Clinical characteristics, predictors, and rates of hospitalized acute cholangitis patients in the United States

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Abstract	
	Background Acute cholangitis (AC) is a relatively uncommon condition, with a mortality rate of 50% without prompt treatment. Our study aimed to assess the impact of demographic and social factors on morbidity, mortality and healthcare utilization of patients with AC in the United States (US).
	Methods We used data from the National Inpatient Sample (2016 and 2017). Our study population included all patients with a discharge diagnosis of AC, identified using the International Classification of Diseases, Tenth Revision (ICD-10) code K830.
	Results A total of 18,649 patients were hospitalized with a diagnosis of AC, with rates higher among older persons. The incidence increased notably from 142.36 cases per million in 2016 to 144.3 in 2017. The majority (53%) of patients were on Medicare. Age >60 years was associated with greater mortality compared to 0-18 years (odds ratio [OR] 2.56, 95% confidence interval [CI] 1.21-5.43). Hispanic race (OR 1.4, 95%CI 1.15-1.76) and Black race (OR 1.3, 95%CI 1.04-1.63) had an increased mortality compared to White race. Among the factors analyzed, age >60 (OR 3.72, 95%CI 2.93-4.70) and male sex (OR 0.91, 95%CI 0.86-0.98) were found to be significantly associated with endoscopic retrograde cholangiopancreatography (ERCP) during hospitalization. The total charge for hospitalizations in 2016 was $766 million, increasing to $825 million in 2017.
	Conclusions The incidence of AC in the US increased slightly year over year. In patients presenting with AC, age and race were associated with mortality while age and sex were associated with the need for ERCP.
	Keywords Acute cholangitis, National Inpatient Sample, common bile duct obstruction, endoscopic retrograde cholangiopancreatography
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Introduction

Acute cholangitis (AC) is a bacterial infection of the biliary tree, usually following an obstruction or stasis [1].

It presents with the classic triad of right upper quadrant pain, fever, and jaundice, known as Charcot's triad. In severe cases, if it also presents with hypotension and altered mental status in addition to the classic Charcot's triad, it is known as Reynold's pentad [2]. In the United States, the peak incidence is between 50 and 60 years, and there is an equal prevalence among males and females [1]. Diagnosis is based on a constellation of clinical symptoms, signs, biochemical markers of cholestasis and imaging. In patients presenting with AC, image findings depending on modality and etiology can vary, but include stones in the bile duct, increased signal intensity, enhancement of the bile duct and biliary stenosis [3]. The severity of AC determines the urgency of biliary drainage: for mild cases, adequate resuscitation and antibiotic therapy may be sufficient, while severe cases involving organ dysfunction require urgent or emergent biliary drainage procedures, such as endoscopic retrograde cholangiopancreatography (ERCP) [4].

Our study aimed to assess the trends, healthcare utilization, costs and outcomes associated with patients admitted with AC in the United States in the years 2016 and 2017.

Materials and methods

Data source and study design

This is a retrospective study of admissions with a discharge diagnosis of AC in 2016 and 2017. Data used in this study were obtained from the National Inpatient Sample (NIS), maintained by the Agency for Healthcare Research and Quality. The NIS is the largest publicly available all-payer inpatient care database in the United States [5]. The diagnoses and procedures in the dataset are encoded using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). Use of the NIS is exempt from Institutional Review Board approval as there is no identifying patient information.

Study population

All patients with a discharge diagnosis of AC in 2016 and 2017 were evaluated. AC was identified using the ICD-10-CM code K83.0.

Variables

Patient variables identified include age, sex, race and ethnicity. Other variables included were income status, insurance type and geographical region. Age was divided into the following categorical variables: <18, 18-39, 40-59, and ≥60. Sex was either male or female. Race and ethnicity included Whites, Blacks, Hispanics, Asian or Pacific Islanders, and other races. Health insurance was categorized into Medicare, Medicaid, private, self-pay and others. Income status was categorized into 4 income groups, according to the average household income of the zip code where the patient lived. The geographic classification was divided into 9 regions (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific).

