Resource Utilization Among Adult Congenital Heart Failure Admissions in Pediatric Hospitals

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We sought to analyze the trends and resource utilization of adult congenital heart disease (ACHD)-related heart failure admissions at children's hospitals. Heart failure admissions in patients with ACHD continue to rise at both pediatric and adult care facilities. Data from the Pediatric Health Information Systems database (2005 to 2015) were used to identify patients (≥18 years) admitted with congenital heart disease (745.xx-747.xx) and principal diagnosis of heart failure (428.xx). High resource use (HRU) admissions were defined as those over the 90th percentile. There were 562 admissions (55.9% male) across 39 pediatric hospitals. ACHD-related heart failure admissions increased from 4.1% in 2006 to 6.3% in 2015 (p = 0.015). Median hospital charge for ACHD-related heart failure admissions was $59,055 [IQR $26,633 to $156,846]. Total charges increased with more complex anatomic category (p = 0.049). Though HRU admissions represented 10% of ACHD-related heart failure admissions, they accounted for >66% of the total charges. The median total hospital charges for HRU admissions were $1,018,656 [IQR $722,574 to $1,784,743], compared with $58,890 [IQR $26,456 to $145,890] for non-HRU admissions (p < 0.001). Inpatient mortality rate (26.3% vs 4.0%) and the presence of ≥2 comorbidities (68% vs 31%) were higher for HRU admissions (p < 0.001). On multivariable analysis, technology dependence (aOR: 4.4, p < 0.001) and renal comorbidities (aOR: 3.0, p = 0.04) were associated with HRU.

In conclusion, heart failure-related ACHD admissions in pediatric hospitals are increasing. Compared with non-HRU, HRU admissions had higher inhospital mortality and greater comorbidities. Additional care strategies to reduce resource use among these patients and improve overall quality of care merits further study. **(Am J Cardiol 2019;123:839−846)**

Background

Adults with congenital heart disease (CHD) now outnumber children with CHD.[1] Hospitalizations for adult CHD (ACHD) patients have doubled over the past 20 years, with higher rates of admissions than the general population.[2−10] Heart failure is common in patients with ACHD and is one of the leading causes of death.[11−13] Understanding patterns and determinants of resource utilization in ACHD-related heart failure admissions may help identify patient characteristics associated with increased in-hospital risk for resource utilization, especially among those with high resource utilization (HRU). Despite the important role that pediatric hospitals play in the care of ACHD patients, resource utilization of these patients when admitted to children's hospitals is understudied. The purpose of this study was to: (1) characterize heart failure-related ACHD hospitalizations in pediatric hospitals in the United States and (2) identify any chronic condition categories that may contribute to HRU among ACHD-related heart failure admissions in pediatric hospitals.

Methods

The study protocol was approved by Children's National Health System Institutional Review Board for the protection of human subjects. We obtained data from the Pediatric Health Information System (PHIS) [Children's Hospital Association; Lenexa, KS]. PHIS is a multicenter, administrative and billing database of 49 children's hospitals across the United States with the aim to improve quality, enhance performance, and provide safe, effective, and efficient care. Participating hospitals provide discharge data including demographic information as well as diagnoses and procedures that are coded using the *International Classification of Diseases,* 9th and 10th Revision (ICD-9, ICD-10) codes. Data quality assurance is ongoing and data from individual hospitals are accepted when classified errors for a given quarter occur less frequently than a criterion threshold of 2%.

The study design was a multicenter, retrospective cohort investigation of all patients admitted to a children's hospital participating in the PHIS database. To identify ACHD-related heart failure admissions, we selected admissions with an ICD-9-CM code indicating congenital heart disease (745.0 to 747.9) and an admitting and/or primary ICD-9-CM code indicating heart failure (428.XX). Adult patients

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See page 846 for disclosure information.

Funding: None.

Relation with industry: None.

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0002-9149/
https://doi.org/10.1016/j.amjcard.2018.11.033

greater than or equal to the age of 18 years admitted to the hospital between October 1, 2005 and September 30, 2015 were included. Given the limitations of administrative databases, an internal audit was performed of admissions at our medical center to ensure documentation accuracy of the dataset. Within the PHIS data from our center, there was 100% congruence with adult congenital heart disease admissions for heart failure.

