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ORIGINAL ARTICLE

Endoscopy and Procedures

Availability and utilization of endoscopic retrograde cholangiopancreatography at children's hospitals

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Abstract

Objectives: No study has explored whether availability of endoscopic retrograde cholangiopancreatography (ERCP) is adequate and equitable across US children's hospitals. We hypothesized that ERCP availability and utilization differs by geography and patient factors.

Methods: Healthcare encounter data from 2009 to 2019 on children with pancreatic and biliary diseases from the Pediatric Health Information System were analyzed. ERCP availability was defined as treatment at a hospital that performed pediatric ERCP during the year of service.

Results: From 2009 to 2019, 37,946 children (88,420 encounters) had a potential pancreatic or biliary indication for ERCP; 7066 ERCPs were performed. The commonest pancreatic diagnoses leading to ERCP were chronic (47.2%) and acute pancreatitis (43.2%); biliary diagnoses were calculus (68.3%) and obstruction (14.8%). No ERCP was available for 25.0% of pancreatic encounters and 8.1% of biliary encounters. In multivariable analysis, children with public insurance, rural residence, or of Black race were less likely to have pancreatic ERCP availability; those with rural residence or Asian race were less likely to have biliary ERCP availability. Black children or those with public insurance were less likely to undergo pancreatic ERCP where available. Among encounters for calculus or obstruction, those of Black race or admitted to hospitals in the West were less likely to undergo ERCP when available.

Conclusions: One-in-four children with pancreatic disorders and one-in-12 with biliary disorders may have limited access to ERCP. We identified racial and geographic disparities in availability and utilization of ERCP. Further studies are needed to understand these differences to ensure equitable care.

KEYWORDS

health equity, hepatobiliary, pancreatitis, pediatric

1 | INTRODUCTION

Since its introduction in 1968, endoscopic retrograde cholangiopancreatography (ERCP) has evolved into an effective therapeutic modality for pancreaticobiliary disorders. Numerous studies show its safety and efficacy in children.[1–10]

Population studies in adults have described regional and racial disparities in the use of ERCP in pancreatic cancer.[11–14] Recent studies utilizing national databases

in children have shed light on indications for, and outcomes of, ERCP at a population-level, though data on national availability and patient and hospital-level factors that impact utilization are limited.[15,16] Data from the INSPPIRE (INternational Study Group of Pediatric Pancreatitis: In search for a cuRE)[7] cohort also provide insight on ERCP utilization and benefit. However, INSPPIRE only captures a subset of patients treated at participating centers, and the denominator of total children at any given center is not documented.[7] A recent survey of pediatric gastroenterologists highlights limitations in ERCP availability; 19% reported that ERCP was not performed at their center and 61% reported that their institutions' arrangement for performing ERCP was inadequate.[17] However, no data using a national database are published on what patient or hospital characteristics inform this lack of availability or if utilization among hospitals differs when ERCP is offered.

Historically, the lower volume of children potentially requiring ERCP has contributed to limited availability of appropriate equipment and access to advanced endoscopists with pediatric expertise. However, assessment of whether the limited availability is adequate and equitable for children with pancreatic and biliary disorders is not clear. Identifying differences in availability, utilization, and outcome metrics of ERCP will help focus advocacy to optimize care for children with pancreatic and biliary disorders.

This is the first study to systematically describe "in-house" ERCP availability (i.e., ERCP provided at the admitting hospital, not requiring transfer) and utilization in a national cohort tracking patients longitudinally. We explored hospital and patient-level characteristics associated with (1) "in-house" ERCP availability for children and adolescents for potential ERCP indications, and (2) ERCP utilization among children seen at hospitals with "in-house" ERCP availability. Both outcomes were stratified by pancreatic and biliary indications given the differences in procedure complexity and potential effects on practice patterns. We hypothesized that differences exist in the "in-house" availability and in utilization of ERCP where it is offered.

