RESEARCH ARTICLE

Profiling Interfacility Transfers for Hospitalized Pediatric Patients

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ABSTRACT

BACKGROUND AND OBJECTIVE: The hospital-to-hospital transfer of pediatric patients is a common practice that is poorly understood. To better understand this practice, we examined a national database to profile pediatric interfacility transfers.

METHODS: We used the 2012 Kids' Inpatient Database to examine characteristics of hospitalized pediatric patients (<21 years; excluding pregnancy diagnoses) with a transfer admission source. We performed descriptive statistics to compare patient characteristics, utilization, and hospital characteristics between those admitted by transfer versus routine admission. We constructed a multivariable logistic regression model to identify patient characteristics associated with being admitted by transfer versus routine admission.

RESULTS: Of the 5.95 million nonpregnancy hospitalizations in the United States in 2012, 4.4% were admitted by transfer from another hospital. Excluding neonatal hospitalizations, this rate increased to 9.4% of the 2.10 million nonneonatal, nonpregnancy hospitalizations. Eighty-six percent of transfers were to urban teaching hospitals. The most common transfer diagnoses to all hospitals nationally were mood disorder (8.9%), other perinatal conditions (8.7%), prematurity (4.8%), asthma (4.2%), and bronchiolitis (3.8%). In adjusted analysis, factors associated with higher odds of being admitted by transfer included having a neonatal principal diagnosis, male gender, white race, nonprivate insurance, rural residence, higher illness severity, and weekend admission.

CONCLUSIONS: Interfacility transfers are relatively common among hospitalized pediatric patients. Higher odds of admission by transfer are associated not only with higher illness severity but also with principal diagnosis, insurance status, and race. Further studies are needed to identify the etiologies and clinical impacts of identified transfer differences.

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The transfer of pediatric patients from one hospital to another is a common practice, but the actual frequency of these interfacility transfers nationally is not known. Although pediatric transfers have been studied in certain patient subsets, such as neonates and the critically ill and the injured, interfacility transfers have not been described across all diagnoses nationwide.[1–6]

Some interfacility transfers occur so patients can access hospitals with specialized care. Such specialty centers include hospitals with NICUs and trauma centers, which have designated levels of care based on complexity of care provided.[7,8] Some specific diseases, such as transplant care and burn care, also have designated specialty centers.[9,10] However, the majority of pediatric conditions do not have level of care systems to guide transfer practices. Due to the lack of evidence-based research to guide transfer systems, transfer practices may be influenced by hospital and payer financial interests.[11,12]

The adult literature demonstrates that race-based transfer disparities exist.[13] Previous adult and neonatal studies also suggest that patients without insurance or with Medicaid are more likely to be transferred than those with private insurance,[2,14,15] although federal law limits hospitals' ability to transfer patients who are clinically unstable.[16] We do not know whether similar transfer disparities exist in the pediatric population. Although pediatric transfer patterns might mimic adult patterns, pediatric hospital care differs from adult care in that pediatric services are more regionalized than adult services.[17] Many hospitals lack the pediatric specialists and resources thought to be necessary to provide definitive care for some diagnoses.[4,18]

The purpose of this study was to examine characteristics of interfacility transfers of pediatric patients using a nationally representative sample. We were interested in characterizing the principal diagnoses, patient characteristics, and hospital characteristics of interfacility transfers. In addition, we evaluated which patient-level factors were associated with higher odds of being admitted by transfer. We hypothesized that interfacility transfers are relatively common among hospitalized pediatric patients nationally and that diagnoses requiring specialty care, such as neonatal diagnoses and mental health diagnoses, would be associated with higher odds of admission by transfer. We also hypothesized that white patients and those without insurance or with Medicaid would have higher odds of admission by transfer, similar to patterns seen in adults.[14,15,19]

METHODS

Study Design and Data Source

We conducted a cross-sectional analysis of pediatric hospitalizations using the 2012 Kids' Inpatient Database (KID). The KID is a nationally representative public-use data set developed for the Healthcare Cost and Utilization Project sponsored by the Agency for Healthcare Research and Quality (AHRQ). This data set provides deidentified discharge data on children aged 0 to 20 years sampled from 4179 hospitals in 44 states. It is generated as a stratified random sample drawn from all hospitals in the sampling frame, with survey weights that allow for national estimates on pediatric discharges in the United States.[20]