Admission characteristics examined included demographics (age, gender, race), diagnosis codes, insurance type, chronic medical conditions (categorized by organ system), length of stay (LOS), discharge status (discharged to home, rehabilitation facility, nursing facility, or inpatient death), and hospital charges. Categories of chronic conditions were used as a surrogate for comorbidities. They were identified using a classification system roughly divided by organ system.[14] Each patient's residential zip code was used to identify the median household income for the calendar year 2015 using the American Community Survey. We categorized payor status into government-sponsored (Medicare, Medicaid, Title V, other government) or nongovernment-sponsored (private, self-pay, other) insurance. To adjust for anatomic complexity, we classified each patient according to the categories defined by the American College of Cardiology Task Force.[15] This method assigns CHD into one of three categories whereby complexity was categorized as simple (e.g. isolated congenital aortic or mitral valve disease, small atrial septal defect, mild pulmonic stenosis, ventricular septal defect), moderate (e.g. atrioventricular canal defects, Ebstein's anomaly, Tetralogy of Fallot), or great severity and complexity (e.g., common ventricle, double-outlet ventricle, Fontan procedure, mitral atresia, transposition of the great arteries). Single ventricle patients were those with common ventricle, hypoplastic left heart syndrome, and congenital tricuspid atresia. We used hospital charges as a surrogate for resource utilization. Inpatient charges were adjusted for regional differences. We accounted for inflation by adjusting charges based on the Consumer Price Index for Hospital and related services for the 2015 US dollar (FRED Economic Data, Federal Reserve of St. Louis). Total hospital charges per day were calculated for each admission based on the LOS for that encounter. Inpatient charges were also categorized as follows: clinical, imaging, laboratory, pharmacy, supply, other service charges. Supply charges include all medical, surgical, and nursing supplies, including cardiovascular devices and prostheses. Imaging charges include diagnostic services such as radiography, angiography, echocardiography, computed tomography, MRI, and nuclear medicine, but exclude cardiac catheterization and coronary angioplasty, which are considered clinical charges. Clinical charges reflect any clinical service rendered by a health care provider by subspecialty. "Other charges" include charges for room, board, and nursing, as well as other ancillary services such as discharge planning and social services.

We examined the distribution of total hospital charges for all ACHD-related heart failure admissions and defined admissions with total charges above the 90th percentile as HRU admissions. We also examined each center and the proportion of HRU admissions and defined HRU centers as centers with ≥10% HRU ACHD-related heart failure admissions. We used the total number of ACHD admissions during the study period as a surrogate for ACHD center volume. Of the 49 hospitals in the PHIS database, 39 had complete inpatient admission data available for the study period. We examined the distribution of total number of ACHD admissions for all 39 centers of those centers and defined centers with a volume of admissions in the top quartile as high volume centers (HVC). Centers with ≥10% of ACHD-related heart failure admissions with HRU were defined as high resource use centers (HRUC).

We examined the distribution of baseline admission characteristics for ACHD-related heart failure admissions and calculated the proportion of ACHD-related heart failure admissions. We analyzed the total hospital charges and charges by category for HRU admissions compared with non-HRU admissions. Categorical data was examined using Fisher's exact test and continuous data was examined using the Wilcoxon rank sum test. Groups of categorical data were compared using chi-square test. Groups of continuous data were compared using ANOVA.

We modeled the likelihood of being an admission with HRU with patient-level characteristics (age, gender, race, chronic medical conditions, anatomic complexity, and insurance status) and admission characteristics (use of emergency department) using generalized estimated equations models, which account for correlation among different admissions within the same hospital. Characteristics with p values <0.1 in bivariate analysis were considered for inclusion into a multivariable model for HRU. A p value of <0.05 was required for retention in the final model. Odds ratios and 95% confidence intervals for HRU were then estimated. All statistical analyses were performed using IBM SPSS Statistics (Version 25.0) [IBM Corp.; Armonk, NY].

Results

There were 562 encounters. The proportion of heart failure admissions was 4.1% of all ACHD admissions in 2006 and 6.3% of all ACHD admissions in 2015 ($p < 0.001$, Figure 1).

Admission characteristics are summarized in Table 1. Median age on admission was 23 years [IQR 19 to 32 years], ranging from 18 to 58 years. The majority of ACHD-related heart failure admissions had severe anatomic complexity (n = 338, 60.1%). Across all age groups, single ventricle was the most common anatomical subtype, although transposition of the great arteries was similar in proportion in patients ≥35 years of age. A single medical comorbidity was present in 39.5% of admissions, with two comorbidities occurring in 37.5% of admissions. The most frequent procedure performed during admission was right and/or left heart catheterization (Table 2). Over the study period (2005 to 2015), the mean LOS remained stable from 2005 to 2015 ($p = 0.847$). The mean charges per hospital day also remained stable across the study period ($p = 0.610$, Figure 2).

Median LOS was 7 days [IQR 3 to 12 days]. Median intensive care unit (ICU) LOS was 5 days [IQR 2 to 9 days]. Most patients [n = 443; 78.8%] were discharged home. There were 34 admissions (6.0%) that were