What is Known

- Endoscopic retrograde cholangiopancreatography (ERCP) is effective for treating pancreaticobiliary disorders in children and adolescents.
- ERCP remains a highly specialized procedure that may not be available to all patients, an issue partly attributable to equity of distribution of pediatric specialists trained to perform ERCP.

What is New

- A large proportion of children with pancreatic or biliary disorders are admitted to a hospital without in-house ERCP availability.
- In hospitals where ERCP is offered, compared to children from other races, Black children are less likely to undergo ERCP for pancreatic diagnoses, and for biliary calculi or obstruction.
- Children with public insurance are less likely to undergo pancreatic ERCP at centers that perform ERCP.

2 | METHODS

2.1 | Data source

This retrospective cohort study used data from the Pediatric Health Information System (PHIS), an administrative database of inpatient, emergency department, ambulatory surgery, and observation encounter-level data from 49 not-for-profit, tertiary care pediatric hospitals in the United States of America that are affiliated with the Children's Hospital Association (CHA). For the study period, data from 46 hospitals were available.

2.2 | Study population

We identified hospital encounters for pancreatic and biliary diagnoses that indicated potential need for ERCP in children and young adults (1 to ≤21 years old at time of hospital encounter) from 2009 to 2019. International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification (ICD-9-CM, ICD-10-CM) diagnostic codes were used to identify diagnoses that indicated potential need for ERCP (Table S1). ICD-9/10-CM procedure codes were used to determine performance of ERCP during the encounter. If two or more predefined pancreatic or biliary diagnoses were present, the more common indication for ERCP was assigned as primary diagnosis (e.g., encounter with choledocholithiasis and acute pancreatitis was categorized as choledocholithiasis).

Hospital encounters in children less than 1-year-old and encounters following liver transplant were excluded. Those less than 1-year-old were excluded given the bias introduced by the extremely limited availability of the infant duodenoscope. Thus, the risk for confounding and the consideration for statistical inaccuracy obviated the ability to include this small cohort. Similarly, beyond being outside the scope of this study, those with liver transplant represented a cohort of patients that precluded standardized comparison of ERCP utilization given not all centers were liver transplant centers, and thus would introduce bias in the statistical modeling.

2.3 | Study definitions

2.3.1 | ERCP availability

ERCP availability was defined as being treated at a hospital that performed at least one ERCP during the year of service of hospital encounter. This definition was applied separately for pancreatic and biliary diagnoses given the differences in complexity of indications and consequent potential effect on practice patterns.

2.3.2 | ERCP volume

ERCP hospital volume was defined as the mean annual number of ERCPs performed at an institution, taken by averaging the total number of ERCPs performed during the study period over the number of years that data were available for that institution. Centers were categorized in tertiles and identified based on relative volumes as "tertile 1" (average of <10 ERCPs per year), "tertile 2" (10–20 ERCPs per year), or "tertile 3" (>20 ERCPs per year) to guard against confounding by volume.

2.3.3 | Rural or urban patient location

Using each patient's residential zip code, rurality was defined per United States Department of Agriculture's Rural-Urban Commuting Area Codes.[18]

2.3.4 | Race and ethnicity

Race and ethnicity were defined by the PHIS database and included given its relevance in social determinants of health. Measuring both was necessary in understanding their impact on procedure availability and utilization, and to best characterize the children at-risk for inequity.

2.4 | Statistical analysis

Pancreatic and biliary ERCP indications were analyzed separately. Descriptive statistics were used to compare characteristics of children with and without ERCP availability. ERCP utilization was similarly evaluated using descriptive statistics to compare characteristics of children that underwent an ERCP during the encounter with those who did not. Differences between groups were evaluated using χ^2 tests for categorical variables and *t*-tests or Wilcoxon rank sum tests for continuous variables as appropriate.

