic, noncomplex	199 212 (29.6)	22 337 (27.5)	176 875 (30.0)
Chronic, complex	252 481 (37.6)	35 772 (44.0)	216 709 (36.7)
Technology assistance, <i>n</i> (%)	80 785 (12)	11 848 (14.6)	68 937 (11.7)

All *P* values < 0.001, as obtained in a bivariate model using Rao-Scott χ^2 tests to compare categorical variables between rural and nonrural patients.

^a Income and categorization were based on the US Department of Health and Human Services 2011 Federal Poverty Guidelines for a family of 4 living in the 48 contiguous states and the District of Columbia and represent family incomes of ≤\$33 525, \$33 526–\$44 700, \$44 701–\$67 050, and ≥\$67 051, respectively.

^b Denotes familial residence in a ZIP code denoted as an HPSA by the US Health Resources and Services Administration.

TABLE 2 Multivariable Analysis of Differences in Children's Hospital Resource Use Between Rural and Nonrural Patients

	Home Residence		
Hospital Resource Use	Rural	Nonrural	<i>P</i>
Model 1: all hospital discharges included			
Mean (95% CI) adjusted LOS, d	2.3 (1.3–3.8)	2.2 (2.1–2.3)	<.001
Mean (95% CI) hospitalization cost, \$	8507 (8101–8934)	7814 (7444–8203)	<.001
30-d Hospital readmission, odds ratio (95% CI)	1.05 (1.02–1.08)	Reference	<.001
Model 2: neonates (age <30 d at admission) excluded			
Mean (95% CI) adjusted LOS, d	2.0 (2.0–2.1)	2.0 (2.0–2.1)	.10
Mean (95% CI) hospitalization cost, \$	7581 (7229–7950)	7210 (6878–7557)	<.001
30-d Hospital readmission, odds ratio (95% CI)	1.07 (1.04–1.11)	Reference	<.001

Multivariable analyses were adjusted for age, gender, insurance type, race/ethnicity, distance to hospital, residence in an HPSA, type and number of CCCs, and need for technology assistance.

are more often discharged from children's hospitals to low-income and medically underserved areas.

Children's hospitals, and the states and surrounding regions in which they reside, may find this information

useful as programs and policies emerge to (1) better integrate tertiary and community care and (2) optimize quality of care for rural children.

Our finding of increased readmissions in rural patients is congruent with 1 previous study that observed more readmissions in children traveling a prolonged distance to the hospital.¹⁷ In our study, this association persisted after excluding neonates, a population known to experience long travel distances and high readmission rates.³⁴ Although not determined from the current study, more readmissions in rural patients could imply that the hospital and local health care providers may not have as much of a familiar, close working relationship with each other, which could make it difficult to decide when to discharge the child and how to keep the child safe and healthy after discharge. More readmissions in rural patients might also represent impediments in the timeliness of care if the child requires assistance from a nonlocal children's hospital, or other nonlocal health care entity or provider, soon after discharge for an urgent health problem or an unmet discharge care need. Policymakers and insurers may choose to take note of the association between rurality and readmission rate when conducting evaluations of hospital quality.

In the current study, hospitalized rural children were 5 times more likely than nonrural children to reside in a medically underserved area. Many medically underserved areas may lack the health care infrastructure to sufficiently implement discharge care plans, particularly for children with medical complexity. Although previous studies reported similar access to a medical home¹ for rural and nonrural children, rural pediatricians often report difficulties accessing subspecialty care³⁵ and caring

for children with special health care needs.⁷ Limited home- and community-based health services may be available for rural children, which could increase the burden of caregiving after discharge on the child's family.¹² Children's hospitals in Canadian provinces and Australian states have developed rigorous educational curricula and telemedicine capabilities to optimize the caregiving skills of rural families and rural health care providers of children with medical complexity.^{36–38} Further investigation is needed to determine how to best meet the health care needs of rural children and support rural pediatricians, family practice physicians, and other health care providers in delivering high-quality care to rural children in medically underserved areas after discharge from children's hospitals. As insurers, state Medicaid programs, and federal agencies consider enacting financial penalties on pediatric hospitals with excess readmissions, the association between patient rurality and the likelihood of readmission should be considered for risk adjustment.^{39,40}

The majority of hospitalized rural children in the current study resided in neighborhoods with high levels of poverty. It is well known that financial challenges of patients and families contribute to suboptimal health and health care outcomes.^{41–43} For rural families in low-income neighborhoods caring for a recently hospitalized child with chronic illness could lead to additional financial stress, especially if higher out-of-pocket health care expenses are incurred.^{44–46} Furthermore, some of these areas may not have access to local social work or care management services for help.^{47,48} As a result, rural children from economically challenged families may experience difficulties adhering to a discharge care plan, especially a plan that is associated with copayments for medications, equipment, and

follow-up visits. Further investigation of the relationship between rurality and poverty for hospitalized children in pediatric hospitals is needed, including how the relationship affects hospitals' performance on measures of hospital quality that are linked with payment.⁴⁹