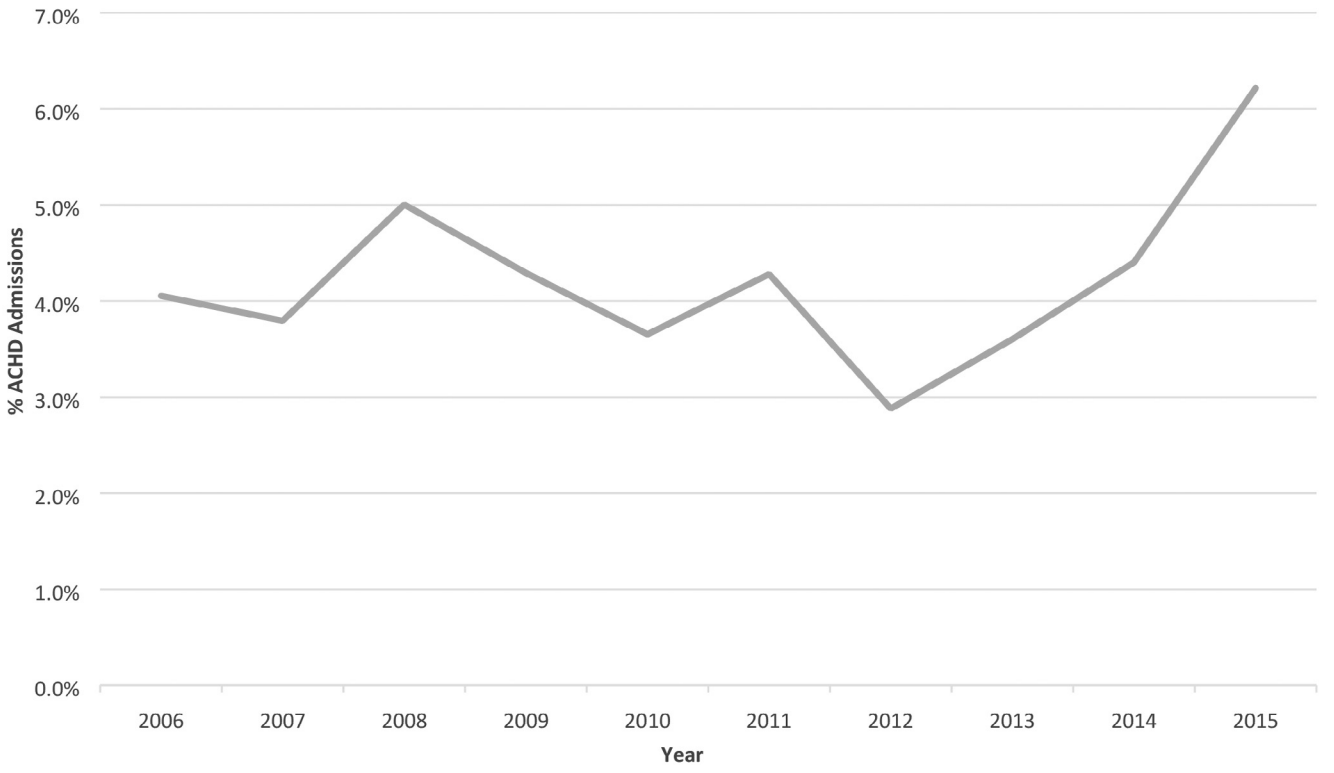

Figure 1. Adult congenital heart disease (ACHD)-related heart failure admissions from 2006 to 2015 in pediatric hospitals as a proportion of all heart failure admissions. The proportion of ACHD-related heart failure admissions increased from 4.1% in 2006 to 6.3% in 2015.

discharged to a short-term rehabilitation facility, intermediate care facility, or skilled nursing facility, and 24 admissions (4.3%) were discharged with home health services. There were a total of 35 in-hospital deaths, resulting in an unadjusted mortality rate of 6.2%. Mortality rates were similar across age groups: age 18 to 24 years (n = 304) had a mortality rate of 6.3%, age 25 to 34 years (n = 152) had a mortality of 6.6%; age ≥35 years (n = 107) had a mortality rate of 5.7% (p = 0.801).

Median hospital charges for ACHD-related heart failure admissions were $59,055 [IQR $26,633 to $156,846]. Median total hospital charges were examined by anatomy for ACHD-related heart failure admissions. Total charges increased with more complex anatomic category (p = 0.049). Admission by way of the emergency room occurred in 35.4% of patients, and 53.4% of all admissions required admission to the intensive care unit.

The 90th percentile threshold for total hospital charges defining HRU admissions was $500,977 (Figure 3). HRU admissions (57 admissions) represented 10% of all ACHD-related heart failure admissions but accounted for more than 66% of the total charges. Despite no difference in anatomic complexity between HRU and non-HRU admissions, HRU admissions were younger, had longer LOS and ICU LOS, and higher unadjusted inpatient mortality rate. Total hospital charges per day were also 4 times more in HRU admissions (Table 3).

The median total hospital charges for HRU admissions were $1,018,656 [IQR $722,574 to $1,784,743], compared with $58,890 [IQR $26,456 to $145,890] for non-HRU admissions ($p < 0.05$). Total charges were examined by category: pharmacy, laboratory, imaging, clinical, supply, and other charges. HRU admissions consistently, but not uniformly, accrued higher charges across each category (all $p < 0.05$, Figure 4). The two most costly categories for HRU admission were "other charges" (including room and nursing) [median charge $327,399 [IQR $208,075 to $580,377] vs $27,412 [IQR $12,371 to $62,423] for non-HRU] and clinical charges [median charge $223,315 [IQR $118,187 to $380,925] vs $5,801 [IQR $1,259 to $19,732] for non-HRU].