Generalized equation estimations (GEE) were used to identify factors associated with ERCP availability at the treating hospital; patient-level and hospital-level characteristics were considered. The GEE model allowed for adjusting analysis by child and thus decreased the bias of repeated hospital encounters by the same child. Univariate factors with $p < 0.10$ were considered in multivariable regression.

For ERCP utilization, sensitivity analyses were performed limiting models to the two most common diagnoses for pancreatic (i.e., acute and chronic pancreatitis) and biliary (i.e., biliary obstruction and calculus) diagnoses. This was a more conservative estimate of ERCP utilization, allowing for more robust comparison of factors associated with ERCP utilization by reducing bias potentially introduced by rare diagnoses. Additional sensitivity analysis was performed with inclusion of obesity in biliary ERCP utilization analysis to address possible confounding. Final models were obtained using backward stepwise regression; final models for sensitivity analysis conserved predictors of the initial model.

p Values <0.05 were deemed significant in all multivariable models. All statistical analyses were performed using STATA 17.0. The study was approved by the Institutional Review Board at the University of California, San Francisco (21-34373).

3 | RESULTS

Our cohort included 37,946 children and adolescents with 88,420 hospital encounters who had a pancreatic or biliary diagnosis that was a potential indication for ERCP (Table S1). In these encounters, 3942 children (10.4%) underwent 7066 ERCPs (8.0% of all encounters). The two most common pancreatic diagnoses among those that underwent ERCP were chronic (47.2%) and idiopathic acute pancreatitis (43.2%). The two most common biliary diagnoses among those that underwent ERCP were biliary calculus (68.9%) and biliary obstruction (14.9%).

3.1 | ERCP availability: Pancreatic disorders

Among the 6828 children treated in 19,293 hospital encounters with pancreatic disorders, 1894 children (27.7%) in 4820 encounters (25.0%) occurred at hospitals that did not perform any pancreatic ERCPs in the encounter year (Table 1). In univariate analysis, encounters for children with rural residence, public insurance, Black and Other/Multiracial/Unknown (OMU) race, non-Hispanic ethnicity, or non-Northeast hospital census region were less likely to occur in a hospital with pancreatic ERCP availability ($p < 0.10$) (Table S2).

TABLE 1 Baseline characteristics for availability of ERCP by diagnostic category.

	Pancreatic ERCP diagnoses $n = 19,293$			Biliary ERCP diagnoses $n = 69,127$		
	No availability	Availability	*p* Value	No availability	Availability	*p* Value
Total encounters	4820	14,473		5525	63,602	
Total children	1894	4934		2643	28,475	
ERCP performed	0%	10.8%		0%	8.7%	
Gender			0.072			0.44
Female	50.9%	52.1%		58.1%	57.6%	
Male	49.1%	47.9%		41.9%	42.4%	
Age at admission	11.2 (5.4)	11.2 (5.3)	0.860	11.4 (5.6)	10.6 (5.9)	<0.001
Rural/urban code			<0.001			<0.001
Rural	18.1%	13.5%		19.9%	13.1%	
Urban	81.9%	86.5%		80.1%	86.9%	
Insurance type			<0.001			<0.001
Public insurance	58.2%	54.7%		59.5%	54.2%	
Private insurance	40.0%	43.3%		38.1%	42.2%	
Uninsured/other	1.8%	2.0%		2.4%	3.6%	
Race			<0.001			<0.001
White	59.2%	61.2%		57.3%	58.9%	
Black	16.7%	15.2%		14.0%	17.0%	
Asian	2.7%	2.4%		2.1%	2.2%	
Pacific Islander	0.5%	0.4%		0.2%	0.3%	
Native American	0.4%	2.2%		0.5%	1.4%	
Other/Multiracial/Unknown	20.5%	18.6%		25.9%	20.2%	
Ethnicity			<0.001			<0.001
Hispanic or Latino	18.6%	23.7%		27.3%	24.2%	
Not Hispanic or Latino	70.1%	69.3%		70.3%	67.1%	
Unknown	11.3%	7.0%		2.4%	8.7%	
Census region			<0.001			<0.001
Midwest	34.4%	24.5%		29.1%	26.6%	
Northeast	6.5%	20.8%		2.0%	18.1%	
South	35.5%	32.5%		26.1%	35.6%	
West	23.6%	22.2%		42.8%	19.7%	

Note: Data is represented as *n*, % of total, or mean (SD); χ^2 tests were used for categorical variables and *t*-tests or Wilcoxon rank sum tests were used for continuous variables as appropriate.

