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Cholecystectomy During Index Admission for Acute Biliary Pancreatitis Lowers 30-day Readmission Rates

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Abstract

Objectives: Few studies have evaluated national readmission rates after acute pancreatitis (AP) in the United States. We sought to evaluate *modifiable factors* impacting 30-day readmissions following AP hospitalizations.

Methods: We utilized the Nationwide Readmission Database (2013) involving all adults with a primary discharge diagnosis of AP. Multivariable logistic regression models assessed independent predictors for specific outcomes.

Results: Among 180,480 patients with AP index admissions, 41,094 (23%) had biliary-AP, of which 10.5% were readmitted within 30-days. The 30-day readmission rate for patients who underwent same-admission cholecystectomy (CCY) was 6.5%, compared to 15.1% in those who did not ($P < 0.001$). Failure of index-admission CCY increased the risk of readmissions (odds ratio

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[OR], 2.27; 95% confidence interval [CI], 2.04–2.56). Same-admission CCY occurred in 55% (n = 19,274) of patients *without* severe-AP. Severe-AP (OR, 0.73; 95% CI, 0.65–0.81), sepsis (OR, 0.63; 95% CI, 0.52–0.75), 3 comorbidities (OR, 0.74; 95% CI, 0.68–0.79), and admissions to small (OR, 0.76; 95% CI, 0.64–0.91) or rural (OR, 0.78; 95% CI, 0.65–0.95) hospitals were less likely to undergo same-admission CCY.

Conclusions: Same-admission CCY should be considered in patients with biliary-AP when feasible. This national appraisal recognizes modifiable risk factors to reduce readmission in biliary-AP and reinforces adherence to major society guidelines.

Keywords

cholecystectomy; nationwide readmission; gallstone-pancreatitis; biliary-pancreatitis; outcomes

Introduction

Acute pancreatitis (AP) accounts for nearly 250,000 hospitalizations yearly in the United States. With rapidly increasing annual rates of admission, AP contributes to a sizeable burden on the healthcare system in terms of resource utilization and healthcare costs.^{1,2} This is further exacerbated by a high 30-day readmission rate of 20%–30% for all admissions with AP.^{3–5} High readmission rates pose several threats within the healthcare system, including an increased 1-year mortality, significant financial liability on the healthcare system, and reflect an inferior quantitative measure of quality of care as per the Center for Medicare & Medicaid Services (CMS).^{6,7}

These issues emphasize the importance of examining and potentially minimizing the elements contributing to 30-day readmissions. There are several recognized risk factors for AP readmission including, but not limited to, delay in cholecystectomy, alcohol use following discharge, male sex, discharge on less than solid diet, and generalized gastrointestinal symptoms of nausea, vomiting, or diarrhea.^{4,8–10}

Gallstones, along with alcohol, represent the most common etiology of acute pancreatitis in the United States and worldwide.¹¹ Current societal guidelines, including the American College of Gastroenterology, the American Gastroenterological Association, and the International Association of Pancreatology, recommend cholecystectomy for mild gallstone-induced AP (biliary-AP) during the index admission.^{11–13} However, several audits from the United States and Europe have revealed that cholecystectomy is usually performed after index-hospitalization and sometimes up to 6 weeks after discharge from the hospital.^{14–17}

To date, there is limited research through population-based studies evaluating readmissions after AP and biliary-AP.^{18–20} Therefore, we sought to determine national level practices to assess the demographic, hospital-associated, clinical, and dispositional factors associated with 30-day readmission rates for AP and biliary-AP, as well as the role of CCY on outcomes.

METHODS AND MATERIALS

Data Source

The Nationwide Readmission Database (NRD), derived from the Healthcare Cost Utilization Project (HCUP) State Inpatient Databases (SID), is an administrative claims databank of all nonfederal acute-care hospitals. The NRD was developed from 21 SIDs with verified patient linkage numbers that could be used to track a patient across all nonfederal acute-care hospitals within a state, while adhering to strict privacy guidelines.²¹ Un-weighted, the NRD contains data from approximately 14 million discharges annually. Discharge weights are provided, allowing extraction of nation-level estimates from the un-weighted database. Weighted to represent US national readmission rates, it estimates roughly 36 million discharges.²¹

The 2013 NRD-HCUP database was queried using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis and procedure codes. Hospitalizations for AP were selected using the ICD-9-CM diagnostic code 577.1 as the primary discharge diagnosis. Discharges between January 1st and November 30th were included to provide for a minimum 30-day follow up before the end of 2013. AP-related etiologies and associated diagnoses were queried from secondary diagnoses using respective ICD-9-CM codes (Supplementary Table 1).