Study Population

Hospitalized pediatric patients aged 0 to 20 years were eligible. We excluded pregnancy-related hospitalizations because transfers for these patients could reflect fetal problems rather than maternal problems and obstetric rather than pediatric resource availability. Pregnancy-related hospitalizations were identified using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis and procedure code screens (Supplemental Table 4).[21]

We defined our population of interest as hospitalized patients with a transfer admission source, which can include a referring hospital's emergency department or inpatient unit. In the KID, transfers from a referring hospital's emergency department cannot be distinguished from transfers from an inpatient unit.[20] We were interested in transfers between acute care facilities; therefore, referring hospitals were limited to acute care hospitals, and we excluded transfers from other facilities such as psychiatric or rehabilitation facilities. We compared transferred patients with non-transferred patients, defined as hospitalized patients who were admitted from home or from the same hospital's emergency department. Hospitalizations with a discharge disposition of transfer to another acute-care hospital were excluded to avoid overlap of patients between groups.

Variables

The patient- and hospital-level variables examined have previously been found to be associated with emergency department use and hospitalizations; we hypothesized that some would also be associated with interfacility transfers.[22–26]

Patient-Level Variables

Patient demographic characteristics included age,[27] gender, race/ethnicity (white, black, Hispanic, Asian or Pacific Islander, other), insurance status, income quartile, and urban versus rural residence (determined by the Core Based Statistical Area).[28]

We identified principal diagnoses using ICD-9-CM codes categorized into Clinical Classifications Software diagnostic groupings.[29] We stratified illness severity as minor, moderate, major, or extreme loss of function using the All-Patient Refined Diagnosis-Related Groups severity index.[30,31] The KID definition of a chronic condition is a condition that lasts ≥12 months and either (1) places limitations on self-care, independent living, and social interactions or (2) results in the need for ongoing intervention with medical products, services, and special equipment.[32] To identify the subgroup of patients with increased medical complexity and more intense health care needs, we additionally recorded the presence of complex chronic conditions using ICD-9-CM codes identified by Feudtner et al.[33]

Utilization

We summarized hospital utilization by calculating aggregate annual total charges. We evaluated whether each patient had a "major operating room procedure" because this variable represents a potential reason

for interfacility transfer. Utilization variables that were not indicators of resource use but could potentially influence the odds of transfer were weekend versus weekday admission and elective versus nonelective admission.

Hospital-Level Variables

Hospital characteristics of interest were hospital bed size,[34] urban/rural location and teaching status, ownership type, and geographic region. Hospitals were additionally categorized as freestanding children's versus non-freestanding children's hospitals based on the American Hospital Association Annual Survey of Hospitals and the National Association of Children's Hospitals and Related Institutions, with consultation from the AHRQ for resolution of any inconsistencies.[20]

Analysis

We performed descriptive statistics for each variable of interest, comparing transfer versus nontransfer status. For each categorical patient and hospital characteristic, we performed a univariate survey-weighted logistic regression analysis to generate a *P* value based on a likelihood ratio test for variation among levels. For each level, we calculated the proportion transferred as a ratio of the number of patients admitted by transfer (numerator) to the number of all patients (denominator). Because a subset of preterm birth patients generates significantly disproportionate hospitalization costs,[35] we additionally performed our descriptive statistics by removing neonatal hospitalizations from the calculations (Supplemental Table 5).[21]

We estimated a multivariable logistic regression model to analyze factors associated with the odds of interfacility transfer, including covariates from the univariate analyses that could potentially influence providers' decision to transfer. We excluded discharge disposition from the model because it represents a utilization outcome rather than potential explanation for transfer.[22] We could not obtain variables describing the transferring hospital because the KID lacks patient-specific linkages to connect pre- and posttransfer hospitals. We examined all patient-level

TABLE 1 Profile of Patient-Level Characteristics for Pediatric Hospitalizations for Transfers and Nontransfers for 0- to 20-Year-Olds Nationally, 2012