Statistical analysis

This dataset contained 14,294,784 entries for 2016 and 2017. The NIS data were extracted and analyzed using STATA, Version 14 (StataCorp LP, College Station, Texas, United States). To obtain national estimates, the dataset was weighted using NIS-weighted parameters, and the core file, which contains most of the data records used in this analysis, was weighted. AC was identified using the ICD-10-CM code K83.0. Most of the data points with Healthcare Cost and Utilization Project (HCUP) codes were recoded using the HCUP core file codes instruction. Some other numerical variables were recoded to categorical variables for descriptive univariate analysis. Mean estimate was analyzed for numerical variables and percentage analysis for categorical variables. To evaluate the effect of factor variables on outcome variables, such as death, length of stay (LOS), hospital charges, and ERCP procedures, binary logistic regression was used to derive odds ratios. The multivariate analysis estimate was weighted with a logistic regression function to get a national estimate. In addition, Poisson regression was applied to estimate non-binary outcome variables.

Results

Baseline characteristics

The baseline characteristics are summarized in (Table 1), which indicates that 9214 and 9435 patients were hospitalized for AC in 2016 and 2017, respectively, showing an increase in hospitalization rate. As 18,649 patients were diagnosed with AC in the 2-year study period, we saw an average of 1500 patients admitted every month. In this analysis, the number of admissions between July and October of both years was higher than in other months. Regarding age, our analysis showed that more than half of the patients diagnosed with AC were above 60 years, and about 3% were younger than 18 years. When compared across age groups, hospitalization rates revealed higher rates with increasing age (Table 2). Our sample showed a slight male predominance, with 53% of patients being male.

Race and ethnicity analysis (Table 2) showed the highest incidence was in Whites, followed by Native Americans, while Asian/Pacific Islanders were the third highest. Household income analysis showed little or no significant difference in the number of AC patients across income groups. Most patients were on Medicare (52%), and a minority were self-payers, mirroring that most patients were above the age of 60 years.

The most common etiology of AC was common bile duct obstruction followed by malignancy, including pancreatic, bile duct and gallbladder cancers (Table 3).

Comorbidities were characterized as other diseases diagnosed during hospitalization in patients with AC. The most

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Table 1 Characteristics of hospitalizations with acute cholangitis, National Inpatient Sample 2016-2017

Characteristics	Frequency	%
Number of cases		
2016	9214	49.41
2017	9435	50.59
Age at admission (years)		
<18	580	3.11
18-39	1995	10.71
40-59	4514	24.23
≥60	11,544	61.95
Sex		
Male	10,034	53.85
Female	8599	46.15
Median household income national quartile for patient		
0-25th percentile	4519	24.65
26th-50th percentile	4581	24.99
51Sth-75th percentile	4581	24.99
76th-100th percentile	4651	25.37
Insurance type (primary expected payer)		
Medicare	9827	52.82
Medicaid	2235	12.01
Private insurance	5593	30.06
Self-pay	444	2.39
No charges	48	0.26
Other	459	2.47
Census division of hospitals		
New England	1214	6.51
Middle Atlantic	2657	14.25
East North Central	2703	14.49
West North Central	1451	7.78
South Atlantic	3406	18.26
East South Central	839	4.5
West South Central	1903	10.2
Mountain	1234	6.62
Pacific	3242	17.38

Table 2 Hospitalization rates for acute cholangitis, National Inpatient Sample 2016-2017

Hospitalization rate	2016 (Cases per 1 million population)	2017 (Cases per 1 million population)
Total hospitalization rate	142.36	144.3
Hospitalization rate by race		
Hispanic or Latinos	88	93
White alone	155	152
Black or African American alone	114	129
Native American	135	114
Asian or Pacific Islanders	122	125
Some other race alone	1599	1530
Hospitalization rate by age		
Less than 18 years	21	20
18-39 years	71	72
40-59 years	105	105
60 years & above	407	408

Table 3 Top 10 etiologies of acute cholangitis, National Inpatient Sample 2016-2017

Etiology of acute cholangitis	%
Common bile duct obstruction	27.80
Bile duct cancer	5.40
Pancreatic cancer	4.80
Hemobilia, adhesions of biliary tract, atrophy of biliary tract,hypertrophy of biliary tract, ulcer of biliary tract	3.90
Choledocholithiasis	1.60
Malignant neoplasm of extrahepatic bile duct	1.30
Gallbladder cancer	1.00
Ampullary cancer	0.50
Malignant neoplasm of biliary tract	0.50
Choledochal cyst	0.20
Benign tumors of bile duct	0.20

common comorbidities were hypertension and hyperlipidemia (Fig. 1). Regarding the number of comorbidities (obtained from the number of other ICD-10 codes in patients hospitalized with AC) across the different ethnicities, Blacks had the highest average with an average of 15 comorbidities and Hispanics the least with an average of 13 comorbidities (Table 4).