Abbreviation: ERCP, endoscopic retrograde cholangiopancreatography.

When adjusting for confounding in multivariable analysis, encounters for children with rural residence, public insurance, Black and OMU race, non-Hispanic ethnicity, or non-Northeast hospital census region were significantly less likely to occur in hospitals with pancreatic ERCP availability (Table 2).

3.2 | ERCP availability: Biliary disorders

Among the 31,118 children treated in 69,127 hospital encounters for biliary disorders, 2643 children (8.5%) in 5525 (8.0%) hospital encounters were at hospitals with no

TABLE 2 Multivariate regression of factors associated of ERCP availability by pancreatic and biliary indication.

	Pancreatic ERCP availability Adjusted odds ratio in multivariate analysis		Biliary ERCP availability Adjusted odds ratio in multivariate analysis	
	OR (95% CI)	*p* Value	OR (95% CI)	*p* Value
Gender				
Female	[a]	[a]	[a]	[a]
Age at encounter	[a]	[a]	0.99 (0.98–0.99)	<0.001
Year of service	[a]	[a]	[a]	[a]
Rural/urban code				
Rural	0.70 (0.61–0.77)	<0.001	0.54 (0.49–0.58)	<0.001
Insurance type				
Public insurance	0.89 (0.82–0.99)	0.020	0.94 (0.89–1.02)	0.142
Uninsured/other	1.42 (1.05–1.92)	0.017	1.51 (1.28–1.79)	<0.001
Race (White)				
Black	0.87 (0.78–0.97)	0.025	1.00 (0.90–1.10)	0.950
Asian	1.07 (0.84–1.41)	0.466	0.70 (0.56–0.88)	0.002
Pacific Islander	1.37 (0.68–2.80)	0.401	1.59 (0.94–2.68)	0.086
Native American	4.30 (2.95–6.36)	<0.001	5.14 (3.64–7.26)	<0.001
Other/Multiracial/Unknown	0.69 (0.61–0.78)	<0.001	0.85 (0.76–0.90)	<0.001
Ethnicity				
Hispanic or Latino	1.54 (1.34–1.71)	<0.001	[a]	[a]
Census region (Northeast)				
Midwest	0.29 (0.24–0.34)	<0.001	0.12 (0.09–0.15)	<0.001
South	0.35 (0.29–0.41)	<0.001	0.19 (0.15–0.23)	<0.001
West	0.24 (0.21–0.29)	<0.001	0.06 (0.05–0.08)	<0.001

Note: Multivariable logistic regression model: threshold for entry into the multivariable model was $p < 0.1$ in univariate model. Threshold for retention in the final model was $p < 0.05$.

Abbreviations: CI, confidence interval; ERCP, endoscopic retrograde cholangiopancreatography; OR, odds ratio.

[a]Not included in multivariable model.

biliary ERCP availability (Table 1). In univariate analysis, encounters for children with rural residence, public insurance, Asian and OMU race, younger age, or non-Northeast hospital census region were less likely to occur in a hospital with biliary ERCP availability (Table S3).

When adjusting for confounding in multivariable analysis, encounters for children with rural residence, Asian and OMU race, or non-Northeast hospital census region were less likely to occur in hospitals with biliary ERCP availability (Table 2).