Patient Characteristics	Transferred (N = 263 367)[a]		Not Transferred (N = 5 688 568)[a]		Proportion Transferred, %	P[b]
	n	%	*n*	%		
Age group, y						<.001
0–1	111 275	(42.4)	4 212 285	(74.1)	2.6	
2–5	33 205	(12.6)	337 045	(5.9)	9.0	
6–11	32 767	(12.5)	315 417	(5.6)	9.4	
12–18	67 505	(25.7)	576 398	(10.2)	10.5	
19–20	17 709	(6.7)	240 448	(4.2)	6.8	
Gender						<.001
Female	118 692	(45.1)	2 737 311	(48.1)	4.2	
Male	144 648	(54.9)	2 949 488	(51.9)	4.7	
Race/ethnicity						<.001
White	124 489	(47.3)	2 712 068	(47.7)	4.4	
Black	37 355	(14.2)	819 124	(14.4)	4.4	
Hispanic	40 389	(15.3)	1 077 889	(19.0)	3.6	
Asian or Pacific Islander	5348	(2.0)	240 595	(4.2)	2.2	
Other	19 979	(7.6)	373 967	(6.6)	5.1	
Missing	35 808	(13.6)	464 925	(8.2)	7.2	
Insurance status						<.001
Private	97 430	(37.0)	2 543 827	(44.8)	3.7	
Public	140 210	(53.3)	2 685 097	(47.3)	5.0	
Self-pay	10 271	(3.9)	226 311	(4.0)	4.3	
No charge or other	15 136	(5.8)	218 783	(3.8)	6.5	
Income quartile						<.001
$1–38 999	81 169	(31.5)	1 651 409	(29.6)	4.7	
$39 000–47 999	69 497	(26.9)	1 361 819	(24.4)	4.8	
$48 000–62 999	59 436	(23.0)	1 344 434	(24.1)	4.2	
$63 000+	47 888	(18.6)	1 220 712	(21.9)	3.8	
Residence						<.001
Urban	204 193	(77.8)	4 810 546	(84.8)	4.1	
Rural	58 323	(22.2)	859 644	(15.2)	6.4	
Illness severity[c]						<.001
Minor or no loss of function	98 167	(37.3)	3 880 348	(68.3)	2.5	
Moderate loss of function	92 286	(35.1)	1 311 517	(23.1)	6.6	
Major loss of function	47 873	(18.2)	407 846	(7.2)	10.5	
Extreme loss of function	24 737	(9.4)	84 754	(1.5)	22.6	
CCs						<.001
No CC	88 437	(33.6)	4 000 071	(70.3)	2.2	
≥1 CC	174 930	(66.4)	1 688 497	(29.7)	9.4	
CCCs						<.001
No CCC	182 832	(69.4)	5 000 567	(87.9)	3.5	
1 or more CCCs	80 536	(30.6)	688 000	(12.1)	10.5	
Principal diagnosis[d]						<.001
Mood disorder	23 353	(8.9)	128 717	(2.3)	15.4	
Other perinatal conditions	22 933	(8.7)	40 783	(0.7)	36.0	
Prematurity[e]	12 757	(4.8)	4741	(0.1)	72.9	
Asthma	11 204	(4.2)	112 922	(2.0)	9.0	

TABLE 1 Continued

Patient Characteristics	Transferred (N = 263 367)[a]		Not Transferred (N = 5 688 568)[a]		Proportion Transferred, %	P[b]
	n	%	*n*	%		
Bronchiolitis or bronchitis	10 101	(3.8)	109 514	(1.9)	8.4	
Pneumonia[f]	9606	(3.6)	115 576	(2.0)	7.7	
Seizure or epilepsy	9166	(3.5)	66 470	(1.2)	12.1	
Appendicitis[g]	6288	(2.4)	79 758	(1.4)	7.3	
Diabetes mellitus	6212	(2.4)	41 808	(0.7)	12.9	
Cardiac congenital anomalies[h]	5862	(2.2)	20 952	(0.4)	21.9	
Other	145 777	(55.4)	4 65 173	(87.3)	2.8	
Utilization						
OR procedure						<.001
No major OR procedure	212 604	(80.7)	4 225 499	(74.3)	4.8	
Major OR procedure	50 763	(19.3)	1 463 069	(25.7)	3.4	
Weekend admission						<.001
Not a weekend admission	195 209	(74.1)	4 535 341	(79.7)	4.1	
Weekend admission	68 158	(25.9)	1 153 216	(20.3)	5.6	
Elective admission						.03
Not an elective admission	237 754	(90.5)	5 275 321	(92.9)	4.3	
Elective admission	24 835	(9.4)	405 771	(7.1)	5.8	
Discharge disposition						<.001
Routine home	237 187	(90.1)	5 466 059	(96.1)	4.2	
Transfer to nonacute facility[i]	8099	(3.1)	41 446	(0.7)	16.3	
Home health	12 924	(4.9)	151 065	(2.6)	7.9	
Against medical advice	693	(0.3)	12 187	(0.2)	5.4	
Died	4464	(1.7)	17 810	(0.3)	20.0	

CC, chronic conditions; CCCs, complex chronic conditions; OR, operating room.