Factors associated with inpatient outcomes (Table 5)

Mortality

Of 18,649 patients diagnosed with AC in the 2 years, 1070 died, 516 in 2016 and 554 in 2017. The factors associated with death in patients with AC were analyzed. Death in the survey was coded as a value of 1 to represent a patient who died and 0 to represent a patient who survived. Since the dependent variable (death) is binary and dichotomous, binary logistic regression was used to obtain the odds ratio of

factors associated with death. Age, sex, race, number of other diagnoses/comorbidities, patient income, and insurance type were used as factors associated with mortality.

Regarding age (age groups), patients 0-17 years of age were identified as the reference age group. The odds ratio of death for patients aged ≥60 years was 2.56 with a P-value of 0.014 and a 95% confidence interval (CI) of 1.21-5.43, which implies that patients within that age group were 2.56 times more likely to die from AC compared to the reference age group, and since the P-value was less than 0.05, this is considered statistically significant. Patients in other age groups were also at greater risk of death compared to the reference age group. However, the differences were not statistically significant as P-values were greater than 0.05.

In the sex analysis, female patients admitted for AC were more likely to die than their male counterparts (OR 1.14,
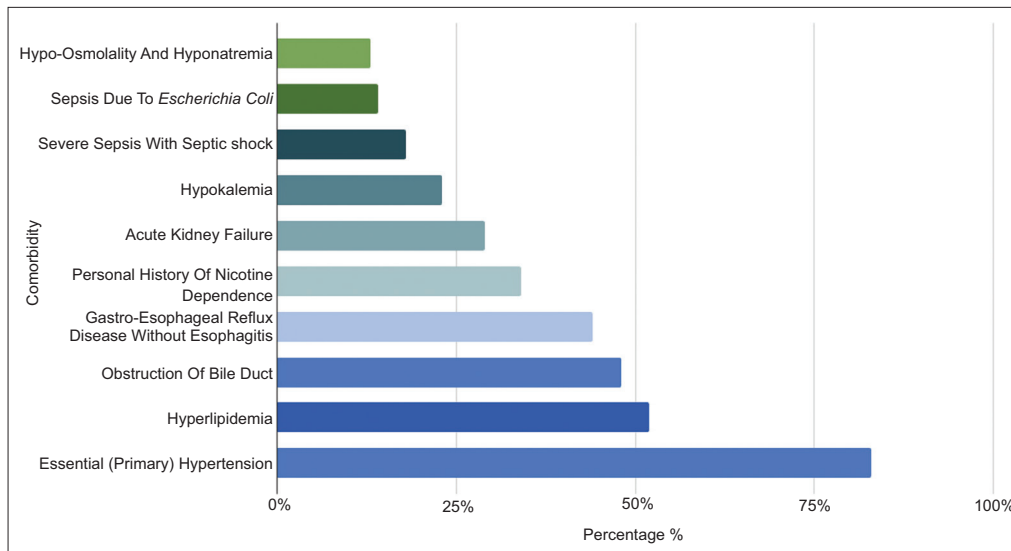
Figure 1 Associated comorbidities

Table 4 Average number of comorbidities by race of hospitalizations for acute cholangitis, National Inpatient Sample 2016-2017

Average comorbidities by race	Average number
Hispanic	13.80
White	15.18
Black	15.37
Native American	14.80
Asian or Pacific Islander	14.32
Other	14.58

95%CI 0.99-1.31) but this was not statistically significant as the P-value was greater than 0.05. Regarding race, Whites were used as a reference. The study showed that Blacks with AC were more likely to die than Whites (OR 1.3, 95%CI 1.04-1.62), with a P-value of 0.02, and Hispanics were more likely to die when compared to Whites (OR 1.42, 95%CI 1.14-1.76), with a P-value of 0.001.

When looking at the number of comorbidities/other diagnoses, the average number of comorbidities/other diagnoses varied from 13.8 to 15.3 depending on the race with the black race having an average of 15.3 and Hispanic race an average of 13.8. The risk of death was greater for patients with more than average number of comorbidities than for those with an average number of comorbidities (OR 1.15, 95%CI 1.14-1.167).