The following exclusions were applied for accrual of index hospitalization with AP: (a) age 17 years, (b) all codes describing status of pregnancy, and (c) concurrent diagnosis of chronic pancreatitis (CP) or pancreatic neoplasms. Specifically, additional exclusions were applied for analyzing 30-day readmissions after index hospitalization with AP: (a) missing information on length of stay or readmission, and (b) death during index admission. Additionally, etiologies other than biliary-AP (alcohol, metabolic, other) were excluded from the biliary-AP subgroup after classifying associated diagnostic codes using a hierarchical algorithm (Fig. 1). Hospital Acquired Conditions (HACs) were defined using ICD-9-CM codes and verified through CMS literature (Supplementary Table 2).²² We determined the incidence rates of HACs among patients readmitted within 30 days after index hospitalization with AP.

The Ohio State University Data and Specimen Policy and Human Subjects Research Policy does not require Institutional Review Board approval for a population based public data set.

Patients and Outcomes

Patient-level variables included age, sex, median household income for patient's zip code (quartiles), and insurance status. Race/ethnicity is not available in the NRD since some SIDs do not divulge this information. Insurance status was categorized as Medicare, Medicaid, private insurance, and uninsured/other based on the primary payer listed on the discharge record. Hospital location and teaching status were combined into a single variable with the following categories: Rural, urban non-teaching, and urban-teaching hospital. Hospital bed size was classified as small, medium, or large, based on an algorithm developed by HCUP. Comorbidities for risk adjustment were derived from AHRQ comorbidity measures based on

the methods by Elixhauser.²³ Patients were given a score of < 3 or ≥ 3 based on the number of comorbidities.

As described previously, we used a hierarchical algorithm using associated diagnosis codes to assign patients into different etiological groups: alcohol-related disorders, gallstone-related disorders, metabolic syndrome, and others (patients not classified into the preceding groups).³ A patient was classified only once in a particular etiological group based on the sequence of hierarchy (Fig. 1; Supplementary Tables 1, 3). According to guidelines from the National Heart, Lung, and Blood Institute and the American Heart Association, metabolic syndrome is diagnosed when a patient has at least 3 of the following 5 conditions: Diabetes, hypertension, hypertriglyceridemia, low high density lipoprotein (HDL) cholesterol, and abdominal obesity.²⁴ Due to lack of specific ICD-9-CM coding for low HDL cholesterol, we defined presence of metabolic syndrome when hyperlipidemia, hypertension, obesity, and diabetes were all identified in a patient.

Severe AP which was defined by presence of either acute renal failure, respiratory failure, or need for intravenous vasopressin (surrogate marker for hypotension/cardiac failure).²⁵ Complications due to AP, including presence of sepsis, intra-abdominal infections, and need for pancreatic surgical procedures, were reviewed. Procedures required for biliary obstructions or gallstones such as cholecystectomy, endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography, and open bile duct exploration were analyzed. Patient disposition included discharge to home, home health, skilled nursing facility, or hospitals with higher acuity care.

The primary outcome of interest was predictors of 30-day readmission following index hospitalization with AP and biliary-AP. The secondary outcomes included predictors of failure to perform same-admission cholecystectomy in patients with biliary-AP.

Statistical Analysis

The study schema is illustrated in Figure 1. There were two sets of analyses: (a) univariable and multivariable analyses for evaluating predictors of 30-day readmission following hospitalization with biliary-AP, and (b) univariable and multivariable analyses for evaluating predictors of failure to perform same-admission cholecystectomy in biliary-AP. Categorical variables were tested for statistical significance with Chi-square analysis. Continuous variables were tested using the *t* test. The mean with standard error (SE) or median with interquartile range (IQR) were calculated for continuous outcomes, and frequency counts and percentages were calculated for categorical outcomes. Statistical significance was defined by $P < 0.05$.