The top quartile threshold for number of admissions for HVC was 494 ACHD admissions (n = 10 centers). The median age on admission at HVC was 28 years [20 to 35 years] compared with 21 years [19 to 25 years] at non-HVC ($p < 0.0001$). LOS was 6 days [3 to 13 days] at HVC and 5 days [3 to 11 days] at non-HVC (p = 0.3371). Forty-five percent of admissions required ICU-level care at HVC compared with 66.5% of admissions at non-HVC ($p < 0.0001$). ICU LOS was 4 days [2 to 9 days] at both HVC and non-HVC. Inpatient mortality was 5.8% at HVC and 7.0% at non-HVC (p = 0.5685). HRU admissions were present in 7.3% of admissions at HVC and 11.6% of admissions at non-HVC (p = 0.0828).

There were 18 centers with ≥10% of HRU admissions. There was no difference between HRUC and non-HRUC for age (p = 0.801). There was a higher proportion of patients with complex congenital heart anatomies admitted to non-HRUC. Total charges for ACHD-related heart failure admissions at HRUC were $16,000 more and total

Table 1
Adult congenital heart disease-related heart failure admission characteristics stratified by high resource utilization

Variables	Total (n = 562) n (%)	HRU (n = 57)	Non-HRU (n = 505) n (%)	p value
Admit Age (years)				
18 to 19	143 (25.4%)	20 (35.1%)	123 (24.3%)	0.076
20 to 24	161 (28.6%)	19 (33.3%)	142 (28.1%)	0.411
25 to 34	152 (27.0%)	11 (19.3%)	141 (27.9%)	0.166
35+	106 (18.9%)	7 (12.3%)	99 (19.6%)	0.182
Age (years)	23 (19-32%)	21 (19-27%)	24 (20-32%)	0.012
Male	314 (55.9%)	30 (52.6%)	284 (56.2%)	0.604
White	398 (70.8%)	41 (71.9%)	357 (70.7%)	0.850
Black	97 (17.3%)	8 (14.0%)	89 (17.6%)	0.496
Asian	17 (3.0%)	1 (1.8%)	16 (3.2%)	0.561
American Indian	1 (0.2%)	0 (0.0%)	1 (0.2%)	N/A
Other	37 (6.6%)	5 (8.8%)	32 (6.3%)	0.470
Not reported	12 (2.1%)	2 (3.5%)	10 (2.0%)	0.460
Gastrointestinal	78 (13.9%)	12 (21.1%)	67 (13.3%)	0.109
Hematologic or Immunologic	41 (7.3%)	9 (15.8%)	32 (6.3%)	0.009
Malignancy	14 (2.5%)	1 (1.8%)	13 (2.6%)	0.715
Metabolic	64 (11.4%)	14 (24.6%)	50 (9.9%)	<0.001
Neurologic or neuromuscular	42 (7.5%)	10 (17.5%)	32 (6.3%)	0.002
Other congenital or genetic defect	75 (13.3%)	6 (10.5%)	69 (13.7%)	0.502
Renal	101 (18.0%)	8 (14.0%)	12 (2.4%)	<0.001
Respiratory	20 (3.6%)	22 (38.6%)	79 (15.6%)	<0.001
Technology dependent	290 (51.6%)	48 (84.2%)	242 (47.9%)	<0.001
Number of comorbidities				
0	129 (23.0%)	4 (7.0%)	132 (26.1%)	0.001
1	222 (39.5%)	14 (24.6%)	217 (43.0%)	0.008
2+	211 (37.5%)	39 (68.4%)	156 (30.9%)	<0.001
Anatomic complexity				
Simple	109 (19.4%)	9 (15.8%)	100 (19.8%)	0.470
Moderate	50 (8.9%)	5 (8.8%)	45 (8.9%)	0.980
Great	338 (60.1%)	40 (70.2%)	298 (59.0%)	0.102
Unassigned	65 (11.6%)	3 (5.3%)	62 (12.3%)	0.118
Median household income (2015 $USD)				
<$30,000	103 (19.6%)	14 (24.6%)	89 (17.6%)	0.196
$30,000 to $100,000	436 (82.9%)	40 (70.2%)	396 (78.4%)	0.160
>$100,000	10 (1.9%)	3 (5.3%)	7 (1.4%)	0.036
Not reported	13 (2.3%)	0 (0.0%)	13 (2.6%)	N/A
Payor status				
Private	219 (39.0%)	25 (43.9%)	194 (38.4%)	0.420
Government	290 (51.6%)	28 (49.1%)	262 (51.9%)	0.689
Self-pay	16 (2.8%)	1 (1.8%)	15 (3.0%)	0.608
Other	24 (4.3%)	1 (1.8%)	23 (4.6%)	0.325
Unknown	13 (2.3%)	2 (3.5%)	11 (2.2%)	0.538
Emergency department services	199 (35.4%)	14 (24.6%)	185 (36.6%)	0.073

charges per day were $1,000 more than admissions at non-HRUC (Table 4).