3.3 | ERCP utilization: Pancreatic disorders

For pancreatic diagnoses, 4931 children with 14,479 hospital encounters were treated at a hospital that offered ERCP during the encounter year (ERCP availability) (Table 1). Of those children, 638 children underwent 1579 pancreatic ERCPs. The most common indications for ERCP included acute, idiopathic pancreatitis, and chronic pancreatitis (Figure 1A). In univariate analysis, encounters for children with public insurance, urban residence, Black and OMU race, male gender, earlier year of service, Hispanic ethnicity, or non-Midwest hospital census region were less likely to receive ERCP at an institution with pancreatic ERCP availability (Table S4).

When adjusting for confounding in multivariable analysis, encounters for children with public insurance, urban residence, male gender, or Black race were significantly less likely to undergo ERCP at an institution with pancreatic ERCP availability (Table 3). Encounters in the Midwest hospital census region were significantly more likely to undergo ERCP (Table 3).

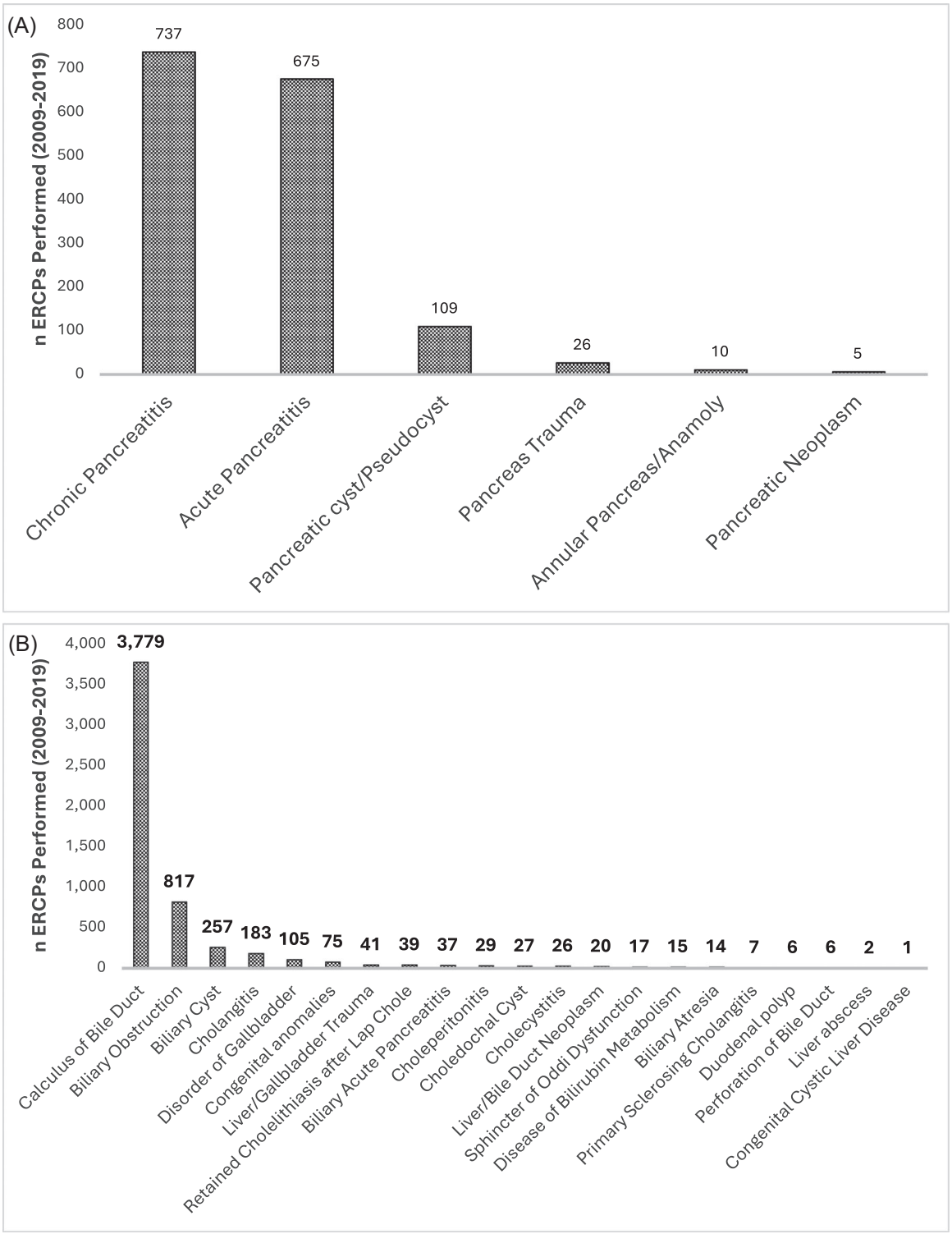

FIGURE 1 ERCP utilization. (A) ERCP utilization by pancreatic diagnoses. (B) ERCP utilization by biliary diagnoses. ERCP, endoscopic retrograde cholangiopancreatography.

For every increasing year from 2009 to 2019, 7% increase in odds of receiving ERCP was observed after controlling for all other factors (Table 3).

In sensitivity analysis, we limited the cohort to acute, idiopathic and chronic pancreatitis ($n = 12,765$ hospital encounters), which included 568 children with 1412 ERCPs performed. In multivariable sensitivity analysis, encounters in "tertile 1" ERCP volume hospitals became significant and decreased the likelihood of receiving ERCP, while those in the South hospital census region

