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Addressing the quality and cost of cholecystectomy at a safety net hospital

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ABSTRACT

Background: The aim of this study was to evaluate the effects of safety-net burden on outcomes of a common, urgent operation like cholecystectomy.**Methods:** We identified all cholecystectomies performed from 2005 to 2011 in the California State Inpatient Database and separated them into three cohorts based on the performing hospital's safety-net burden. Hierarchical multivariable regression analyses were performed with outcomes including laparoscopy, advanced disease, morbidity, length of hospitalization, and cost.**Results:** Safety-net hospitals had similar rates of laparoscopy, overall advanced disease, and post-operative morbidity. Yet, they were able to maintain lower overall costs (cost difference −5592, 95% CI −8928, −2256, $p < 0.01$), despite having similar lengths of stay.**Conclusion:** Safety-net hospitals performed cholecystectomy with similar rates of laparoscopy and morbidity, while achieving lower costs. Safety-net hospitals may be well equipped to perform common, urgent operations like cholecystectomy.

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1. Introduction

Safety-net providers, as defined by the Institute of Medicine, deliver care to the uninsured, Medicaid, and otherwise vulnerable populations.¹ However, their unreliable payment source combined with government mandates to provide unprofitable services threaten their operating margins and financial viability raising concerns about the quality of care they provide.²

Safety-net hospitals do worse with aspects of patient experience like timeliness, patient-centeredness, and overall satisfaction.^{3,4} Data regarding clinical outcomes have been mixed. Safety-net hospitals have been associated with increased readmission rates and mortality with myocardial infarction, heart failure, and pneumonia.^{5–7} Recent studies examining the effects of safety-net burden on surgical outcomes appear to show inferior outcomes with complex, elective surgeries. They have worse outcomes with advanced abdominal operations, urologic surgery, and orthopedic procedures.^{8–11} In addition to these safety concerns, multiple

studies report safety-net hospitals incur higher costs with surgery when compared to their non-safety-net counterparts.^{10–12}

However, there is limited data regarding outcomes of common, urgent general surgery operations. Therefore, it was our aim to evaluate the effect of safety-net burden on outcomes and costs of a common urgent, general surgery operation like cholecystectomy. Our hypothesis was that patients undergoing cholecystectomy at a safety-net hospital present with advanced disease, have less access to technology, and have inferior outcomes, while incurring higher costs.

2. Materials and methods

We used the California State Inpatient Database (SID) from the Healthcare Cost and Utilization Project, which includes all inpatient discharges from non-governmental hospitals in the state, providing discharge data such as patient demographics, insurance status, diagnoses, procedures performed, LOS, and total charges. Cost was inflation adjusted to 2010 dollars using the cost-to-charge ratio files provided by the Healthcare Cost and Utilization Project and published medical consumer price index. The California Hospital Annual Utilization Data was used to determine hospital

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characteristics, such as teaching hospital status and ownership type (public or private).^{13,14}

We queried the California SID from 2005 to 2011 for all admissions with a diagnosis of cholecystitis using *International Classification of Diseases, Ninth Revision (ICD-9)* codes 575.0 (acute cholecystitis), 575.1 (other cholecystitis) including 575.10 (cholecystitis, unspecified), 575.11 (chronic cholecystitis), and 575.12 (acute and chronic cholecystitis). We identified those that had a cholecystectomy as their primary procedure using ICD-9 codes 51.21 (other partial cholecystectomy), 51.22 (cholecystectomy), 51.23 (laparoscopic cholecystectomy), and 51.24 (laparoscopic partial cholecystectomy).

All hospitals that performed a cholecystectomy were then stratified based on their safety-net burden. A hospital's safety-net burden was defined as the percentage of patients treated within each calendar year that were either Medicaid or uninsured. These hospitals were then grouped into three different cohorts with low-burden hospitals (LBHs) having cared for the lowest quartile of Medicaid and uninsured, medium-burden hospitals (MBHs) having cared for the middle two quartiles of Medicaid and uninsured, and high-burden hospitals (HBHs) having cared for the highest quartile of Medicaid and uninsured.

Primary outcomes included rates of perforation, hydrops, use of laparoscopy, morbidity, as well as mean length of stay (LOS) and cost. Hydrops was identified using ICD-9 code 575.3 and perforation was identified using ICD-9 code 575.4. We investigated common complications associated with cholecystectomy including infectious complications (wound infection, intra-abdominal abscess) and intestinal complications (perforation, *C difficile* infection, other digestive system complications [code 997.4]) using appropriate ICD-9 codes. Other miscellaneous complications included renal failure, postoperative respiratory complications (i.e. atelectasis, pneumonia, pneumothorax, acute respiratory insufficiency), and postoperative cardiovascular complications (i.e. deep vein thrombosis, pulmonary embolus, postoperative stroke, cardiac arrest).

Given the California SID is an inpatient database, our assumption was that most patients were admitted urgently for an unscheduled procedure. Most patients scheduled for an elective procedure would have been treated as an outpatient, therefore, not included in our analysis. To validate this assumption, we tried to determine the proportion of patients that were diagnosed with acute cholecystitis, an urgent surgical diagnosis, versus chronic cholecystitis, which is often treated as an outpatient.

Bivariate and multivariate analyses were performed on the three cohorts of hospitals stratified by safety-net burden. Hierarchical multivariable regression was performed on mean LOS, cost, as well as rates of laparoscopy, perforation, hydrops, and morbidity with random intercepts by hospital ID and hospital county code. To account for a significant right skew, the complication rate was log transformed, giving the data a more normal distribution. Covariates included in the study were patient age, hospital ownership (public or private), teaching hospital status, and hospital volume (number of cholecystectomies performed per year).^{13,14} All data analysis was conducted using Stata 14.2 software.