Cases were defined as those patients (both for AP and biliary-AP cohorts) who were readmitted within 30 days following hospital discharge whereas *controls* were those who weren't readmitted within 30 days. For patients with more than one readmission within 30 days, their first readmission was included for analysis. Univariable analysis was performed to compare demographic characteristics, hospital features, insurance, Elixhauser comorbidity index, AP-etiology, complications, AP severity, AP-related endoscopic and surgical procedures, and dispositional factors of AP between the cases and controls.

Subsequently, multivariable analyses were performed where terms included in the final model were determined through backwards selection where all terms in the univariable analysis were eligible for inclusion. Results from the multivariable analyses were represented using odds ratios (OR) and 95% confidence intervals (CI). Separate multivariable analyses were performed to evaluate predictors of same-admission cholecystectomy among patients with biliary-AP. Cumulative hazard curves for 30-day readmission (event) in AP were constructed based on etiologies (alcohol, gallstone, metabolic, and others) and same-admission cholecystectomy; equality of the curves was evaluated with the log-rank test.

These analyses were performed on weighted data from the NRD using SAS 9.4 (SAS Institute, Cary, NC) employing appropriate survey procedures to produce national estimates. The large population-database facilitated exclusion of infrequent missing data (0.006%; Fig. 1) thus improving the specificity of the results.

RESULTS

There were 222,588 unique inpatient hospitalizations with a principal diagnosis of AP in 2013 during which 1661 (0.75%) died at index admission (Fig. 1). After exclusions, 180,480 index AP hospitalizations were included. Among these, 22,527 (12.5%) patients were readmitted within 30 days. The median time to readmission was 10 (IQR, 4.00–17) days.

In a subgroup analysis, a total of 41,094 (23%) with biliary-AP were identified. Among these, 4333 (10.5%) patients were readmitted within 30 days. The median time to readmission was 9 (IQR, 4.00–17) days. The 30-day readmission rates were less than half for patients who underwent same-admission CCY compared to those who did not (6.5% vs. 15.1%, $P < 0.001$).

Reasons for 30-day Readmission

Table 1 details the reasons for 30-day readmissions following index all-cause AP and biliary-AP hospitalizations. The most frequent reason for readmission were pancreatitis-related diagnoses (AP, CP, or pancreatic pseudocyst) as primary or secondary discharge diagnosis in 8573 (38%) and 4332 (19%) of patients respectively for all-cause AP, and 1321 (30%) and 925 (21%) of patients respectively for biliary-AP. Among all-cause AP and for those readmitted within 30 days, 50% had one, 22% had two, 17% had three or four, and 10% had five or more readmissions during that year. HACs (Supplementary Table 2) as primary diagnosis accounted for less than 2.3% of readmissions.

Univariable Analysis

Univariate analysis (Supplementary Table 4) comparing cases and controls for biliary-AP revealed that older patients, male gender, those with 3 comorbidities, complicated disease course with severe-AP, sepsis, intra-abdominal infections, need for surgical pancreatic procedures, transfers from outside hospitals, and those with prolonged hospitalization had significantly higher rates of 30-day readmission. Differences were also observed across multiple variables involving other demographic features (income level, insurance type), hospital characteristics (location, size) and discharge dispositions.

Among 41,094 patients with biliary-AP, 21,838 (53%) underwent cholecystectomy during index hospitalization. Among patients with biliary-AP who underwent cholecystectomy, 11.74% (n = 2564) were classified as having severe AP. Same-admission CCY was only performed in 55% (n = 19,274) of patients *without* severe AP. The univariate predictors of same-admission cholecystectomy are shown in Supplementary Table 5.

Kaplan-Meier Analysis

All Cause AP: Compared with gallstone and alcohol-related AP, patients with metabolic syndrome-related etiology demonstrated a higher cumulative hazard of 30-day readmission (univariate analysis, log-rank test, $P < 0.001$; $\chi^2 = 616$; Fig.2A). Biliary-AP had the lowest risk of 30-day readmission.

