

## ONLINE FIRST

# Payer Status and Treatment Paradigm for Acute Cholecystitis

Alexander J. Greenstein, MD, MPH; Alan Moskowitz, MD; Annetine C. Gelijns, PhD; Natalia N. Egorova, PhD, MPH

**Hypothesis:** Medicaid recipients who present to the emergency department with acute cholecystitis (AC) would have reduced access to cholecystectomy compared with a similar population of private insurance carriers.

**Design:** The Nationwide Inpatient Sample (NIS) database from 1998 to 2008.

**Participants:** Emergent hospitalizations (843 179) with AC as a primary diagnosis.

**Interventions:** Insurance type was analyzed against cholecystectomy in propensity score–matched cohorts.

**Main Outcome Measures:** Surgical intervention and surgical outcomes.

**Results:** Approximately 200 000 patients were in each matched cohort. The median age of the matched patients was 43.9 years, 76% were women, and the mean Charlson Comorbidity Index was 0.5. While 89% of the

private insurance cohort underwent cholecystectomy during their hospitalization, only 83% of the Medicaid population received equivalent care ( $P < .001$ ). The Medicaid cohort also had reduced rates of laparoscopic surgery (78% vs 69%;  $P < .001$ ) and an increased conversion rate from laparoscopic to open surgery (3.9% vs 3.0%;  $P < .001$ ). While disparities in the rates of laparoscopic surgery between the 2 groups sequentially narrowed during the 10-year period, overall disparities in surgical treatment remained constant over time.

**Conclusions:** Medicaid payer status confers inferior access to surgical treatment for AC. While this finding may be due in part to patients' health beliefs and physician preferences, the magnitude of difference suggests that health systems factors may provide a significant contribution toward clinical decision making in this entity.

*Arch Surg.* 2012;147(5):453-458. Published online January 16, 2012. doi:10.1001/archsurg.2011.1702

**T**HE ISSUE OF CUTBACKS IN Medicaid spending has been at the top of the political agenda for several state legislatures this past year. Even without proposed changes in Medicaid, concern has been mounting regarding the disparities in access, execution, and outcomes of care for underserved populations dependent on a Medicaid Health Program in comparison to those with private insurance. While disparities in medical care and disease management are well known, more recent surgical literature has revealed new unsettling findings. To be more precise, data have shown Medicaid recipients who undergo vascular surgery have more advanced disease than their non-Medicaid counterparts, as well as worse outcomes for trauma surgery and worse overall adjusted mortality with major surgery.<sup>1-3</sup>

One of the most common surgical problems resulting in emergency department presentations is acute cholecystitis (AC). While there are conservative ways to man-

age AC (antibiotics, a cholecystostomy tube, or both), the preferred and most efficient method is cholecystectomy. To be more specific, laparoscopic cholecystectomy has generally been adopted as the approach of choice. The prevailing literature, including several randomized controlled trials, meta-analyses, and reviews, has shown it to be safe and durable in the short term.<sup>4-7</sup> Conservative therapy,

## See Invited Critique at end of article

in turn, is generally reserved for those patients who are deemed too sick to undergo operative intervention, but it also can be used as an option to delay surgical intervention until the patient's inflammation has decreased per surgeon's preference, or when surgical intervention is not readily available. Thus, differential use of this generally preferred and commonly performed treatment option provides a suit-

**Author Affiliations:** Departments of Surgery (Drs Greenstein and Moskowitz) and Health Evidence and Policy (Drs Gelijns and Egorova), The Mount Sinai Medical Center, New York, New York.

able means to evaluate for comparability of health care among different groups of patients.

The objective of this study was to compare the treatment paradigm for emergent presentation of AC in the Medicaid vs private insurance groups. We used a large, national administrative database to examine this question and hypothesized that patients with Medicaid coverage who present emergently with AC would undergo cholecystectomy at a reduced rate compared with a similar population with private insurance.