TABLE 3 Multivariate regression of factors associated of ERCP utilization by pancreatic and biliary indication.

	Pancreatic ERCP utilization Adjusted odds ratio in multivariate analysis		Biliary ERCP utilization Adjusted odds ratio in multivariate analysis	
	OR (95% CI)	*p* Value	OR (95% CI)	*p* Value
Gender				
Female	1.20 (1.05–1.37)	0.005	1.16 (1.09–1.25)	<0.001
Age at encounter	[a]	[a]	1.06 (1.05–1.06)	<0.001
Year of service	1.07 (1.05–1.11)	<0.001	1.02 (1.01–1.03)	<0.001
Hospital ERCP volume (Tertile 2)				
Tertile 1	0.78 (0.61–1.00)	0.052	0.69 (0.61–0.75)	<0.001
Tertile 3	1.77 (1.51–2.07)	<0.001	1.46 (1.38–1.58)	<0.001
Rural/urban code				
Rural	1.56 (1.31–1.86)	<0.001	[a]	[a]
Insurance type				
Public insurance	0.78 (0.69–0.89)	<0.001	1.09 (1.02–1.17)	0.011
Uninsured/other	0.81 (0.54–1.23)	0.354	1.39 (1.18–1.62)	<0.001
Race (White)				
Black	0.67 (0.53–0.82)	<0.001	1.00 (0.92–1.10)	0.825
Asian	0.88 (0.59–1.39)	0.420	0.96 (0.74–1.23)	0.737
Pacific Islander	0.84 (0.23–2.69)	0.756	1.03 (0.59–1.80)	0.945
Native American	0.72 (0.40–1.31)	0.356	1.52 (1.21–1.92)	<0.001
Other/Multiracial/Unknown	0.97 (0.81–1.16)	0.781	1.09 (1.00–1.20)	0.049
Ethnicity				
Hispanic or Latino	[b]	[b]	1.16 (1.06–1.24)	0.001
Census Region (Northeast)				
Midwest	1.83 (1.50–2.26)	<0.001	1.03 (0.92–1.13)	0.790
South	1.27 (1.06–1.52)	0.013	1.25 (1.12–1.37)	<0.001
West	1.22 (0.96–1.51)	0.092	0.95 (0.82–1.06)	0.224

Note: Multivariable logistic regression model: threshold for entry into the multivariable model was $p < 0.1$ in univariate model. Threshold for retention in the final model was $p < 0.05$.

Abbreviations: CI, confidence interval; ERCP, endoscopic retrograde cholangiopancreatography; OR, odds ratio.