Two or more comorbidities on admission were present in 68.4% of HRU admissions compared with 30.9% of non-HRU admissions ($p < 0.001$). On multivariable analysis, admissions with a technology dependent (including tracheostomy tube, need for positive pressure ventilation, and gastrostomy tube) comorbidity had a fourfold greater adjusted odds for HRU. Admission with a renal (including congenital anomalies, chronic renal failure, and chronic bladder diseases) comorbidity had a threefold greater adjusted odds for HRU (Table 5).

Table 2
Most common procedures performed during heart failure admissions

Right and/or left heart catheterization	78 (13.9%)
Venous catheter placement	40 (7.1%)
Heart transplantation	31 (5.5%)
Percutaneous abdominal drainage	23 (4.1%)
Packed cell transfusion	14 (2.5%)

Discussion

Our study demonstrates an increasing number and proportion of ACHD-related heart failure admissions in pediatric hospitals in the 10-year study period. Generally, adult survivors of pediatric illness accrue a disproportionate

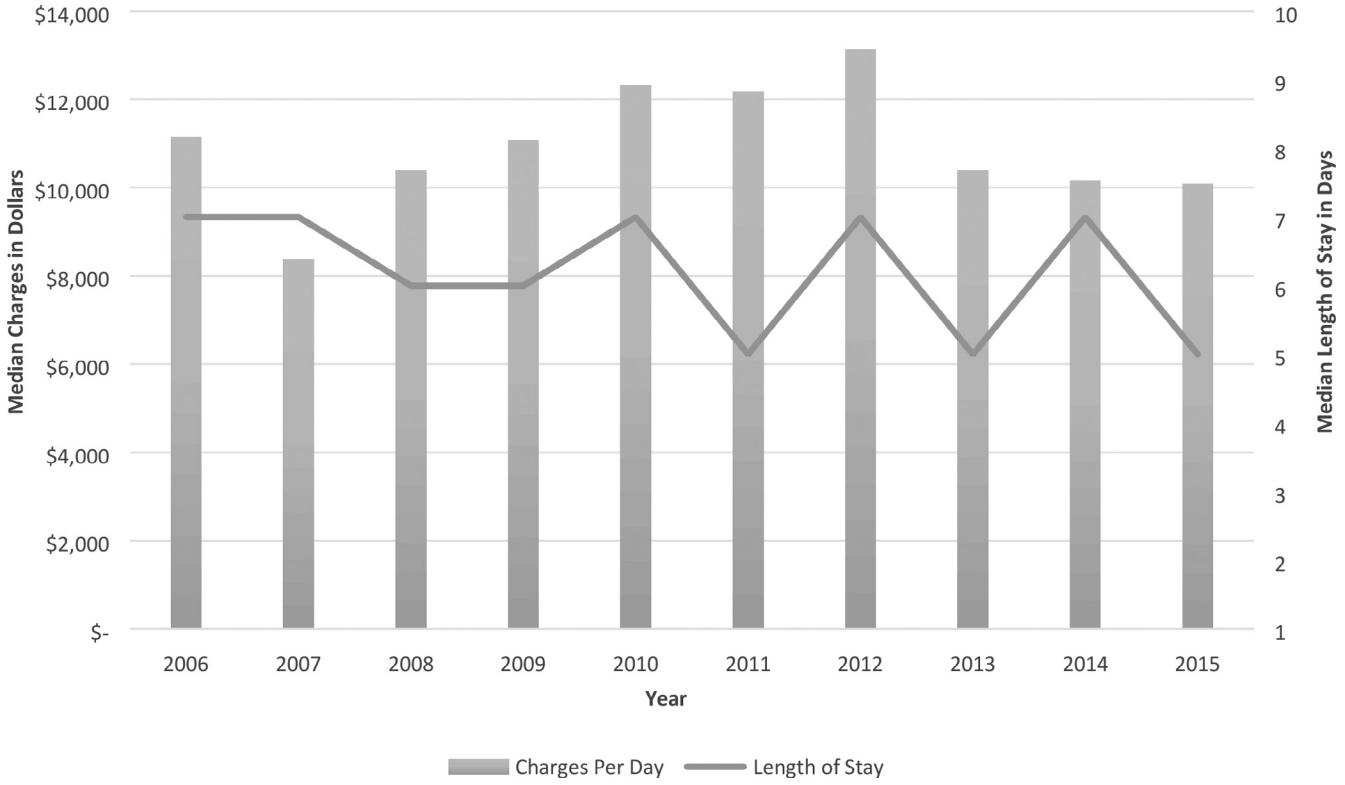

Figure 2. Trends of median total hospital charges per patient day versus median length of stay across the study period. The hospital charges and length of stay remained the same across the study period.