## METHODS

### DATA SOURCE

We obtained data for this study from the Nationwide Inpatient Sample (NIS) databases from 1998 to 2008. The NIS is a 20% stratified sample of nonfederal acute-care hospitals throughout the United States and is the largest all-payer database of national hospital discharges. It is maintained as part of the Healthcare Cost and Utilization Project (HCUP) by the Agency for Healthcare Research and Quality (AHRQ). Each record in the NIS represents a single hospital discharge and includes demographic data (age, sex, and race), admission type (emergent, urgent, or elective), primary and secondary diagnoses, procedures (up to 15), expected primary and secondary insurance payers, total hospital charges, length of stay (LOS), and hospital characteristics (region, urban vs rural location, bed-size, and teaching status). For this study we used an NIS uniform primary payer variable that was composed of Medicare, Medicaid, private insurance, self-pay, no charge, and other payers. Medicare includes both fee-for-service and managed care Medicare patients; Medicaid includes both fee-for-service and managed care Medicaid patients; private insurance includes Blue Cross/Blue Shield, commercial carriers, and private health maintenance organizations and preferred provider organizations while other payers includes Worker's Compensation, CHAMPUS, CHAMPVA, Title V, and other government programs. This study was exempt from formal institutional review board review because it did not meet the regulatory definition of human subject research.

### PATIENTS AND OUTCOMES

Using a combination of *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnoses codes (574.0—calculous of gallbladder with AC and 575.0—AC) in primary position, we identified all hospitalizations in the NIS data set for patients aged 18 years or older who presented to the emergency department with AC. We then identified hospitalizations with cholecystectomy using the following procedure codes (*ICD-9-CM* 51.21—open partial cholecystectomy, and 51.22—open cholecystectomy, 51.23—laparoscopic cholecystectomy, 51.24—laparoscopic partial cholecystectomy). Hospitalizations with intra-abdominal cancer (*ICD-9-CM* codes 150-159.9 or 197.4-197.8) were excluded. Patients were stratified by payer status into 2 comparison groups: Medicaid and private insurance. Patient comorbid disease was assessed using 28 different comorbid conditions established by the Healthcare Utilization Project.<sup>8</sup> In addition, a Charlson Comorbidity Index was calculated for each hospitalization.<sup>9</sup> The primary outcome of interest in this study was the use of surgical therapy as identified by one of the *ICD-9-CM* codes listed earlier. Secondary outcomes includes conversion from laparoscopic to open surgery, in-hospital mortality, in-hospital complications, and

hospital length of stay (LOS). We identified conversion using *ICD-9-CM* code V64.41 and complications using *ICD-9-CM* diagnostic codes that corresponded to each of 9 complication types (wound problems; infections; and urinary, cardiovascular, pulmonary, gastrointestinal tract, systemic, acute renal failure, and operative complications).<sup>2</sup>

## STATISTICAL ANALYSIS

We used the *t* test for univariate analysis of continuous variables and the Rao-Scott  $\chi^2$  test for dichotomous variables. Statistical significance was expressed as both *P* values and 95% CIs. Values of *P* < .05 were considered significant. We used SAS survey procedures to produce national estimates from the NIS data, considering weights, clusters, and strata. To determine the propensity score, a logistic regression model was developed with insurance type as the dependent variable. All baseline confounders including sex, comorbid diseases (as categorical variables), age and year of surgery, and hospital characteristics were included in the model as independent variables. A subset analysis accounting for race/ethnicity and socioeconomic status was also performed. The hospitalizations were matched using the "greedy" matching algorithm, which used an 8- to 1-digit matching scheme without replacement. The matched cohorts were evaluated using paired *t* testing (for continuous variables) and the McNemar nonparametric test (for categorical variables) to evaluate differences in demographics and comorbid characteristics. In addition, standardized differences were used to assess similarity in baseline characteristics.

To assess for an association between insurance status and surgical complications while adjusting for other relevant covariates, we constructed a set of multivariable regression models in which a selected complication was the outcome. These models included insurance status, sex, patient age, comorbidities (as categorical variables), year of surgery, and hospital characteristics as independent variables. Model performance were assessed with receiver operating curves (model discrimination) and Hosmer-Lemeshow statistic (model calibration). Adjusted rates were calculated according to the algorithm offered by Norton and Kleinman.<sup>10</sup> Data were analyzed using SAS, version 9.13 (SAS Institute).