[a] Unweighted transfers = 187 096. Unweighted nontransfers = 2 493 120. Transfers include hospitalizations with an admission source from another inpatient hospital or emergency department. Nontransfers include hospitalizations with a nontransfer admission source. Excluding neonatal hospitalizations resulted in N = 198 564 for transfers and N = 1 904 030 for nontransfers (unweighted = 141 536 and 1 350 039, respectively).

[b] P values refer to comparisons between transfers and nontransfers. Determined by using univariate survey–weighted logistic regression analysis based on a likelihood ratio test for variation among levels.

[c] All-Patient Refined Diagnosis-Related Groups illness severity.

[d] Designation of the principal diagnosis is based on physician discharge documentation. The diagnoses listed are the most frequently transferred principal diagnoses, listed in descending order.

[e] Prematurity includes short gestation, low birth weight, and fetal growth retardation.

[f] Pneumonia includes pneumonia except that caused by tuberculosis or sexually transmitted disease.

[g] Appendicitis includes appendicitis and other appendiceal conditions.

[h] Cardiac congenital anomalies includes cardiac and circulatory congenital anomalies.

[i] Nonacute facility includes skilled nursing facility, intermediate care facility, and another type of facility.

covariates for multicollinearity using pairwise variable inflation factors and excluded the following covariates from the model due to variable inflation factors >10 and conceptual similarity to other model variables: income quartile, chronic conditions, and complex chronic conditions.[36] The resulting covariates that were included in the model were principal diagnosis, age group, gender, race/ethnicity, insurance status, urban/rural residence, illness severity, major operating room procedure, weekend admission, and elective admission type.

To account for the possibility that patients aged 18 to 20 years can be managed by adult providers and thus might have different transfer patterns, we performed a robustness analysis removing these older adolescents from the model. In addition, to account for level of specialization, resources, and location at the posttransfer hospital, we also stratified the model into 2 strata by hospital location and teaching status (urban teaching vs urban nonteaching and rural). Lastly, the KID has a large proportion of missing race/ethnicity data that are not missing at random.[37] We accounted for these missing data by conducting sensitivity analyses, removing discharges from all hospitals that did not report race/ethnicity.

Survey weights, provided by AHRQ, were used for all analyses to generate national estimates and proper variance estimates, including 95% confidence intervals (CIs) for adjusted odds ratios. Data were analyzed using Stata 13 (Stata Corp, College Station, TX).[38] This study was approved as exempt by the University of California—San Francisco Committee on Human Research.

RESULTS

In 2012, there were 263 367 hospital discharges of 0- to 20-year-olds admitted via transfer from another hospital nationally (4.4% of all nonpregnancy discharges). Patients aged 0 to 1 year were less likely to be admitted by transfer (2.6%) than patients in other age categories (6.8%–10.5%). When removing neonatal hospitalizations from the calculations, admissions via transfer represented 9.4% of all nonneonatal, nonpregnancy discharges.

Rural patients were admitted by transfer 1.6-fold more frequently than urban patients. Public insurance covered the majority of discharges, especially for transferred patients. Among pediatric patients admitted by transfer, the most common principal diagnoses were mood disorder (8.9%), other perinatal conditions (8.7%), prematurity (4.8%), asthma (4.2%), and bronchiolitis (3.8%), with transfer proportions of 15%, 36%, 73%, 9%, and 8%, respectively (see Supplemental Table 6 for top 11 through 25 most common principal diagnoses). Approximately 1.7% of pediatric patients admitted by transfer died, compared with only 0.3% of those who were not admitted by transfer (Table 1).

