

# Emergency Department Visits and Hospitalizations in Children With Chronic Pancreatitis in the United States

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## ABSTRACT

We analyzed 2 national databases to assess the use of health care resources by children with chronic pancreatitis (CP). In 2012, the hospital discharge rate for pediatric CP was 2.73/100,000 children. Patients with CP were sicker with a greater burden of illness than age- and sex-matched counterparts. Acute pancreatitis occurred frequently in hospitalized children with CP. Abdominal pain and nausea, and vomiting were the most common gastrointestinal symptoms associated with emergency department visits in children with CP. A significant proportion of these visits resulted in a hospitalization. These findings add to our understanding of the epidemiology of CP in the United States.

**Key Words:** children, chronic pancreatitis

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Chronic pancreatitis (CP) in children is an uncommon disorder; the available data suggest the incidence ranges from 0.5 to 1.46/100,000 person years (1,2). Clinical experience and limited epidemiological data indicate CP in children is a debilitating disease (3,4). A report involving registry data from 14 institutions confirmed that pediatric CP is associated with a significant burden of disease involving frequent emergency department (ED) visits and hospitalizations (5). The aim of the present study was to determine the nationwide use of these health care resources by children with CP.

## METHODS

Two separate US national databases were used, the nationwide Kids' Inpatient Database (KID) comprising hospital discharges and the Nationwide Emergency Department Sample (NEDS) comprising hospital-based ED visits. These databases and study methods have been described elsewhere (6–8). Briefly, both the databases are sponsored by the Agency for Healthcare Research and Quality (AHRQ) and contain data from community hospitals and hospital-based EDs, as defined by the American Health Association, within the United States. Community hospitals are

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## What Is Known

- Chronic pancreatitis is a chronic debilitating disease in children.
- The incidence of chronic pancreatitis is rare in the pediatric age group.
- Chronic pancreatitis in children is associated with a significant burden of hospitalizations and emergency department visits.

## What Is New

- Children with chronic pancreatitis have a high number of medical comorbidities.
- Children with chronic pancreatitis often have a concurrent diagnosis of acute pancreatitis and liver/biliary disease.
- Chronic pancreatitis–related hospitalizations in children are associated with longer hospital stays and higher hospital charges.

nonfederal, short-term general, and special hospitals (eg, children's hospitals, obstetrics and gynecology, orthopedics) accessible by the general public. These hospitals can be academic medical centers or other teaching hospitals. Individual hospitalizations (ie, discharge level, not patient level, information is collected) of patients are deidentified and maintained in these databases as unique entries. Each discharge entry includes 1 primary discharge diagnosis and up to 1 to 24 secondary diagnoses (based on the ICD-9-CM [*International Classification of Diseases, Ninth Revision, Clinical Modification*] diagnosis codes). They also provide an individual-level population weight to generate national level estimates of total patients. All of the data in this manuscript are presented as national level estimates. ICD-9-CM diagnosis codes were used to identify patients with CP (5771) 1 to 18 years of age. Children <1 year of age were excluded given the low likelihood of CP in this age group.

The comorbid burden was assessed using the Elixhauser Comorbidity Index using SAS-generated software (SAS 9.3, SAS Institute, Cary, NC) provided by Healthcare Cost and Utilization Project (HCUP) (9). This is a widely used index consisting of 29 disease states including cardiovascular, pulmonary, renal, hepatic, neurological, and metabolic diseases. Higher scores indicate greater comorbid burden of disease. Other specific comorbid conditions also were queried based on a priori knowledge of their association with pediatric CP (5). These were acute pancreatitis (AP), liver and biliary disease, cystic fibrosis (CF), diabetes mellitus (DM), and inflammatory bowel disease (IBD). Also recorded was the performance of endoscopic retrograde cholangiopancreatography (ERCP) (6,8).

ED visits were assessed for concurrent clinical diagnoses that included nausea and vomiting (ICD-9 codes 7870 and 78701–78703), abdominal pain (ICD-9 codes 7890 and 78900–78909),

diarrhea (ICD-9 codes 78791 and 78799), jaundice (ICD-9 codes 7824), and ascites (ICD-9 codes 7895).

Statistical analyses were performed as described (6,7). Case-control matching involved high-dimensional propensity scores and a greedy matching algorithm. Regression model covariates included demographic variables and comorbidity scores; multicollinearity was ruled out.

## RESULTS

Analysis of the KID revealed that in 2012 within the United States, there were a total of 1,777,238 hospital discharges in children 1 to 18 years of age. Of these, 2025 children (0.11% of all hospital discharges in children) had a principal or secondary diagnosis of CP. Specifically, there were 436 discharges with a principal diagnosis of CP and 1589 discharges with a secondary diagnosis of CP. Adjusting for the estimated age-based population, we calculated a discharge rate of 2.73/100,000 children. Among hospitalized children with CP, 59.1% were female, the median age was 14 years (interquartile range [IQR] 6 years), and 76% of children were 10 years of age and older.