For insurance types, the reference factor used was patients under Medicare. Patients under Medicaid were more likely to die than Medicare patients (OR 1.56, 95%CI 1.21-2.00), with a P-value of 0.001. Patients treated under private insurance are at a higher risk of death than patients under Medicare (OR 1.31, 95%CI 1.09-1.58).

LOS

LOS (Table 6) was calculated by subtracting the admission date from the discharge date, with same-day discharges counted as 0. The LOS ranged from 0-194 days for patients with AC. Poisson regression was applied to understand the index-rate ratio of factors associated with the LOS. Age, sex, race, number of other diagnoses/comorbidities, patient income and insurance type were identified as factors associated with LOS.

Regarding age (age groups), the reference group was again set as 0-17 years. The incidence rate ratio (IRR) for the age group 18-39 years was 0.53 (95%CI 0.43-0.66), implying that the risk of staying longer in the hospital is reduced compared to the reference group. Patients aged 40-49 years had an IRR of 0.50 (95%CI 0.40-0.61) compared to the 0-17 age group, while patients 60 years and above had an IRR of 0.44 (95%CI 0.35-0.54).

Concerning race/ethnicity, Blacks were more likely to stay longer in the hospital compared to Whites (IRR 1.19, 95%CI 1.12-1.27), with Hispanics (IRR 1.11, 95%CI 1.05-1.18) and Asian/Pacific Islander (IRR 1.18, 95%CI 1.10-1.27) more likely to have a longer stay than Whites.

Again, the reference factor used for insurance types was patients under Medicare. Patients under Medicaid were 1.16 times (i.e., 16% greater risk) more likely to stay longer in the hospital than patients with Medicare (95%CI 1.07-1.25; P=0.001). Patients under self-pay were more likely to stay longer (IRR 1.17, 95%CI 1.01-1.35).

Hospital charges

Total hospital charges for patients with AC ranged from 233 USD to 5,155,906 USD. The total charges in 2016 were $766 million, which increased to $825 million in 2017. Poisson

Tle 5 Factors associated with inpatient outcomes in hospitalizations with acute cholangitis

Predictors	Mortality OR (95%CI)/P-value	Length of stay IRR (95%CI)/P-value	Hospital charges IRR (95%CI)/P-value	ERCP OR (95%CI)/P-value
Age range (years)				
18-39 vs. 0-18	1.20 (0.55-2.63) 0.64	0.53 (0.43-0.66) <0.001	0.45 (0.32-0.63) <0.001	1.78 (1.40-2.28) <0.001
40-59 vs. 0-18	1.74 (0.82-3.68) 0.14	0.50 (0.40-0.61) <0.001	0.41 (0.29-0.57) <0.001	2.96 (2.34-3.76) <0.001
>60 vs. 0-18	2.56 (1.20-5.43) 0.01	0.44 (0.35-0.54) <0.001	0.34 (0.24-0.47) <0.001	3.71 (2.93-4.70) <0.001
Sex: female vs. male	1.14 (0.99-1.31) 0.05	0.94 (0.91-0.98) 0.003	0.90 (0.85-0.95) <0.001	0.91 (0.86-0.98) 0.01
Race				
Black vs. white	1.30 (1.04-1.62) 0.02	1.19 (1.12-1.27) <0.001	1.15 (1.106-1.26) 0.001	1.04 (0.94-1.16) 0.39
Hispanics vs. whites	1.42 (1.14-1.76) 0.001	1.11 (1.05-1.18) <0.001	1.41 (1.28-1.55) <0.001	1.27 (1.14-1.42) <0.001
Asian/Pacific Islander vs. whites	1.13 (0.83-1.54) 0.40	1.18 (1.10-1.277) <0.001	1.46 (1.29-1.64) <0.001	1.28 (1.10-1.48) 0.001
Native American vs. whites	1.69 (0.80-3.57) 0.16	1.06 (0.86-1.31) 0.53	1.06 (0.78-1.46) 0.67	1.03 (0.69-1.55) 0.85
Others vs. whites	1.41 (1.02-1.95) 0.03	1.21 (1.06-1.38) 0.003	1.39 (1.13-1.71) 0.002	1.46 (1.17-1.82) 0.001
Number of diagnoses above average vs. average number of diagnoses	1.15 (1.14-1.16) <0.001	1.07 (1.06-1.07) <0.001	1.08 (1.07-1.09) <0.001	1.00 (0.99-1.00) 0.97
Health insurance				
Medicaid vs. Medicare	1.56 (1.21-2.00) <0.001	1.16 (1.107-1.25) <0.001	1.18 (1.05-1.34) 0.006	1.13 (1.003-1.27) 0.04
Private vs. Medicare	1.31 (1.09-1.5) 0.004	1.103 (0.98-1.08) 0.23	1.08 (1.00-1.17) 0.04	1.08 (.99-1.18) 0.06
Self-pay vs. Medicare	1.41 (0.88-2.27) 0.14	1.17 (1.01-1.35) 0.03	1.07 (0.80-1.43) 0.61	1.58 (1.26-1.98) <0.001
No charge vs. Medicare	1.66 (0.35-7.74) 0.51	1.38 (1.01-1.90) 0.04	1.48 (0.76-2.88) 0.23	2.29 (1.09-4.79) 0.02
Others vs. Medicare	1.71 (1.06-2.75) 0.025	1.09 (0.95-1.25) 0.19	0.95 (0.79-1.15) 0.66	1.00 (0.78-1.27) 0.98
Income status (percentiles)				
26th-50th vs. 0-25th	0.90 (0.73-1.10) 0.32	0.97 (0.92-1.02) 0.29	1.02 (0.94-1.11) 0.47	0.96 (0.87-1.05) 0.40
51st-75th vs. 0-25th	0.94 (0.76-1.15) 0.56	0.94 (0.90-0.99) 0.04	0.99 (0.91-1.07) 0.91	0.96 (0.87-1.06) 0.46
76th-100th vs. 0-25th	0.87 (0.71-1.07) 0.19	0.95 (0.90-1.00) 0.08	1.10 (1.00-1.20) 0.03	0.94 (0.85-1.03) 0.22