## RESULTS

From 1998 to 2008, we identified 843 179 emergency hospitalizations in which AC was the primary diagnosis. Of these hospitalizations, 219 326 were for patients with Medicaid, while 623 853 were for patients with private insurance. The median age for all the patients was 46.4 years, 66% were women, and the Charlson Comorbidity Index was 0.4. The median age of the matched patients was 43.9 years, 76% were women, and the mean Charlson Comorbidity Index was 0.5. In total, 744 776 (88.3%) received surgical therapy for their condition, of which 637 566 procedures were carried out laparoscopically, representing 75.6% of all the cases and 85.6% of all the surgical procedures performed. Conversion to open surgery from the laparoscopic approach was seen in 4.8% of all laparoscopic cholecystectomies. Surgical complications occurred in 7.9% of all hospitalizations, and surgical mortality represented 0.4%. Average LOS for all surgical patients was 3.6 days, while hospital LOS for conservatively treated patients was 3.7 days.

Baseline characteristics of the patients and coexisting conditions are listed in **Table 1** and the eTable (<http://>

**Table 1. Baseline Characteristics of Hospitals and Hospitalizations of Patients With Medicaid and Private Insurance Before and After Matching by Propensity Score**

Variable	Before Matching, %				After Matching, %			
	Private Insurance (n=623 853)	Medicaid (n=219 326)	Standardized Difference	P Value	Private Insurance (n=199 505)	Medicaid (n=200 655)	Standardized Difference	P Value
Demographics								
Age, mean, y	46.8	45.4	0.0003	<.001	44.3	43.5	0.0003	<.01
Female, %	62.9	76.4	29.7	<.001	76.0	76.2	0.3	.79
Hospital characteristics and location, %								
Small	12.9	13.3	1.13	.56	13.2	13.2	-0.02	.99
Medium	28.3	29.5	2.6	.40	29.0	29.3	0.6	.86
Large	58.8	57.2	-3.2	.28	57.7	57.4	-0.5	.86
Rural	14.0	17.1	8.7	<.001	15.6	16.5	2.5	.17
Urban								
Nonteaching	51.0	42.2	-17.8	<.001	44.1	43.3	-1.5	.58
Teaching	34.9	40.6	11.8	<.001	40.3	40.1	-0.3	.92
Northeast	20.3	25.0	11.4	<.001	22.0	23.7	4.0	.24
Midwest	20.6	16.1	-11.6	<.001	16.1	16.4	0.7	.71
South	37.1	33.5	-7.5	<.01	32.6	33.5	1.9	.48
West	22.1	25.4	7.8	.01	29.2	26.4	-6.4	.05
Charlson Comorbidity Index								
Mean index, No.	0.3	0.6	0.007	<.001	0.5	0.5	0.0005	.09
0	77.8	65.3	-28.0	<.001	70.1	69.8	-0.6	.58
1	16.2	20.5	11.2	<.001	19.8	19.6	-0.5	.52
2-3	5.2	11.2	21.8	<.001	8.4	8.7	1.1	.23
≥4	0.7	3.0	16.7	<.001	1.7	1.9	1.2	.10
Associated conditions, %								
Cholangitis	0.6	0.8	2.5	<.001	0.8	0.7	-0.1	.88
Gallstone pancreatitis	4.0	5.3	6.1	<.001	4.9	5.0	0.5	.57

**Table 2. Outcomes of Patients With Medicaid and Private Insurance Before and After Matching by Propensity Score**

Outcome Measure	Before Matching, %			After Matching, %		
	Private Insurance (n=623 853)	Medicaid (n=219 326)	P Value	Private Insurance (n=199 505)	Medicaid (n=200 655)	P Value
Surgical therapy	90.7	81.7	<.001	89.2	83.2	<.001
Laparoscopic surgery	78.6	65.2	<.001	77.8	68.9	<.001
Conversion to open surgery	3.5	4.0	<.001	3.0	3.9	<.001
Partial OC	0.1	0.2	<.001	0.04	0.1	<.001
Partial LC	0.1	0.1	.86	0.06	0.07	.48
Cholecystostomy tube	0.7	1.6	<.001	1.00	1.2	.008

Abbreviations: LC, laparoscopic cholecystectomy; OC, open cholecystectomy.