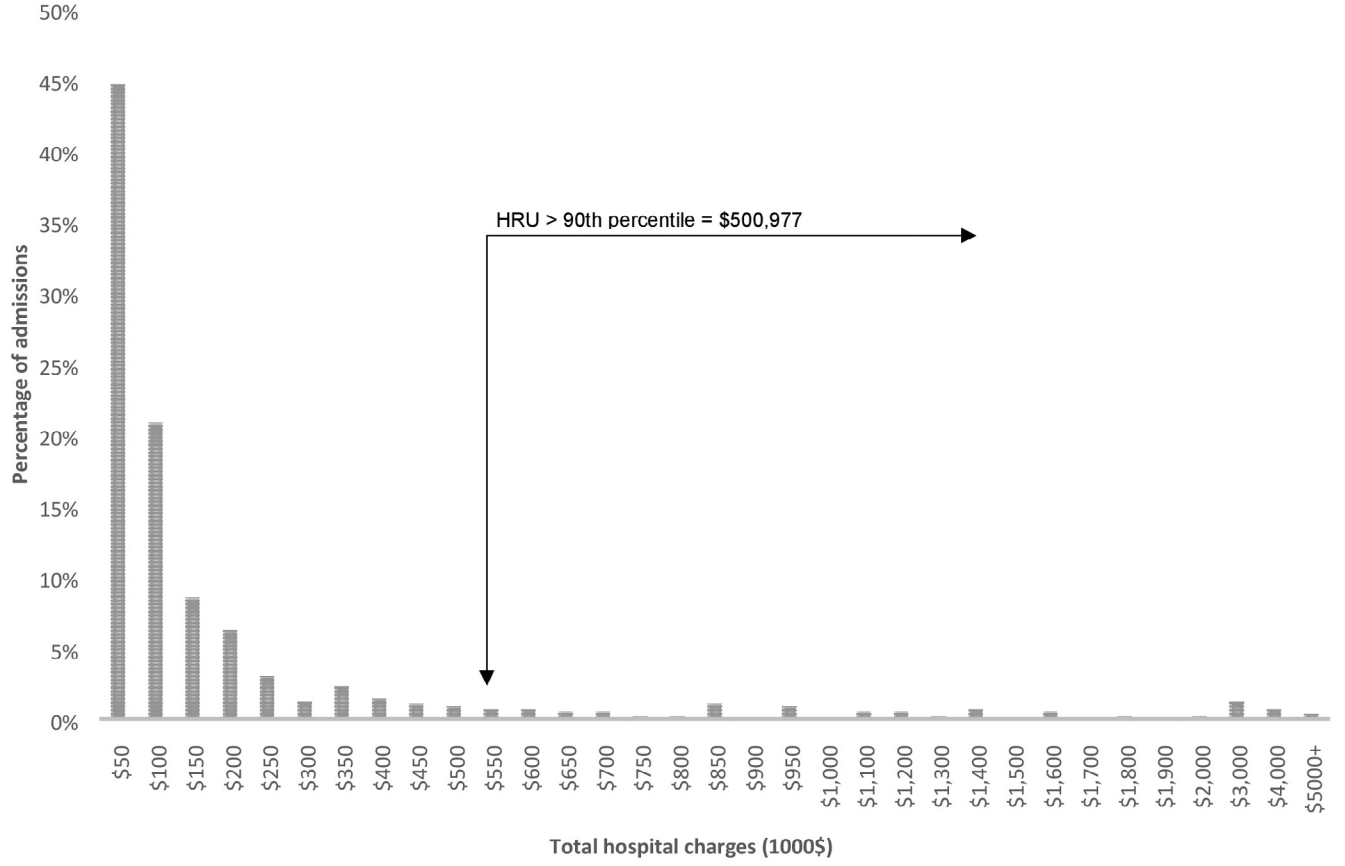

Figure 3. Distribution of total hospital charges for 562 ACHD-related heart failure admissions from 2005 to 2015. HRU indicates high resource use.

Table 3
Unadjusted adult congenital heart disease-related heart failure admission characteristics and outcomes by resource utilization

	HRU (n = 57)	Non-HRU (n = 505)	p value
LOS, days	31 (44 to 75)	5 (3 to 9)	<0.001
ICU LOS, days	15 (21.5 to 39.5)	3 (2 to 6)	<0.001
ICU, n (%)	54 (94.7)	263 (52.1)	<0.001
Inpatient mortality rate, n (%)	15 (26.3)	20 (4.0)	<0.001
Total hospital charges, $1000	$1,019 ($723 to $1,785)	$59 ($26 to $146)	<0.001
Total hospital charges per day, $1000	$24.8 ($17.7 to $31.4)	$7.2 ($10.2 to $14.8)	<0.001

HRU = high resource use, LOS = length of stay, ICU = intensive care unit.

amount of total inpatient charges.[16] The annual adjusted hospital charges for adults with conditions of childhood-onset who receive care in children's hospitals are estimated to exceed $1 billion.[16] In our study, although HRU admissions represented only 10% of all ACHD-related heart failure admissions, they accounted for more than two-thirds of the total hospital charges for all ACHD-related primary heart failure admissions. We also found that a large proportion of these adults utilize the emergency room before admission, require ICU-level care, and subsequently have longer ICU stays.

Single ventricle and transposition of the great arteries were the two most common anatomical subtypes. We found a large proportion of younger patients admitted for heart failure had single ventricle physiology, presumably indicative of failing Fontan physiology. This observation corresponds with another study identifying the highest incidence of heart failure was in patients with single-ventricle physiology.[17] Not surprisingly, transposition of the great arteries was the most common anatomical subtype amongst older patients (≥35 years). Within this age group, patients most likely had previously undergone an atrial switch operation in childhood and were subsequently presenting with a failing systemic right ventricle. We also demonstrated that with greater anatomic complexity, there is a trend for higher hospital charges.