Biliary-AP: When comparing patients with and without cholecystectomy on index admission, patients without same-admission cholecystectomy demonstrated a higher hazard of readmission (log-rank test, $P < 0.001$, χ^2 , 719; Fig. 2B).

Multivariable Analysis for All-Cause Acute Pancreatitis

On multivariate analysis (Table 2), insurance status [Medicare: (OR, 1.47; 95% CI, 1.36–1.59) and Medicaid (OR, 1.59; 95% CI, 1.48–1.72)], 3 Elixhauser comorbidities (OR, 1.38; 95% CI, 1.31–1.46), severe AP (OR, 1.43; 95% CI, 1.34–1.52), performance of pancreatic surgical procedures (OR, 1.58; 95% CI, 1.29–1.94), increasing length of stay (OR, 1.02; 95% CI, 1.01–1.02), and all non-routine patient discharges were significant predictors of increased 30-day readmission risk.

Multivariable Analysis for Biliary Acute Pancreatitis

On multivariate analysis (Table 3), most of the variables predictive of 30-day readmission for all-cause AP were associated with an increased risk of 30-day readmission following index gallstone-AP hospitalization. Notably, absence of same-admission cholecystectomy was associated with 30-day readmission (OR, 2.27; 95% CI, 2.04–2.56).

Multivariate Analysis for Predicting Same-admission Cholecystectomy for Biliary Acute Pancreatitis

Multivariate analysis (Table 4) revealed that rural hospitals (OR, 0.78; 95% CI, 0.65–0.95), small (<250 beds) hospitals (OR, 0.76; 95% CI, 0.64–0.91), 3 Elixhauser comorbidities (OR, 0.74; 95% CI, 0.68–0.79), severe AP (OR, 0.73; 95% CI, 0.65–0.81), and presence of sepsis (OR, 0.63; 95% CI, 0.52–0.75) were associated with not undergoing same-admission cholecystectomy. However, female gender (OR, 1.14; 95% CI, 1.07–1.22) and undergoing ERCP (OR, 1.14; 95% CI, 1.05–1.25) were associated with same-admission cholecystectomy.

DISCUSSION

In this large population-based study of unique patients, we demonstrate that nearly 1-in-8 patients with all-cause AP and 1-in-10 patients with biliary-AP were readmitted within 30-days of discharge. Notably, around 50% of these readmissions were related to recurrences or

AP-related complications. Among factors predicting 30-day readmission in AP, modifiable risk factors included management and outcomes of inpatient hospitalization, whereas non-modifiable factors mostly comprised insurance type, hospital size and location. While this novel analysis demonstrates adherence to published guidelines for same admission cholecystectomy following biliary-AP, failure to do so was independently associated with higher odds of 30-day readmissions. All patients with non-necrotizing biliary-AP should thus be evaluated for same-admission cholecystectomy, and this appraisal of the national readmission database raises such awareness and emphasizes adherence to major society guidelines.

The 30-day readmission rate for all-cause AP was 12.5%. Prior studies from single academic tertiary care centers in the US reveal 30-day readmission rates of 19% (2005–2007),⁸ 16.5% (2003–2010),⁴ and 15.2% (2007–2011).⁶ The readmission rates for “urban teaching hospitals” described here were 13.2%. Overall, these rates are comparable to prior published data from centers managing complex patients with AP.

Regarding insurance status and hospital size, this study confirms previously published data detailing AP readmissions as they relate to health system demographics. As identified by AHRQ, readmission rates amongst patients for ‘any hospitalization’ differ based on insurance type, with Medicare and Medicaid beneficiaries suffering a 55.9% and 20.6% rate of 30-day readmission, respectively, in comparison to the rate of 18.6% in privately insured patients.²⁶ This notion of stratified readmission rates based on insurance type was upheld in our study. In a review of a large US commercial claims and encounters database (Thomson Reuters MarketScan), researchers found that patients who underwent cholecystectomy within the first 30-days of hospitalization had fewer comorbidities.²⁷ These findings are similar to our analyses that patients with 3 Elixhauser comorbidities were associated with not undergoing same-admission cholecystectomy and having higher odds of 30-day readmission.