[a]Not included in multivariable model.

[b]Not retained in the final multivariable model.

became nonsignificant; results otherwise showed no additional marked change in direction, significance, or magnitude of association (Table S5).

3.4 | ERCP utilization: Biliary disorders

For biliary diagnoses, 28,475 children with 63,602 hospital encounters were treated at a hospital that offered biliary ERCP at least once during year of service (ERCP availability) (Table 1). Of those children, 3304 children underwent 5487 total biliary ERCP. The most common indications for ERCP utilization included biliary duct calculus and obstruction (Figure 1B). In univariate analysis, encounters for children with private insurance, male gender, earlier year of service, younger age, non-Hispanic ethnicity, in "tertile 1" ERCP volume hospitals, or non-South hospital census regions were less likely to undergo ERCP at an institution with biliary ERCP availability ($p < 0.10$) (Table S6).

When adjusting for confounding in multivariable analysis, encounters for children treated in "tertile 1" ERCP volume hospitals, non-Hispanic ethnicity, male gender, or being treated at a hospital not in the South

were significantly less likely to receive ERCP at an institution with biliary ERCP availability after controlling for other factors (Table 3). With every 1 year increase in patient age, there was 6% increase in odds of receiving ERCP (Table 3). With every increasing year from 2009 to 2019, a 2% increase in odds of undergoing biliary ERCP was observed, controlling for all other factors (Table 3).

Sensitivity analysis for biliary disorders included biliary calculus and obstruction ($n = 32,622$ hospital encounters), which included 19,177 children with 4596 ERCPs performed. In sensitivity analysis, encounters for children with Black race or in West census region were significantly less likely to receive biliary ERCP (Table S7). Public insurance and Hispanic ethnicity were no longer significantly associated with receiving ERCP (Table S7). No additional marked changes in direction, significance, or magnitude of association were found. Given biliary calculus and obstruction often occur with obesity, an additional sensitivity analysis including obesity was performed and did not change results (data not shown).

4 | DISCUSSION

This analysis is the first to specifically evaluate patient and hospital characteristics associated with "in-house" ERCP availability for children in a national database. We identified differences in ERCP availability and utilization associated with indication (pancreatic vs. biliary) and demographic and hospital-level metrics. For children with pancreatic disorders that might require ERCP, one in four encounters occurred at a hospital without ERCP availability; for those with biliary disorders, one in every 12 encounters occurred at a hospital without ERCP availability.

Children with public insurance, living in rural areas, or of Black or OMU race are less likely to receive care in a hospital that performed pancreatic ERCP. Similarly, children living in rural areas or of Asian or OMU race were less likely to be in a hospital with biliary ERCP availability, though no differences in insurance type were noted. This difference in insurance impact may be secondary to coverage of the procedure, provider experience, or other factors. Regardless, these factors associated with decreased availability of ERCP are similar to historical barriers to even primary care: public insurance, rural residence, and racial minorities.[19–21] For both pancreatic and biliary ERCP, hospital encounters in the Northeast are more likely to have "in-house" ERCP availability than in other regions. This may be related to the concentration of tertiary care hospitals in more densely populated and urban regions.

Our algorithm for "in-house" ERCP availability attempted to best capture children that had a potential indication for ERCP by using diagnoses that hospitals associated with a performed ERCP. Notably, biliary ERCP indications are more established, while pancreatic ERCP indications have only recently been defined in pediatrics.[7,22] This study does not determine when ERCP should be done, but rather reports the associated diagnoses listed in the database. Although a recent systematic literature review suggests ERCP is performed in both adult and pediatric patients for acute pancreatitis, and recent reports suggest ERCP can be performed safely during acute pancreatitis episodes, we cannot distinguish if acute pancreatitis diagnoses may have also been associated with other pancreatic disorders that were not coded, and thus may represent a more complex paradigm of disease.[23,24]