3. Results

Of the 303,360 cholecystectomies performed from 2005 to 2011, 65,319 were performed at LBHs, 159,708 were performed at MBHs, and 78,333 were performed at HBHs. Less than 14% of patients at LBHs were on Medicaid or uninsured, while 15–41% of patients at MBHs were on Medicaid or uninsured, and greater than 42% of patients at HBHs were on Medicaid or uninsured. Of approximately 303,360 total cholecystectomies identified, only 18,311 (6.0%) had

Table 1
Descriptive characteristics and outcomes.

	Low-burden (n = 477)	Medium-burden (n = 1199)	High-burden (n = 636)	p-value
Age				
<18	1.2 ± 1.7%	3.0 ± 10.8%	8.7 ± 22.4%	<0.01
18–35	16.1 ± 8.3%	22.2 ± 10.6%	31.2 ± 13.2%	<0.01
36–50	22.4 ± 8.8%	23.6 ± 9.9%	24.3 ± 11.9%	=0.01
51–65	25.0 ± 11.1%	21.7 ± 9.7%	16.6 ± 8.4%	<0.01
>65	35.3 ± 17.3%	29.5 ± 12.2%	19.2 ± 13.3%	<0.01
Sex				
Female	58.9 ± 13.9%	63.3 ± 12.0%	68.8 ± 11.6%	<0.01
Race				
White	53.8 ± 20.9%	51.6 ± 22.5%	21.6 ± 19.0%	<0.01
Black	4.0 ± 8.1%	2.9 ± 4.8%	5.5 ± 9.0%	<0.01
Hispanic	17.7 ± 15.8%	24.0 ± 18.4%	53.0 ± 23.3%	<0.01
Other	8.4 ± 12.7%	6.3 ± 8.8%	5.3 ± 7.9%	<0.01
Missing	16.3 ± 16.0%	15.1 ± 14.2%	14.6 ± 12.4%	0.12
Insurance				
Medicare	35.5 ± 19.1%	30.5 ± 12.6%	19.9 ± 14.9%	<0.01
Medicaid	5.4 ± 5.6%	20.1 ± 10.8%	41.7 ± 15.8%	<0.01
Private	54.1 ± 19.9%	37.9 ± 15.3%	20.0 ± 14.0%	<0.01
Uninsured	2.9 ± 3.9%	5.8 ± 6.8%	7.4 ± 8.5%	<0.01
Other	2.1 ± 4.4%	5.8 ± 9.9%	11.0 ± 14.6%	<0.01
Laparoscopy	87.5 ± 15.8%	89.4 ± 11.5%	86.4 ± 12.3%	<0.01
Advanced Disease				
Perforation	1.1 ± 5.2%	0.8 ± 2.2%	0.7 ± 1.5%	0.06
Hydrops	2.1 ± 3.6%	2.4 ± 4.9%	2.5 ± 4.1%	0.32
Perforation or Hydrops	3.2 ± 6.2%	3.3 ± 5.3%	3.2 ± 4.4%	0.99
Complications	9.2 ± 8.8%	8.0 ± 6.7%	6.5 ± 5.8%	<0.01
Infectious	2.9 ± 4.2%	2.6 ± 3.0%	2.3 ± 3.2%	=0.01
Gastrointestinal	4.3 ± 7.6%	3.4 ± 4.7%	2.7 ± 3.7%	<0.01
Other	3.1 ± 3.1%	3.0 ± 4.1%	2.4 ± 3.7%	<0.01
Length of Stay (days)	5.6 ± 7.5	4.5 ± 5.0	4.8 ± 2.1	<0.01
Cost (dollars)	18,955 ± 14,808	16,363 ± 8240	15,073 ± 6175	<0.01

Bold values were used to signify all p-values less than 0.05.

the ICD-9 diagnosis code 575.0 (acute cholecystitis), and only 7062 (2.3%) had the ICD-9 diagnosis code 575.11 (chronic cholecystitis). Therefore, over 90% of the cholecystectomies in the California SID had no associated diagnosis code.

Patient demographics can be found in [Table 1](#). HBHs had a younger patient population with more females and minorities. Consistent with experimental design, HBHs had more patients whose funding source was Medicaid (41.7% at HBH vs. 20.1% at MBH vs. 5.4% at LBH, $p < 0.01$) or who were uninsured (7.4% vs. 5.8% vs. 2.9%, $p < 0.01$).

As seen in [Table 1](#), HBHs had lower rates of laparoscopy (86.4% vs. 89.4% vs. 87.5%, $p < 0.01$). HBHs had similar rates of advanced disease with no difference in rates of perforation and hydrops. However, HBHs had lower infectious (2.3% vs. 2.6% vs. 2.9%, $p = 0.01$), gastrointestinal (2.7% vs. 3.4% vs. 4.3%, $p < 0.01$), and overall morbidity (6.5% vs. 8.0% vs. 9.2%, $p < 0.01$). HBHs had a shorter length of stay compared to LBHs (4.8 vs. 4.5 vs. 5.6 days, $p < 0.01$), and HBHs had the lowest overall costs (\$15,073 vs. \$16,363 vs. \$18,955, $p < 0.01$).

Multivariate analysis, found in [Table 2](#), failed to show any difference in rates of laparoscopy. High-burden hospitals were more likely to treat patients with hydrops (OR 1.36, 95% CI 0.44, 2.28, $p < 0.01$), but there was no difference in overall advanced disease and overall complication rates. HBHs had similar length of stay, but had the lowest overall costs (cost difference -5053 , 95% CI -8425 , -1680 , $p < 0.01$).

4. Comments

HBHs, otherwise known as safety-net hospitals, treated a larger

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