TABLE 2 Profile of Hospital-Level Characteristics for Pediatric Hospitalizations for Transfers and Nontransfers for 0- to 20-Year-Olds Nationally, 2012

Posttransfer Hospital Characteristics	Transferred (N = 263 367)[a]		Not Transferred (N = 5 688 568)[a]		Proportion Transferred, %	P[b]
	n	%	*n*	%		
Children's hospital						<.001
Not freestanding	181 881	(69.1)	5 192 746	(91.3)	3.4	
Freestanding	81 486	(30.9)	495 822	(8.7)	14.1	
Hospital bed size						.14
Small	23 810	(9.0)	618 145	(10.9)	3.7	
Medium	56 383	(21.4)	1 403 184	(24.7)	3.9	
Large	183 174	(69.6)	3 667 238	(64.5)	4.8	
Location and teaching status						<.001
Rural	5177	(2.0)	591 786	(10.4)	0.9	
Urban nonteaching	31 473	(12.0)	1 839 835	(32.3)	1.7	
Urban teaching	226 717	(86.1)	3 256 946	(57.3)	6.5	
Ownership						.01
Public, nonprofit	32 003	(12.2)	745 311	(13.1)	4.1	
Private, nonprofit	209 470	(79.5)	4 183 962	(73.6)	4.8	
Private, investor-owned	21 894	(8.3)	759 294	(13.4)	2.8	
Region						.03
Northeast	39 257	(14.9)	990 939	(17.4)	3.8	
Midwest	72 110	(27.4)	1 220 267	(21.4)	5.6	
South	100 187	(38.0)	2 151 166	(37.8)	4.4	
West	51 813	(19.7)	1 326 195	(23.3)	3.8	

[a] Unweighted transfers = 187 096. Unweighted nontransfers = 2 493 120. Transfers include hospitalizations with an admission source from another inpatient hospital or emergency department. Nontransfers include hospitalizations with a nontransfer admission source. Excluding neonatal hospitalizations resulted in N = 198 564 for transfers and N = 1 904 030 for nontransfers (unweighted = 141 536 and 1 350 039, respectively).

[b] P values refer to comparisons between transfers and non-transfers. Determined by using univariate survey-weighted logistic regression analysis based on a likelihood ratio test for variation among levels.

Aggregate charges for all pediatric hospitalizations admitted via transfer in 2012 were $19.5 billion. Although these transfers comprised 4.4% of hospital discharges, they represented 15.2% of aggregate charges. After removing neonatal hospitalizations, nonneonatal, nonpregnancy hospitalizations admitted via transfer represented 12.0% of aggregate charges.

Characteristics of receiving hospitals are shown in Table 2. Among the pediatric patients admitted by transfer, 30.9% of them were hospitalized at freestanding children's hospitals. By comparison, only 8.7% of patients with routine admission were hospitalized at freestanding children's hospitals. The posttransfer hospitals were rural (2.0%), urban nonteaching (12.0%), and urban teaching (86.1%), with transfer proportions of 1%, 2%, and 6%, respectively.

Characteristics Associated With Transfer

In multivariable analysis, patient factors associated with higher odds of being admitted by transfer rather than routinely admitted included having a neonatal principal diagnosis, age >1 year, male gender, white race (versus black, Hispanic, and Asian), nonprivate insurance, rural residence, higher illness severity, and weekend admission (Table 3). Relative to the most frequent principal diagnosis category (mood disorders), other perinatal conditions, prematurity, bronchiolitis, and cardiac anomalies had higher odds of admission by transfer, whereas asthma, pneumonia, appendicitis, and diabetes had lower odds of admission by transfer.

When we removed patients aged 18 to 20 years from the multivariable model, the results were unchanged. Similarly, when we removed discharges from hospitals that did not report race/ethnicity, the results did not substantively change. However, when we stratified the model by hospital location/teaching status, the association between race/ethnicity and the odds of admission by transfer differed between strata. Among urban teaching hospitals, white patients had significantly higher odds of admission via transfer than black (0.76; (95% CI: 0.69–0.85), Hispanic (0.73; 95% CI: 0.65–0.82), and Asian (0.65; 95% CI: 0.57–0.73)) patients. However, among urban nonteaching and rural hospitals, the odds of admission via transfer varied little by race/ethnicity: black (0.97; 95% CI: 0.85–1.11), Hispanic (1.11; 95% CI: 0.84–1.46), and Asian (0.81; 95% CI: 0.67–0.97).