In keeping with several prior studies, our study confirmed severity of disease as a major predictor of AP readmission.^{4,28} The use of surgical pancreatic procedures in the management of AP patients also lends to increased readmission risk. We found that nearly one in three patients who underwent a pancreatic-related procedure at the time of index admission required readmission. Prolonged hospitalization also contributed to readmission rates. It can be hypothesized that prolonged hospitalization implies local or systemic AP-related complications. Therefore, a higher readmission rate in prolonged hospitalization could be secondary to a more severe disease course that necessitates longer hospitalization.

It is an established practice that patients admitted for severe biliary-AP have cholecystectomy delayed until local complications have resolved. A nationwide study in the Netherlands demonstrated that 75.5% of 249 patients admitted with mild biliary-AP underwent cholecystectomy after a median of 6 weeks post-discharge, and 23% were readmitted with either a biliary event or biliary-AP prior to cholecystectomy.¹⁴ There was previously a lack of evidence from prospective randomized controlled trials (RCTs), and hence a majority of surgeons performed an interval cholecystectomy due to uncertainty regarding the efficacy and safety of same-admission cholecystectomy. These doubts were

answered in a study by the Dutch Pancreatitis Study Group (the PONCHO trial), a multicenter RCT that revealed same-admission cholecystectomy reduced the risk of acute readmission in mild biliary-AP from 17% to 4.7%, and was proven to be cost-effective compared to interval cholecystectomy.²⁹

A prior analysis of the Nationwide Inpatient Sample (NIS) from 1998–2003 similarly demonstrated that around 50% of patients with biliary-AP underwent same-admission cholecystectomy.¹⁶ This study also found that hospitals with high volumes of cholecystectomy adhere to societal guidelines to a greater degree than low-volume centers. These realities reinforce our findings that cholecystectomy is less likely to be performed at rural and smaller hospitals, thus creating a need for possible solutions in low-volume and rural centers.^{16,29} Furthermore, AP is a complex disease entity requiring multidisciplinary care. Large urban centers traditionally offer a myriad of resources ranging from advanced endoscopists, pancreatobiliary surgeons, clinical nutritionists, and social workers that aid in the multifaceted care of patients with AP, whereas rural hospitals may be limited in terms of resources.³⁰ The role and effectiveness of educating treating physicians to promote adherence to guidelines, while sounds theoretically effective, needs to be proven in prospective studies. Additionally, changes in hospital infrastructure to incorporate multidisciplinary management of AP is difficult to achieve when resources are limited. Thus, future studies will need to assess the role of patient transfer from low-volume to high-volume hospitals to alleviate patient readmissions.

Our study has several limitations as this is an analysis of an administrative database which is dependent on the limitations of the ICD-9-CM coding. A major advantage of utilizing NRD over NIS is that we are able to study individual/unique patients and follow them longitudinally over the course of one calendar year. Prior studies evaluating accuracy of ICD-9-CM coding for AP have reported a median diagnostic accuracy of 80%.^{31,32} In the absence of etiology-specific diagnostic coding of AP, we used associated codes for predisposing etiological diseases or conditions; the limitation being that we were unable to find associated etiology in nearly 50% of patients with AP. Also, administrative databases relying on ICD-9 coding are unable to precisely categorize patients with ‘necrotizing pancreatitis’ and ‘severe AP’. Hence, we used ICD-9 codes for organ failure to define severe AP. Prior studies have successfully implemented the above methodologies utilizing county and national databases.^{1,5} Additionally, this dataset is limited in identifying patients who have had a prior cholecystectomy and are admitted with choledocholithiasis; albeit this would contribute to a minority of patients with biliary AP. We are unable to study readmissions based on race and ethnicity, as this is not provided in the NRD.