OR, odds ratio; CI, confidence interval; IRR, incidence rate ratio; ERCP, endoscopic retrograde cholangiopancreatography

Table 6 Length of stay of patients with acute cholangitis

Average length of stay by age	Mean (days)
Less than 18 years	11.19
18-39 years	6.70
40-59 years	7.30
≥60 years	6.87
Total	7.09

regression was applied to derive the index-rate ratio of factors associated with hospital charges. Age, sex, race, number of other diagnoses/comorbidities, patient's income and insurance type were again identified as factors associated with hospital charges. In the age-group category, the reference group remained patients aged 0-17 years. The IRR for patients 18-39 years was 0.45, (95%CI 0.32-0.63), implying that the total hospital charges were reduced compared to the reference age group. Patients aged 40-59 years had an IRR of 0.41, (95%CI 0.29-0.57) and patients 60 years and above had an IRR of 0.34, (95%CI 0.24-0.47) in hospital charges compared with patients less than 18 years.

Concerning insurance types, the reference factor was patients under Medicare. Patients under Medicaid were 1.18 times (i.e., 18% increased risk) more likely to pay higher hospital charges compared to patients under Medicare (P=0.006, 95%CI 1.05-1.34) and patients with private insurance were 1.08 times more likely to pay higher hospital charges compared to patients under Medicare (P=0.045, 95%CI 1.00-1.17).

In the sex-based analysis, female patients had less in hospital charges compared to male patients admitted for AC (IRR 0.90, 95%CI 0.85-0.95), and the analysis showed patients with a higher-than-average number of comorbidities had higher hospital charges compared with patients with the average number of comorbidities IRR 1.08 (95%CI 1.07-1.09).

Concerning race and ethnicity, Blacks were 1.15 times (95%CI 1.06-1.26; P=0.001) more likely to pay higher hospital charges compared to Whites, while Hispanics were 1.41 times (95%CI 1.28-1.55; P=0.001) more likely and Asian/Pacific Islanders 1.461 times (95%CI 1.29-1.64; P=0.001) more likely to pay higher hospital charges than Whites.

ERCP

Patients with AC who underwent ERCP were extracted from the data using a regular expression. Each patient with AC was examined to generate a new variable, recoded as 1 for patients who underwent ERCP and 0 for patients who did not. About 75.7% of patients underwent ERCP (Table 7), of whom most (93.7%) were discharged and the others died.