After establishing where ERCP was performed, we sought to evaluate factors associated with ERCP utilization among hospitals with "in-house" ERCP availability. Encounters of children with pancreatic disorders who had public insurance, male gender, or were of Black race were less likely to undergo ERCP. Children treated in hospitals that performed higher volume of pancreatic ERCP were more likely to undergo ERCP for the same diagnoses than children in lower volume centers. To account for confounding by diagnostic indication, we performed sensitivity analysis limiting diagnoses to acute and chronic pancreatitis, and these differences in utilization persisted. ERCP utilization lower volume centers did not significantly differ for pancreatic ERCP using all pancreatic diagnoses, though significant differences were found when limiting to the top two pancreatic diagnoses. Although children in the Northeast were most likely to have ERCP available, those in the Midwest had the highest utilization of pancreatic ERCP. This may be related to a higher incidence of genetic pancreatitis in the Midwest region, a greater comfort with endotherapy in pancreatic diagnoses, or other factors not assessed in this analysis. Over the 10-year period, a 7% increase in odds was noted for every year, suggesting a greater comfort with performing the procedure. Indeed, with the recent society publication on the roles of ERCP in those with chronic pancreatitis, we may expect an increased awareness of the therapeutic options, and comfort performing ERCP in these children.[22]

Our data on the utilization of biliary ERCP show a 5% increase in odds of receiving ERCP for every 1-year increase in age suggesting greater confidence and equipment availability/suitability in performing ERCP in older children closer to adult size and anatomy.

In sensitivity analysis limiting the biliary cohort to those with biliary calculi or obstruction, Black race and West hospital census region were associated with lower utilization of biliary ERCP, while other demographic factors and insurance type were no longer significant. Even among biliary calculus and obstruction cases, where relatively more standardization of procedural indication exists, racial and regional differences in ERCP use are apparent.

Racial, regional, and age-related differences have been reported in the adult studies comparing ERCP utilization in those with pancreatic cancer.[14,25] These findings have in turn informed an understanding of complications and overall outcomes research that provide a call to action to ensure equitable access to care.[26]

Our study has limitations. A key limitation is the reliance on ICD codes. ERCPs coded with diagnoses not in our list (e.g., abdominal pain, unspecified pancreatic disease) were excluded from our cohort. However, we felt that limiting the diagnoses to those with higher ERCP potential provided a more accurate understanding of availability and utilization. Similarly, coding practice is a limitation in understanding comorbidities; diagnoses such as obesity are often not coded. Since pancreatic ERCP is less common than biliary ERCP, it is possible that an institution did not perform a single pancreatic ERCP because there were no cases; as such, pancreatic ERCP availability may be closer to biliary ERCP availability. Additionally, only centers in the CHA consortium, comprised of tertiary care children's hospitals that are likely referral hospitals in their regions, are included in PHIS. Although smaller hospitals not represented in this analysis could have greater barriers in availability, we acknowledge they alternatively may have adult hospital affiliations and consequently greater access and utilization of ERCP or specialized procedures. An analysis comparing CHA and non-CHA admissions would be needed to gain this insight. It was not possible to monitor patient transfers, thus they would be counted among those without ERCP availability. The cohort included limited numbers of some racial minorities, including Pacific Islander and Native Americans, and we were unable to make reliable conclusions about these populations.

Our study suggests demographic and geographic differences in ERCP availability and utilization for children. These findings represent another step forward in understanding current ERCP availability and utilization at US children's hospitals. We cannot derive from this analysis whether these are sufficient to meet the needs of this population. However, differential "in-house" availability by patient and hospital factors is present, and differential utilization of ERCP among children's hospitals that perform ERCP exists. More in-depth, multicenter studies are needed to help improve understanding of the causes and potential solutions for these differences.

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CONFLICT OF INTEREST STATEMENT

M. A. serves as a consultant to Boston Scientific, Cook, and Olympus though is not relevant to this manuscript. The remaining authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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