While our report on readmissions following AP represents one of few studies utilizing a national readmission database in the US, it is perhaps unsurprising to find that we demonstrated similar results compared to single or multicenter studies. Among multiple factors predictive of readmission after AP, failure to undergo same-admission cholecystectomy stands out as a prominent amendable factor. It appears that, despite guidelines in place by a multitude of authoritative entities, there is inadequate adherence to recommendations for same-admission cholecystectomy. Hence, future studies should focus on ways to further promote well-established guidelines among all hospital practices in order

to lower readmission rates and the burden that it places on both the patient and the healthcare system.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

AP	Written fully on first use- Acute Pancreatitis
CMS	Center for Medicare & Medicaid Services
CCY	Cholecystectomy
CP	Chronic Pancreatitis
CI	Confidence Intervals
ERCP	Endoscopic Retrograde Cholangiopancreatography
biliary-AP	Gallstone-induced AP
HCUP	Healthcare Cost Utilization Project
HDL	High Density Lipoprotein
HACs	Hospital Acquired Conditions
IQR	Interquartile Range
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
NIS	Nationwide Inpatient Sample
NRD	Nationwide Readmission Database
OR	Odds Ratios
RCTs	Randomized Controlled Trials
SE	Standard Error
SID	State Inpatient Databases

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FIGURE 1.

Study schematic. AP: Acute pancreatitis, Index-AP: Index hospitalization with biliary acute pancreatitis.

FIGURE 2.

Kaplan-Meier cumulative hazard analysis of 30-day readmission. A, 30-day readmission for acute pancreatitis based on underlying etiology. B, 30-day readmission in biliary acute pancreatitis comparing patients with and without cholecystectomy.

Table 1.

Reasons for 30-day Readmission Following Index Hospitalization, Nationwide Readmission Database (2013)

Reason for Readmission	AP-related Disorders [*] as Primary Discharge Diagnosis	AP-related Disorders [*] as Secondary Discharge Diagnosis	Pancreatitis Related Surgical Procedures [†]	Others	Total
Acute Pancreatitis, n					
Primary diagnoses					
AP-related disorders [*]	8573	0	0	0	8573
HACs [‡]	0	168	2	338	508
Other related disorders [§]	0	4164	88	838	5090
Other unrelated disorders	0	0	123	8233	8356
Total					22,527
Biliary AP, n					
Primary diagnoses					
AP-related disorders [*]	1321	0	0	0	1321
HACs [‡]	0	3	0	38	41
Other related disorders [§]	0	922	12	429	1363
Other unrelated disorders	0	0	18	1590	1608
Total					4333

^{*} AP-related disorders: Includes readmission with AP, chronic pancreatitis, and pancreatic pseudocyst

[†] Pancreatitis related surgical procedures: Includes pseudocyst drainage, pancreatectomy (proximal, distal, removal of lesion), and abdominal wall incision, exploratory laparotomy, and percutaneous abdominal drainage related to pancreatic surgery

[‡] Hospital Acquired Conditions (HACs) were defined using the ICD-9-CM codes and verified through Center for Medicare & Medicaid Services

[§] Other related disorders: Patients readmitted without a primary diagnosis of pancreatitis related disorders or HACs

^{||} Other unrelated disorders: Patients readmitted without a primary or secondary diagnosis of pancreatitis related disorders or HACs

Table 2.

Multivariable Logistic Regression Analysis for Analysis of 30-Day Readmission Following Index Hospitalization with Acute Pancreatitis, Nationwide Readmission Database 2013

n = 180,480	30-day Readmission OR (95% CI)	P
Age	0.99 (0.99–1.00)	<0.001
Type of insurance [*]		<0.001
Private	Reference	
Medicare	1.47 (1.36–1.59)	
Medicaid	1.59 (1.48–1.72)	
Other	1.04 (0.95–1.13)	
Type of hospital		0.012
Urban teaching	Reference	
Urban non-teaching	0.94 (0.89–1.00)	
Rural	0.89 (0.81–0.96)	
Hospital size [†]		<0.001
Small	0.92 (0.85–1.00)	
Medium	0.86 (0.82–0.92)	
Large	Reference	
AHRQ-Elixhauser Index [‡]		<0.001
<3	Reference	
3	1.38 (1.31–1.46)	
Severe AP	1.43 (1.34–1.52)	<0.001
Pancreatic procedures	1.58 (1.29–1.94)	<0.001
Etiology		<0.001
Gallstone related	Reference	
Alcohol	1.08 (1.00–1.18)	
Metabolic	1.11 (0.94–1.31)	
Other	1.36 (1.27–1.45)	
Length of stay	1.02 (1.01–1.02)	<0.001
Disposition		
Home/routine	Reference	
Transfer to critical access/short term hospital	1.95 (1.58–2.42)	
Transfer to SNF/similar	1.48 (1.34–1.64)	
Home health	1.72 (1.56–1.89)	
Other	2.58 (2.32–2.86)	