Hospitalized rural children in our study had higher rates of medical complexity when compared with hospitalized nonrural children. This finding should be interpreted with caution, because our study was not intended to assess differences in underlying disease prevalence between nonrural and rural children. Rural areas are associated with higher rates of certain chronic medical and behavioral diseases than urban areas^{1,3,4}; however, the relationship between rurality and medical complexity is unclear. It is likely that some rural children with medical complexity preferentially seek hospital care at urban, freestanding children's hospitals more so than rural children without medical complexity, which might occur in situations when a local hospital proficient in treating health problems for children with medical complexity does not exist. A growing body of literature shows that individuals with complex medical needs often travel long distances for hospital care.^{17,50,51} Future studies should explore the reasons why rural children admitted to urban children's hospitals have a higher degree of medical complexity than urban children.

This study has several limitations. We used patient ZIP codes to approximate rurality, travel distance, access to health services, and family income. Although previous studies have reported a strong relationship between neighborhood-level characteristics and health outcomes,⁵² alternative sources of patient-level data (eg, survey to assess family income) might be preferred. ZIP codes may be a crude measure

of individual income and may overestimate or underestimate the level of individual or family poverty. Estimation of the FPL is based on income levels for families of 4 and it does not adjust for variation in cost-of-living differences across communities. When assessing rurality, we aggregated small and large rural communities together; we did this because the intent of the analysis was to assess, broadly, differences in children's hospital utilization of children residing in rural compared with nonrural areas. Important differences in utilization might exist between children residing in small versus larger rural communities; we hope that subsequent analyses will explore these differences.²⁰ Although the use of ZIP codes to approximate travel distance does not take into account traffic patterns, speed limits, and other factors that could affect the travel time, distance-based and travel time-based assessments have been reported to correlate well in children.¹⁷ HPSA designation may not take into account nonphysician health care providers (eg, nurse practitioners, physician assistants) who provide primary care services to children. Furthermore, urban areas with sufficient physician to patient ratios but with other barriers to accessing timely care may be underestimated.

Hospital cost did not include professional (eg, physician) services, because this information is not available in PHIS. The PHIS database contains freestanding children's hospitals and thus the findings are

probably the most generalizable to freestanding children's hospitals. Freestanding children's hospitals admit a larger proportion of patients with CCCs and technology assistance when compared with non-children's hospitals; therefore, the findings may not be as generalizable to non-children's hospitals. We could not measure readmissions to non-PHIS hospitals (eg, rural hospital near a patient's home residence), which could have led to undercounting of readmissions, although a recent study found that few (13%) readmissions among children occur in a different hospital.⁵³ We used ICD-9-CM-based clinical groupers (eg, CCI and CCC), which may underestimate the presence of chronic conditions that may be underreported in hospital billing records.

Despite these limitations, children's hospitals may find the information from the current study useful as they strive to (1) better integrate with their surrounding local and regional care areas and (2) ameliorate disparities in health and quality of care between rural and nonrural children, especially those with complex medical needs. With extremely large geographic catchment areas, often spanning multiple counties and states, children's hospitals provide health care to rural children residing nearly 70 miles away. Further investigation is needed to assess the access and availability of local hospitals and their proficiency to provide high-quality inpatient care to children, especially those with medical complexity.^{36,54}

Federal legislation is gaining support in the US Congress to create optional regional networks (across state lines) that will better serve children with medical complexity, especially those in rural areas who rely on children's hospitals for their specialty and hospital care.⁵⁵ It is hoped that these care networks will have an impact on integrating tertiary care with primary and community care for rural children. This integration could influence LOS, hospital cost, and hospital readmission for rural patients who use children's hospitals. As more children's hospitals enter shared savings programs (eg, an Accountable Care Organization, bundled payments) with their local and regional communities, consideration of rural children will be extremely important.

ABBREVIATIONS

CCC: complex chronic condition
 CCI: Chronic Condition Indicator
 CI: confidence interval
 FPL: federal poverty level
 HPSA: Health Professional Shortage Area
 ICD-9-CM: *International Classification of Diseases, Ninth Revision, Clinical Modification*
 IQR: interquartile range
 LOS: length of stay
 PHIS: Pediatric Health Information System
 RUCA: Rural-Urban Commuting Area

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