DISCUSSION

This nationally representative study of pediatric transfers between acute-care

TABLE 3 Patient Characteristics Associated With Being Admitted by Transfer Rather Than Routinely Admitted for Hospitalized 0- to 20-Year-Olds Nationally, 2012

	Unadjusted OR, 95% CI	Adjusted OR, 95% CI	*P*
Principal diagnosis			<.001
Mood disorder	Ref	Ref	
Other perinatal conditions	2.91, 2.41–3.50	10.26, 8.56–12.29[a]	
Prematurity	11.47, 8.78–14.98	35.96, 27.92–46.32[a]	
Asthma	0.55, 0.45–0.66	0.66, 0.55–0.80[a]	
Bronchiolitis or bronchitis	0.51, 0.42–0.61	1.60, 1.32–1.95[a]	
Pneumonia	0.45, 0.38–0.54	0.50, 0.42–0.60[a]	
Seizure or epilepsy	0.76, 0.63–0.91	0.87, 0.71–1.06	
Appendicitis	0.44, 0.35–0.54	0.54, 0.44–0.67[a]	
Diabetes mellitus	0.82, 0.68–0.99	0.70, 0.58–0.85[a]	
Cardiac congenital anomalies	1.46, 1.20–1.78	3.16, 2.53–3.94[a]	
Other	0.16, 0.14–0.19	0.42, 0.36–0.49[a]	
Age group, y			<.001
0–1	Ref	Ref	
2–5	3.74, 3.33–4.20	4.32, 3.90–4.78[a]	
6–11	3.94, 3.50–4.44	4.86, 4.37–5.41[a]	
12–18	4.42, 3.90–5.02	5.13, 4.64–5.66[a]	
19–20	2.78, 2.45–3.16	3.15, 2.80–3.53[a]	
Female gender	0.89, 0.87–0.90	0.89, 0.88–0.91[a]	<.001
Race/ethnicity			<.001
White	Ref	Ref	
Black	1.00, 0.89–1.11	0.85, 0.77–0.94[a]	
Hispanic	0.82, 0.72–0.94	0.80, 0.71–0.89[a]	
Asian or Pacific Islander	0.49, 0.41–0.57	0.69, 0.61–0.77[a]	
Other	1.16, 1.00–1.35	1.27, 1.11–1.44[a]	
Insurance status			
Private	Ref	Ref	<.001
Public	1.36, 1.26–1.46	1.30, 1.22–1.38[a]	
Self-pay	1.18, 1.04–1.34	1.23, 1.11–1.36[a]	
No charge or other	1.79, 1.53–2.10	1.46, 1.25–1.72[a]	
Urban residence	0.63, 0.57–0.71	0.64, 0.57–0.71[a]	<.001
Illness severity			<.001
Minor or no loss of function	Ref	Ref	
Moderate loss of function	2.73, 2.60–2.86	1.60, 1.53–1.68[a]	
Major loss of function	4.45, 4.15–4.78	2.62, 2.45–2.80[a]	
Extreme loss of function	10.12, 9.02–11.35	6.26, 5.68–6.91[a]	
Major operating room procedure	0.70, 0.65–0.75	0.82, 0.77–0.89[a]	<.001
Weekend admission	1.37, 1.33–1.41	1.33, 1.29–1.36[a]	<.001
Elective admission	1.36, 1.03–1.81	0.51, 0.41–0.64[a]	<.001

Associations with hospitalizations with an admission source of being transferred from another hospital were compared with hospitalizations with a routine admission source. The multivariable logistic regression model included the covariates that are listed in Table 3. OR, odds ratio; Ref, reference.
[a] Significant adjusted OR with $P < .05$.

hospitals in 2012 found that 4.4% of ~6 million nonpregnancy hospitalizations (and 9.4% of ~2 million nonneonatal, nonpregnancy hospitalizations) were admitted via transfer from another hospital. Expected factors, such as higher illness severity and rural residence, were independent predictors of being admitted via transfer. Certain principal diagnoses, including neonatal diagnoses, bronchiolitis, and mood disorder, were also associated with higher odds of admission by transfer. However, nonclinical factors including white race (compared with black, Hispanic, and Asian race/ethnicity) and having nonprivate insurance (compared with private insurance) were also independently associated with admission via transfer. When we stratified the model by hospital location/teaching status, we found that racial/ethnic variation in the odds of admission by transfer was greater for urban teaching hospitals than for urban nonteaching and rural hospitals. Although this finding may reflect geographic clustering of nonwhite families near urban teaching hospitals, such that nonwhite children are less likely to require interfacility transfer to such hospitals, our finding may also reflect variations in provider and/or patient decision-making.