* Private insurance includes HMO. Insurance category of 'others' includes self-pay and with 'no charge'

[†] Bed size categories are based on hospital beds, and are specific to the hospital's location and teaching status. Bed size assesses the number of short-term acute beds in a hospital¹

[‡] Comorbidities for risk adjustment were derived from Agency for Healthcare Research and Quality (AHRQ) comorbidity measures based on the methods by Elixhauser. A total of 29 comorbidity indicators are reviewed

SNF indicates Skilled nursing facility

Table 3.

Multivariable Logistic Regression Analysis for Analysis of 30-Day Readmission Following Index Hospitalization with Biliary Acute Pancreatitis, Nationwide Readmission Database 2013

n = 41,094	30-day Readmission OR (95% CI)	P
Type of insurance *		0.002
Private	Reference	
Medicare	1.09 (0.94–1.27)	
Medicaid	1.38 (1.15–1.65)	
Other	0.97 (0.80–1.19)	
AHRQ-Elixhauser Index †		<0.001
< 3	Reference	
3	1.39 (1.22–1.57)	
Severe AP	1.57 (1.34–1.82)	<0.001
Cholecystectomy	0.44 (0.39–0.49)	<0.001
Length of stay	1.02 (1.01–1.03)	<0.001
Disposition		<0.001
Home/Routine	Reference	
Transfer to critical access/short term hospital	1.31 (0.87–1.98)	
Transfer to SNF/similar	1.36 (1.09–1.70)	
Home health	1.55 (1.29–1.86)	
Other	2.8 (1.95–4.01)	

* Private insurance includes HMO. Insurance category of 'others' includes self-pay and with 'no charge'

† Comorbidities for risk adjustment were derived from Agency for Healthcare Research and Quality (AHRQ) comorbidity measures based on the methods by Elixhauser. A total of 29 comorbidity indicators are reviewed

Table 4.

Multivariable Logistic Regression Analysis for Analysis of Same-Admission Cholecystectomy Following Index Hospitalization with Biliary Acute Pancreatitis, Nationwide Readmission Database 2013

n = 41,094	OR (95% CI)	P
Age	0.98 (0.98–1.00)	<0.001
Sex		<0.001
Male	Reference	
Female	1.14 (1.07–1.22)	
Type of hospital		<0.001
Urban Teaching	Reference	
Urban Non-Teaching	1.18 (1.05–1.33)	
Rural	0.78 (0.65–0.95)	
Hospital size *		0.007
Small	0.76 (0.64–0.91)	
Medium	0.92 (0.81–1.04)	
Large	Reference	
AHRQ-Elixhauser Index †		<0.001
<3	Reference	
3	0.74 (0.68–0.79)	
Severe AP	0.73 (0.65–0.81)	<0.001
Sepsis	0.63 (0.52–0.75)	<0.001
ERCP	1.14 (1.05–1.25)	0.003
Length of stay	1.05 (1.03–1.06)	<0.001
Disposition		<0.001
Home/Routine	Reference	
Transfer to Critical Access/Short Term Hospital	0.14 (0.09–0.23)	
Transfer to SNF/similar	0.6 (0.51–0.71)	
Home health	0.8 (0.69–0.92)	
Other	0.07 (0.04–0.12)	

* Bed size categories are based on hospital beds, and are specific to the hospital's location and teaching status. Bed size assesses the number of short-term acute beds in a hospital¹

† Comorbidities for risk adjustment were derived from Agency for Healthcare Research and Quality (AHRQ) comorbidity measures based on the methods by Elixhauser. A total of 29 comorbidity indicators are reviewed