A recent study evaluated outcomes of heart failure-related admissions in adults with congenital heart disease in hospitals in the United States using the National Inpatient Sample (NIS).[18] Although the NIS database is comprised of a sample of both adult and pediatric hospitals, it is predominantly adult hospital data. As a result, the cohort in the previous NIS study was older than this study, with 5.8% of patients age 18 to 30 in the NIS study versus 81% of patients age 18 to 34 in our study. In spite of the difference in age, LOS (7.6 days vs 7 days) and total hospital charges ($68,384 vs $73,000 per admission) were not markedly different between the two studies. However, in spite of similar LOS and total charges, in-

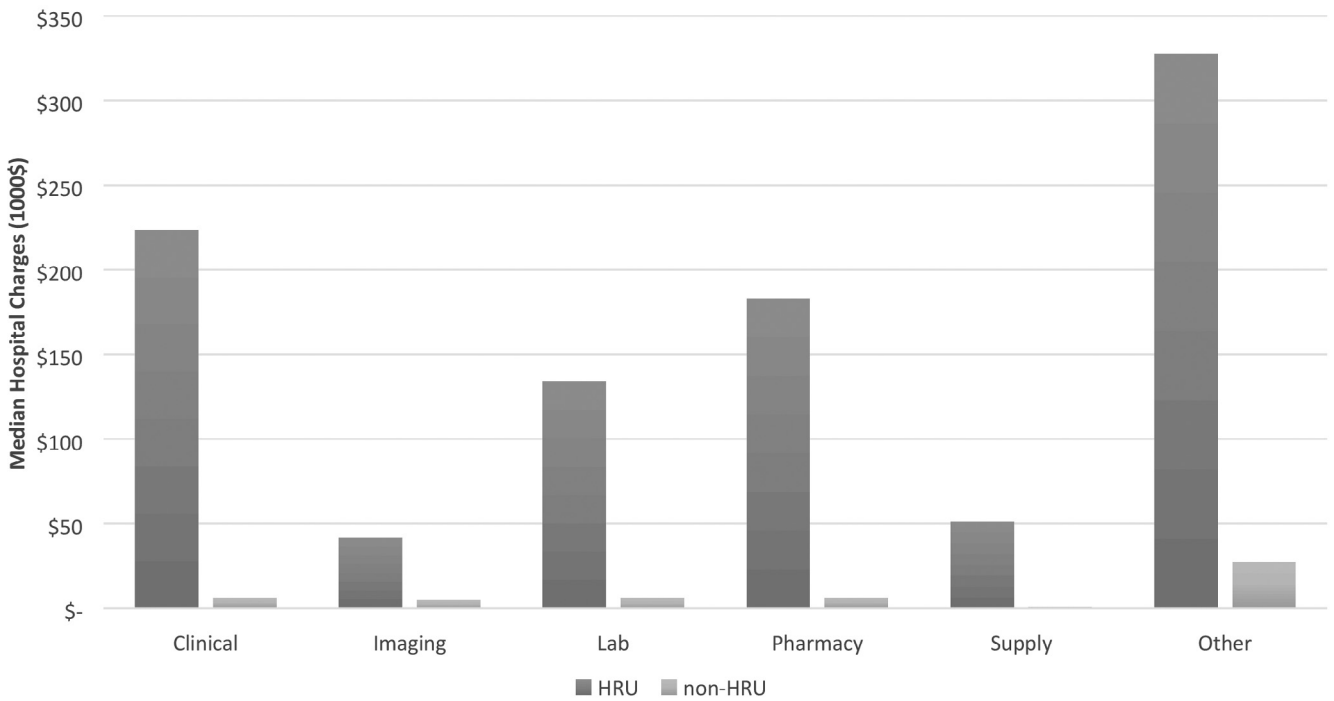

Figure 4. Total hospital charges for high resource use (HRU) admissions compared with non-HRU admissions by category. HRU admissions consume 38 times the clinical resources, 9 times the imaging resources, 24 times the laboratory resources, 32 times the pharmacy resources, 58 times the supply resources, and 12 times other resources than non-HRU admissions.