//www.archsurg.com). Patients with Medicaid were younger, had a higher Charlson Comorbidity Index, and were more likely to have a major coexisting condition than were those with private insurance. Following propensity score matching, there were 400 160 hospitalizations, with approximately 200 000 in each cohort (Medicaid and private insurance). The average age was 44 years. Approximately 76% were women, and the average Charlson Comorbidity Index was 0.47.

#### TREATMENT PURSUED—MATCHED AND STRATIFIED ANALYSIS

Both before and after matching, a significant difference was noted between the Medicaid and private insurance

groups for the use of surgical therapy and open conversion rate with laparoscopic cholecystectomy (**Table 2**). Comparing matched cohorts, 89% of the private insurance cohort compared with only 83% of the Medicaid cohort underwent cholecystectomy during their hospitalization for AC ( $P < .001$ ). In total, 78% of the private insurance cohort compared with 69% of the Medicaid cohort received laparoscopic cholecystectomy ( $P < .001$ ). Finally, the open conversion rate from laparoscopic to open surgery differed between the Medicaid and private insurance groups (3.9% vs 3.0%;  $P < .001$ ).

As shown in **Figure 1**, the difference in the rate of conservative therapy for AC remained relatively stable over time from 1998 to 2008, with Medicaid patients consistently receiving less surgical care. The Medicaid co-

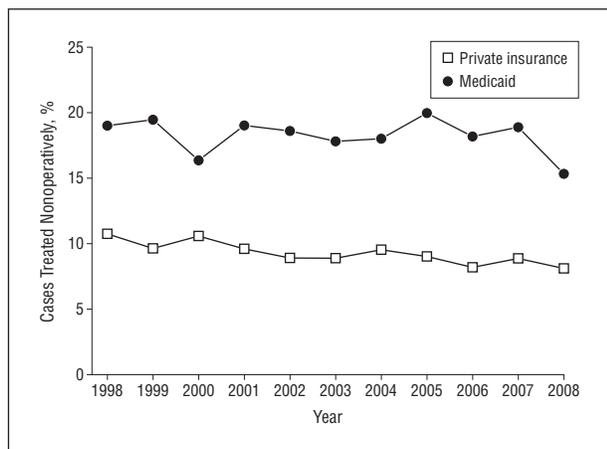


Figure 1. Trend in treatment over time for acute cholecystitis.

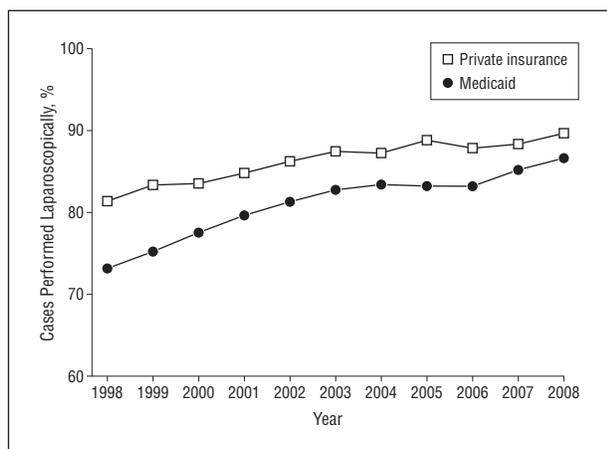


Figure 2. Trend in laparoscopic approach over time for acute cholecystitis.

hort also had reduced rates of laparoscopic surgery (78% vs 69%;  $P < .001$ ). As displayed in **Figure 2**, the trend toward increased use of the laparoscopic approach to cholecystectomy for both insurance cohorts was evident during the 10 years of observation. The rate of increase was higher among the Medicaid cohort, which narrowed the difference between groups over time.