Neonatal principal diagnoses were associated with higher odds of admission by transfer than other common pediatric diagnoses, consistent with the fact that hospitals are designated on the basis of the level of complexity of newborn care provided.[7] Because neonatal hospitalizations demonstrate different transfer patterns and generate disproportionate hospitalization costs, it may be useful to examine neonatal and nonneonatal transfer patterns separately.[35]

We also found that bronchiolitis had higher odds of admission by transfer in comparison with other common principal diagnoses. The majority of patients hospitalized with bronchiolitis are <6 months of age, which might affect the comfort level of referring providers.[39] Furthermore, pediatric patients are sometimes transferred based on the future possibility of requiring specialty services such as intensive care.[40] Because bronchiolitis is a dynamic disease process, these patients might be transferred in anticipation of future clinical needs. Outcomes research is needed to better understand when it is worthwhile to transfer patients with bronchiolitis.

Similarly, mood disorders warrant further study as the most common principal

diagnosis admitted by transfer. Whereas diagnoses such as asthma, pneumonia, or appendicitis can be managed without pediatric specialists, mood disorders often require mental health providers and specialty resources. Interestingly, children's hospitals have a lower proportion of mental health hospitalizations than general hospitals, indicating that general hospitals deliver more inpatient psychiatric services than freestanding children's hospitals.[22] Federal health policies have targeted pediatric mental health as an area for quality improvement.[41] Given our findings, further research to understand transfer practices for pediatric mood disorders is warranted.

Although our study found associations between principal diagnoses and admission by transfer, we also found associations with nonclinical factors. The importance of developing improved understanding of racial differences in pediatric transfer practices is supported by previously published data showing race-related delays in transfers of adult patients. For example, black adults needing revascularization for acute myocardial infarction are transferred more slowly than white adults.[13] Furthermore, a previous study using an adult national sample found that white patients had higher odds of transfer than either black or Hispanic patients, consistent with our results.[19] Regarding gender differences, we found a statistically significant association between gender and admission by transfer, but the adjusted odds ratio was nearly 1 and perhaps not clinically significant. Similar to our results, adult studies have found that women are less likely to be transferred than men.[19,26] Additional investigations are needed to determine if racial and gender differences in pediatric transfers occur at the patient, geographic, institutional, or provider level, and whether these differences affect patient outcomes. Although our study raises concern for an association between race/ethnicity and admission by transfer, our results must be interpreted cautiously because of the prevalence of missing race/ethnicity data in KID.

We also found that public insurance (in comparison with private insurance) was associated with higher odds of admission by transfer. We hypothesized that insurance status might influence transfer practices in that hospitals may perceive patients with public insurance or no insurance to be less economically desirable than patients with private insurance. Previous adult and neonatal studies examining transfers and insurance status have reported mixed results.[2,15,19,26] Clearly, research examining transfer practices is sparse, and additional investigations are required to evaluate the quality of care associated with pediatric transfers.[11]

The aggregate charges for pediatric hospitalizations admitted via transfer are high relative to their frequency among all hospitalizations, consistent with previously published findings that patients admitted by transfer have longer lengths of stay and consume more hospital resources than those not admitted by transfer.[42–44] We did not have information about patients' pretransfer hospitalizations and thus could not estimate the overall hospital charges incurred by patients who were transferred.

Our study had several limitations. Although we demonstrated demographic and clinical variation in the odds of admission by transfer, we could not account for other explanations for these results. A limitation of the KID is the absence of identifiers to permit linkage among multiple discharges per individual. A linked database would allow evaluation of characteristics of both the source and the destination facility. Additionally, the KID contained a large proportion of missing race/ethnicity data, limiting our ability to understand the relationship between race/ethnicity and hospital transfer practices. Lastly, we could not examine appropriateness of transfer for individual patients, acknowledging the roles of other factors such as hospital-hospital arrangements, payment agreements, resource limitations, and patient preferences. Despite these limitations, we are able to provide a robust profile of pediatric hospital transfers in the United States.

CONCLUSIONS

Interfacility transfers occur in nearly 1 in 10 nonneonatal, nonpregnancy pediatric hospitalizations. Certain principal diagnoses, such as neonatal diagnoses, bronchiolitis, and mood disorders, were associated with increased odds of admission by transfer. After adjusting for such clinical factors and rural residence, demographic factors were still significantly associated with the odds of admission by transfer. Minority patients, female patients, and those with private insurance were less likely to be admitted by transfer than white patients, male patients, and those with nonprivate insurance. Further investigations using data sets that link pre- and posttransfer hospitalizations would help to confirm whether nonclinical factors are associated with higher odds of admission by transfer. Additional research may be needed to identify the etiologies and effects of these variations in transfer practices.

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