Table 4
Adult congenital heart disease-related heart failure admission characteristics and outcomes stratified by centers with high proportion of high resource utilization

	HRUC (18 centers, n = 228)	Non-HRUC (20 centers, n = 334)	p value
Age (years)	22 (19 to 30)	24 (20 to 32.75)	0.055
Male	132 (57.9%)	182 (54.5%)	0.426
Great anatomic complexity	152 (66.7%)	186 (55.7%)	0.009
LOS (days)	7 (4 to 15.25)	5 (2.25 to 11)	<0.001
ICU LOS (days)	6 (2-15)	3 (2 to 6.25)	<0.001
ICU	144 (63.2%)	156 (46.7%)	<0.001
ACHD HRU heart failure admissions (%)	21 (15 to 32)	0 (0 to 7)	<0.001
ACHD admissions	303 (103 to 477)	234 (170.5 to 483.5)	0.631
ACHD heart failure admissions	9 (5.25 to 17)	9 (6 to 13)	0.881
Inpatient mortality rate	11 (4.8%)	24 (7.2%)	0.248
Total hospital charges, $1000	$68 ($32 to $281)	$52 ($25 to $121)	<0.001
Total hospital charges per day, $1000	$11 ($8 to $18)	$10 ($7 to $15)	0.019

ACHD = adult congenital heart disease, HRU = high resource use, HRUC = high resource use center, ICU = intensive care unit, LOS = length of stay.

hospital mortality was lower in the NIS study, 4.1% compared with 7.3% in our study. When viewed in light of a more recent NIS study that reported charges in HRU heart failure admissions (congenital and noncongenital) at adult hospitals were $115,427, this suggests the increased mortality in PHIS hospitals may be related to more complicated admissions, such as patients with single ventricle subtypes.[19] This population has been shown to have numerous multiorgan system disease and the resulting comorbidities contribute to increased resource utilization and mortality rates.[20] The subspecialty expertise to manage these patients may not be as readily available at pediatric centers.

We demonstrated that ACHD-related heart failure HRU admissions had higher inpatient mortality and increased LOS, despite mean LOS and charges for all heart failure admissions were consistent over the study period. We also demonstrated that HRU admissions had higher charges across all charge categories, with an almost 60-fold increase for charges in certain categories in admissions with HRU. A larger proportion of admissions at non-HVC were admitted to the ICU. In addition, while there was no difference in total ACHD admissions or ACHD heart failure admissions between HRUC and non-HRUC, HRUC had more admissions with greater anatomic complexity with longer ICU and total LOS, in addition to higher inpatient mortality, total hospital charges, and total hospital charges per day. A possible reason for the spike in admissions after 2012 is the increased proportion of single ventricle patients surviving to adulthood. Canadian studies have shown that prevalence of adults with congenital heart disease increased 55% from 2000 to 2010.[21] Adherence to practice guidelines have been shown to reduce mortality in the general (non-ACHD) adult heart failure population.[22] In addition, multidisciplinary heart failure clinics have been shown to reduce heart failure readmissions in this population.[23] Establishing care guidelines and examining the effects of multidisciplinary ACHD and single ventricle survivorship programs will be important next steps as this population continues to expand.

We also found that comorbidities such as renal insufficiency are a powerful predictor of HRU. Renal insufficiency has already been noted to be prognostic in ACHD and is associated with increased mortality.[24,25] This finding continues to emphasize the importance of recognizing certain comorbidities that may help in not only preventing HRU for inpatient admissions.[26] If these patients continue to be admitted to children's hospitals, it will be important to have adequate adult-oriented subspecialty support including availability of consultants and advanced treatments such as dialysis. In addition, establishing guidelines as to which patients are best suited for admission to a pediatric versus adult hospital may improve care for these patients and reduce overall morbidity and mortality.

There are several limitations to using data sources such as PHIS. Administrative data provide limited clinical information and may not have captured other important risk factors for increased resource use. The number of participating hospitals in the PHIS database has been increasing steadily over the last 2 decades; however, because of the ongoing enrollment of hospitals, not all current hospitals have contributed to the dataset over the entire of the study period and were thus excluded from data collection. In our study, we did not account for readmissions and treated each admission from the same patient as an individual encounter. However, each encounter resulted in a different LOS, mortality, and accrued different total charges. It is also important to note this was a study of children's hospitals and outcomes of ACHD-related heart failure admissions

Table 5
Multivariable analysis* of factors associated with high resource utilization

	Adjusted Odds Ratio	95% Confidence Interval	p value
Comorbidity			
Hematologic or immunologic	2.8	(1.16, 6.81)	0.022
Metabolic	2.2	(1.03, 4.54)	0.041
Renal	3.0	(1.04, 8.90)	0.042
Respiratory	2.1	(1.11, 3.94)	0.023
Technology dependent	4.4	(2.05, 9.40)	<0.001

* Generalized estimating equation model included patient-level characteristics (age group, gender, race, comorbidities categories, anatomic complexity, median household income, and insurance status) and admission characteristics (use of emergency department).

in these pediatric hospitals may not be generalized outside of those hospital settings. Adults with congenital heart disease who are admitted for heart failure in a children's hospital likely have a different clinical profile from those admitted in an adult hospital.

Conclusion

The number of adults with congenital heart disease admitted for heart failure in pediatric hospitals is increasing. High resource use admissions were associated with longer LOS and higher mortality in addition to the presence of noncardiac comorbidities. The relation between high resource utilization and certain comorbidities merits further study to identify care strategies to reduce resource use among these patients and improve overall quality of care. Establishing care guidelines and examining the effects of multidisciplinary ACHD and single ventricle survivorship programs will be important next steps as this population continues to increase.

Disclosure

The authors have no conflicts of interest to disclose.

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