Binomial logistic regression was applied to derive the odds ratio of factors associated with an ERCP. Age, sex, race, number of other diagnoses/comorbidities, the income of the patient, and insurance type were used as factors associated with

Table 7 Relationship between endoscopic retrograde cholangiopancreatography (ERCP) and mortality amongst hospitalizations with acute cholangitis, National Inpatient Sample 2016-2017

No of patients	Survived (%)	Died (%)	Total (%)
Patients without ERCP	4342 (24.70)	187 (17.43)	4529 (24.29)
Patients with ERCP	13,234 (75.30)	886 (82.57)	14,120 (75.71)
Total	17,576 (100)	1,073 (100)	18,649 (100)

Likelihood ratio 31.20, P<0.001

undergoing an ERCP.

Concerning age-group, the reference was set as patients aged 0-17 years, and the odds ratio for patients aged 18-39 years was estimated at 1.78 (95%CI 1.40-2.28), implying that patients between 18-39 years were 1.78 times more likely to undergo ERCP compared to patients less than 18 years old. Patients 40-59 years were 2.97 times more likely to undergo an ERCP compared to patients less than 18 years old (95%CI 2.34-3.76; P=0.001), and patients older than 59 years were 3.72 times more likely to have an ERCP when compared to patients under 18 years (95%CI 2.93-4.70; P=0.001).

Female patients had a 9% lower risk of undergoing an ERCP when compared to male patients (95%CI 0.86-0.98; P=0.012), and looking at race/ethnicity, Hispanics were 1.27 times more likely to undergo an ERCP compared to Whites (95%CI 1.14-1.42; P=0.001) and Asian/Pacific Islanders were 1.28 times more likely to undergo ERCP compared to Whites (95%CI 1.10-1.48; P=0.001). Blacks and Native Americans were shown to have a higher risk of undergoing an ERCP, but the P-values were greater than 0.05.

Concerning insurance types, patients under Medicaid were 1.13 times more likely (i.e., 13% greater risk) to undergo an ERCP when compared to patients under Medicare (95%CI 1.00-1.27; P=0.04), and patients under self-pay were 1.58 times more likely to undergo an ERCP compared to Medicare patients (95%CI 1.26-1.98; P=0.001). Odds ratios for other types of insurance had P-values greater than 0.05.

Discussion

This study looked at the incidence and outcomes of AC in the United States from 2016 to 2017, as reported in the NIS database. AC was diagnosed as biliary obstruction and clinical evidence of infection.

A 1.36% increase in AC-related hospital admissions resulted in a 7.7% increase in hospitalization costs from 2016-2017. Our study showed that most of the patients with AC in both years were White and the smallest population were Hispanics. This contrasts with Jamal et al [6], who found the highest hospitalizations were amongst Asian/Pacific Islanders and the lowest rates in African Americans. The findings may be attributed to the increased risk of gallstones amongst native

Americans. AC results from biliary obstruction, for which the most common cause is gallstones [7], more prevalent in Native Americans [7,8]. Males were slightly more affected than females, while more than half of the patients were aged above 60 years and the smallest group were <18 years old. This finding could be linked to older patients' increased likelihood of being sicker with other comorbidities. In contrast, younger patients are more likely to be healthier with a less severe course. The study showed that younger patients had greater LOS compared to older patients, in contrast to McNabb-Baltar et al [17]. This disparity could be explained by the differences between the two studies' inclusion criteria and the presence of patients below 18 years of age in our study.

In 2017, there was a rise in mortality compared to 2016, with the highest burden among females and patients over 60 years old, consistent with Sugiyama et al [9]. Our study revealed a lot of racial disparities; patients admitted with AC who were Blacks, Hispanics or Asians/Pacific Islanders had worse outcomes, including in-hospital mortality, longer LOS, and higher hospital costs than Whites. African Americans, followed by Asian/Pacific Islanders, were noted to have higher risks of a more extended hospital stay than Whites. More comorbidities were also associated with a more extended hospital stay. African Americans were 1.3 times more likely to die than Whites, although out of the people hospitalized, a greater proportion were whites compared to other ethnicities. One could speculate that these differences were due to a greater number of comorbidities and disparity in health care availability. Our findings agreed with those of Jamal et al [6], which showed the highest hospital mortality were amongst blacks/hispanics compared to the whites. Patients under Medicaid were also more likely to die than patients under Medicare.