Demographic characteristics of patients with CP were compared with a 1:5 age- and sex-matched cohort ( $P = 0.9$  for age and  $P = 0.7$  for sex) of hospitalized patients (Table 1). Children with CP were more likely to be white (odds ratio [OR] 1.4, 95% confidence interval [CI] 1.2–1.5) and less likely to be black (OR 0.47, 95% CI 0.40–0.55). No significant differences were noted overall for geographical region, household income, and insurance coverage between the 2 groups with and without CP (data not shown).

Patients with CP were more likely to carry  $\geq 3$  comorbidities (OR 2.9, 95% CI 2.5–3.3), an All Patient Diagnosis Related Group (APR-DRG) subclass indicating major or extreme risk of mortality (OR 2.8, 95% CI 2.3–3.3), and an APR-DRG subclass indicating major or extreme illness (OR 3.3, 95% CI 3.0–3.7). Children with CP were also more likely to have been admitted from the ED (OR 1.3, 95% CI 1.2–1.5) to a teaching hospital (OR 2.2, 95% CI 2.0–2.6) and to a hospital in an urban location (OR 1.8, 95% CI 1.4–2.2).

The 2 groups also were compared for select comorbid conditions and procedures (Table 2). A significant proportion (41.8%) of hospitalized children with CP carried a concurrent diagnosis of AP; this incidence was several times greater compared

with children without CP (OR 89.7, 95% CI 70.7–113.6). Hospitalized children with CP were also more likely to have an associated diagnosis of liver and biliary disease (OR 9.1, 95% CI 7.5–11.1), CF (OR 9.0, 95% CI 6.6–12.3), DM (OR 4.2, 95% CI 3.5–4.9), and IBD (OR 2.3, 95% CI 1.6–3.1). They also were more likely to undergo an ERCP (OR 69.1, 95% CI 40.0–119.0) during the course of their hospital stay.

Mortality was low and similar between the 2 groups (0.3% vs 0.4%,  $P = 0.22$ ). Patients with CP, however, had longer hospital stays (median 4 days [IQR 5 days] vs 2 days [IQR 2 days],  $P < 0.001$ ) and higher hospital charges (median \$24,000 [IQR \$39,000] vs \$16,000 [IQR \$22,000];  $P < 0.001$ ).

Analysis of the NEDS revealed that in 2012, there were a total of 26,365,637 ED visits in children 1 to 18 years of age. Of these, 1656 ED visits (0.006% of all pediatric ED visits) were associated with a diagnosis of CP. Specifically, there were 443 discharges with a principal diagnosis of CP and 1213 discharges with a secondary diagnosis of CP. In children with CP who presented to the ED, 22.7% complained of abdominal pain and 11.5% complained of nausea and vomiting. The presence of diarrhea, ascites, and jaundice were all much less frequent at  $\sim 1\%$ . The most frequent associated diagnosis in children with CP who were admitted from the ED was AP (43.9%).

Regarding the disposition of patients with CP from the ED, 61.2% were admitted to the same hospital, 5.1% to another short-term hospital, whereas 33.5% underwent routine discharge to home. Using a multiple variable regression model, independent risk factors for hospital admission included presentation to a teaching hospital (adjusted odds ratio [aOR] 4.6, 95% CI 3.6–6.1) and the presence of  $\geq 3$  comorbid conditions (aOR 4.4, 95% CI 2.6–7.6).

## DISCUSSION

To date, this is the largest investigation in terms of number of patients with pediatric CP. We assessed the use of health care resources in both the inpatient and the outpatient clinical setting.

Although the discharge rate for CP in the present study (2.73/100,000 children) is not an incidence rate, it is useful to compare similar rates reported for other childhood diseases. In this manner, the burden on health care resources imposed by CP may be kept in perspective. For example, using data from the 2009 KID, Hasegawa

TABLE 1. Comparison of demographics and hospitalization characteristics in children 1 to 18 years of age with and without CP matched in a 1:5 ratio by age ( $P = 0.9$ ) and sex ( $P = 0.7$ )

Variable	Without CP, %	With CP, %	P	OR	95% CI
Sex					
Female	58.6	59.10	0.7		
Age group, y					
1–4	6	6.1	0.9		
5–9	18	17.9	0.9		
10–14	29.7	29.6	0.9		
15–18	46.3	46.4	0.9		
Comorbidities $\geq 3$	7.5	19.2	<0.001	2.9	2.5–3.3
ED admit	30.3	35.7	<0.001	1.3	1.2–1.4
Race					
White	47.5	55.2	<0.001	1.4	1.2–1.5
Black	17.2	8.9	<0.001	0.47	0.40–0.55
Hispanic	19.6	21.5	0.05		
Other	7.6	5.9	0.01	0.77	0.63–0.94
APR-DRG mortality risk 3 or 4	3.5	9	<0.001	2.8	2.3–3.3
APR-DRG illness severity 3 or 4	14.2	35.6	<0.001	3.3	3.0–3.7
Urban location of hospital	92.4	95.5	<0.001	1.8	1.4–2.2
Teaching hospital	70.6	84.4	<0.001	2.2	2.0–2.6

Comorbidities assessed using the Elixhauser comorbidity index. APR-DRG classification of major (3) or extreme (4) risk of mortality or severity of illness. We used the HCUP-KID 2012 sponsored by the AHRQ. Data were weighted to generate national-level estimates. AHRQ = Agency for Healthcare Research and Quality; APR-DGR = All Patient Diagnosis Related Group; CI = confidence interval; CP = chronic pancreatitis; HCUP = Healthcare Cost and Utilization Project; KID = Kids' Inpatient Database; OR = odds ratio.