There may be multiple factors contributing to the observed increase in mortality among hospitalized adults in this study. Certain theories have been proposed to explain our findings, this includes the possibility that Blacks, Hispanics and Asians/Pacific Islanders may present late and with more severe disease, worsening their health outcomes [10]. Previous research has found racial differences in disease stage and severity at presentation [11]. Anatomical or biological differences could also explain racial disparities. For example, because they have more anatomical variation, Asians have a higher risk of bile duct injury during cholecystectomy [11]. When all predisposing factors are considered, it is also possible that Blacks, Hispanics, and Asians/Pacific Islanders do not receive the same standard of treatment as their white counterparts [12-14]. Racial disparities could also be exacerbated by language barriers [16]. Our study did find differences in ERCP rates between racial groups. They were significantly higher among other races than Whites and thus are unlikely to have been a significant factor in explaining mortality differences. Finally, some have suggested that various patient-physician relationship issues could contribute to the observed disparities [15].

In this study, the financial burden due to AC ranged from $233 to $5,155,906, resulting in a substantial burden on the healthcare system. There was a 7.7% increase in hospitalization costs between 2016 and 2017. Hospital costs were significantly

higher for other races when compared to White patients. This may result from other races having a more severe disease course. However, the cost of care was dramatically lower among patients in their 60s, representing beneficial outcomes of welfare policy for the senior population.

Additionally, compared to their privately insured counterparts, Medicaid and Medicare patients had a higher risk of in-hospital mortality, longer LOS and higher hospital expenditures. Hospital bills were marginally higher for Medicaid recipients than for individuals with private insurance, and a few factors could explain this gap. As reported for other illnesses [16], Medicaid and Medicare individuals may present with a later stage of the disease. Poor healthcare accessibility could also be a factor [17]. Alternatively, the disparity in outcomes could be related to unrecognized socioeconomic inequalities.

Between 2016 and 2017, there was a 0.8% increase in the number of patients who underwent ERCP, according to our research. ERCP was shown to be more common in patients over 60 than in other age groups. These findings could be attributed to older patients being more likely to be sicker at presentation with other comorbidities and to require immediate drainage. In contrast, younger patients are more likely to be healthier, have a less acute presentation, and safely get elective ERCP or none [18]. According to our study, the patients who had to undergo an ERCP had a higher risk of death, probably because these patients were more critical than those who did not require an ERCP. In terms of race Hispanics and Asians/Pacific Islanders were more likely to undergo ERCP than Whites. The increasing use of ERCP in Hispanics has already been observed [19] and may be related to the higher occurrence of biliary stones in that community [16]. In a previous study, Asian and Pacific Islander patients were more likely to require surgical drainage than White patients. This could be related to an increase in the prevalence of biliary tract diseases amongst Asia and pacific islanders such as hepatolithiasis and choledochal cysts, which frequently necessitate surgical intervention [20].

This study is the second to evaluate nationwide hospitalization and factors associated with inpatient outcomes in the United States. The large sample size employed for analysis is the investigation's main strength. The NIS database is one of the country's most extensive all-payer inpatient and health information databases. Furthermore, it is designed to approximate an immense sample of patients from an extensive range of hospital settings, including academic medical centers, public hospitals, and specialty hospitals in urban and rural areas. As a result, the trends observed from this database are not limited to specific subpopulations of patients and are therefore likely to reflect actual trends occurring across the nation.

A limitation of the study is that accurate diagnosis of AC is dependent on proper ICD-10-CM coding, susceptible to error if coding is not accurately completed. However, this error level was unlikely to have changed across the study period and should not have affected the overall trends. The ICD-10 codes related to cholangitis did not change over the study period.

In conclusion, the hospitalization rate for cholangitis in the United States has declined since its peak in 1998. Factors such as age, sex, comorbidities, race and insurance status are

independent predictors of mortality, length of hospitalization, hospital charges, and the need for ERCP. This study added to the current literature by linking the use of ERCP to factors such as age, race, comorbidities, and insurance.

Summary Box

What is already known:

- The prevalence of acute cholangitis (AC) is higher amongst Asians/Pacific Islanders and the lowest in African Americans
- Peak incidence of AC was found between the ages of 50 and 60 years, with equal prevalence in males and females
- The most frequent etiology for AC is gallstones

What the new findings are:

- The prevalence of AC was highest amongst Whites and lowest amongst Hispanics, with the most frequent etiologies being common bile duct obstruction and neoplasm
- More than half of the patients hospitalized with AC were above 60 years old, with a male predominance
- Racial disparities were noted, with Blacks, Hispanics and Asians/Pacific Islanders having worse outcomes, greater mortality, longer hospital stay and higher hospital costs
- The burden of AC on the healthcare system increased from $766 million in 2016 to $825 million in 2017

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