TABLE 2. Association of comorbid conditions and performance of ERCP in children 1 to 18 years of age with and without CP matched in a 1:5 ratio by age ( $P=0.9$ ) and sex ( $P=0.7$ )

Variable	Without CP, %	With CP, %	P	OR	95% CI
<b>Comorbidity</b>					
AP	0.8	41.8	<0.001	89.7	70.7–113.6
Liver/biliary disease	1.8	14	<0.001	9.1	7.5–11.1
CF	0.6	5.3	<0.001	9	6.6–12.3
Diabetes	3.5	13	<0.001	4.2	3.5–4.9
IBD	1.1	2.5	<0.001	2.3	1.6–3.1
<b>Procedure</b>					
ERCP	0.1	8.8	<0.001	69.1	40–119

We used the HCUP-KID 2012 sponsored by the AHRQ. Data were weighted to generate national-level estimates. AHRQ=Agency for Healthcare Research and Quality; AP=acute pancreatitis; CF=cystic fibrosis; CI=confidence interval; CP=chronic pancreatitis; ERCP=endoscopic retrograde cholangiopancreatography; HCUP=Healthcare Cost and Utilization Project; IBD=inflammatory bowel disease; KID=Kids' Inpatient Database; OR=odds ratio.

et al (10) observed the discharge rate for patients with pediatric asthma was 18.4/10,000 children. The age-, sex-, and race-related demographics of our study population were similar to the cohort of patients in the INSPPIRE registry (5). When hospitalized children with CP were compared with an age- and sex-matched cohort of patients, several key differences were noted. Children with CP were ~3 times more likely to have a high number of medical comorbidities; this was reflected in the concurrently high APR-DRG subclasses. The greater burden of illness in children with CP may explain their greater likelihood of having been admitted through the ED and to urban teaching hospitals.

Although assessing for selected comorbidities in hospitalized children with CP, 2 noteworthy points emerged. First, a little less than half of the patients had a concurrent diagnosis of AP. A number of these children may have suffered acute recurrent pancreatitis (ARP). A single-center study reported that 20.5% of 78 patients with ARP in children were associated with a family history of CP (11). Second, liver and biliary disease, which is a known risk factor for pediatric AP (6), occurred with a significant frequency in patients with CP too. The association of other medical conditions such as CF, DM, and IBD with CP has been well established by prior studies (5). Unfortunately, because of the lack of suitable ICD-9-CM codes, we are unable to determine the presence of pancreatic anatomical abnormalities or genetic mutations in this cohort of patients (5). The use of ERCP as a therapeutic procedure for pancreatic disorders in children including CP is well documented (12). Fortunately, mortality in children with CP remained low. Patients with CP, however, imposed a significant burden on health care resources with longer hospital stays and higher hospital charges.

In children with CP who presented to the ED, the most frequently associated gastrointestinal complaint was abdominal pain followed by nausea and vomiting. The incidence of other gastrointestinal complaints, however, was quite low. In a significant proportion of children with CP, visits to the ED resulted in a subsequent hospital admission. A significant proportion (43.9%) of children with CP who were admitted from the ED carried a concurrent diagnosis of AP. Two major risk factors for hospitalization were identified in the present study: the presence of  $\geq 3$  comorbidities and presentation to a teaching hospital. It is possible that these risk factors were the result of a selection bias, wherein sicker children were transferred from smaller EDs to larger facilities where they are subsequently admitted. The disparity in the volume of patients with CP assessed from the KID and the NEDS was most

likely because of a number of direct admissions to the hospital who bypassed the ED.

The present study has several limitations. We relied solely on ICD-9-CM codes for the identification of patients. We could not correlate patients with laboratory or radiological confirmation of disease given the lack of this information in the database. Our assessment of comorbidities was limited by the use of suitable ICD-9-CM codes. For similar reasons, we could not investigate the occurrence of several well-described etiologies of pancreatitis. The HCUP-KID does not track individual patients; therefore, it was not possible to determine recurrences or readmissions related to CP. We also cannot determine whether a patient with CP was evaluated in the ED or admitted to the hospital for a reason not related to CP. Finally, hospital charges and not costs were reported in the present study. Our intent, however, was to only make the comparison between the patients with and without CP and not a direct estimation of the true costs of the medical care of these patients.

## CONCLUSIONS

Children with CP account for a small percentage of patients seen in EDs, but those who present to EDs frequently require hospitalization. Hospitalized children with CP tend to be sicker than the general hospital population and require longer stays and have higher costs associated with the hospitalizations. AP was a frequently associated comorbidity in pediatric hospitalizations with CP and both diseases shared common risk factors. These results represent the first US nationwide study concerning the use of health care resources by children with CP and should help guide future studies regarding the epidemiology of pediatric CP.

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