### SURGICAL OUTCOMES ANALYSIS

As given in **Table 3**, overall mortality for cholecystectomies was 0.43% higher for patients with Medicaid ( $P < .001$ ). After adjustment for relevant covariates, patient with Medicaid had just more than a 2-times-higher risk of death ( $P < .001$ ). For nonfatal complications, wound complications, infections, acute renal failure, and conversion to open surgical procedures remained significantly higher among Medicaid-insured patients after multivariable adjustment.

### COMMENT

In this matched-cohort study of approximately 400 000 patients who presented to an emergency department with AC, we found that patients with Medicaid were signifi-

cantly less likely to receive definitive surgical therapy for their condition. Although disparities with regard to use of the laparoscopic approach have narrowed over time, patients with Medicaid remain at slightly higher risk for conversion to an open surgical procedure, wound complications, infection, and mortality.

Diseases of the gallbladder are among the most common reasons for surgical admission and frequently occur in young, otherwise healthy people. For patients who present with AC, cholecystectomy is the definitive treatment. Historically, many patients were treated with an interval or delayed cholecystectomy 6 to 10 weeks after initial medical therapy. At that time, about 20% of patients would fail initial medical therapy and require surgery during the initial admission or before completing the planned cooling-off period. In multiple series demonstrating both its efficacy and safety, the preferred therapy for AC has proven to be early cholecystectomy performed within 2 to 3 days of presentation.<sup>4,5,11</sup>

This study confirms and extends the literature on health care disparities in the following ways. Insurance-based disparities in treatment and patient outcomes have been reported for various disorders, but most studies have focused on clinical parameters as the outcomes of interest. Past studies have revealed insurance status to predict disease severity among patients undergoing vascular surgery<sup>1</sup> and that Medicaid patients have a 22% higher risk of complications after colorectal cancer resections and a 57% higher risk of in-hospital death in comparison with patients with private insurance.<sup>12</sup> In a more recent large study of 893 658 major surgical operations, unadjusted mortality for Medicaid (3.7%; odds ratio, 2.86) patient groups were higher compared with private insurance groups after controlling for comorbid disease and socioeconomic status.<sup>2</sup> Similarly, our study demonstrates that clinical outcomes for Medicaid patients undergoing cholecystectomy are not as good as their non-Medicaid counterparts and that treatment plans differed as well. One study of pediatric orthopedic injuries had similar findings, showing that children insured by Medicaid experienced a delay in care for injuries when compared with privately insured children.<sup>13</sup> In an era of multiple proposed federal and state cutbacks to an already beleaguered medical system, the results of this study add to the important effort of describing the extent of national health care disparities. Studies such as this may ultimately help toward developing focused interventions to reduce inequalities in use and outcome of surgical care.

To our knowledge, this is the first study to demonstrate a disparity in utilization of cholecystectomy for AC based on insurance type, and there are many organizational, educational, and cultural factors that could be responsible for the observed differences.

First, patients' health beliefs, risk aversion, treatment preferences, and cultural factors, among others, have been shown to influence health-seeking behaviors and may have had a role in the treatment selection process. Second, communication failures and reduced levels of health literacy may have an impact on health outcomes of Medicaid patients. Clearly, others have found that communication failures have been shown to adversely affect patient safety.<sup>14-16</sup> Third, aspects of the health care sys-

**Table 3. Analyses of Postoperative In-Hospital Complications and Conversion Rates From Laparoscopic to Open Cholecystectomy**

Variable	Unadjusted Rates, %			Adjusted Rates, %		Adjusted ORs	
	Private Insurance (n=565 664)	Medicaid (n=179 112)	P Value	Private Insurance (n=565 664)	Medicaid (n=179 112)	Medicaid vs Private Insurance, OR (95% CI for OR)	P Value
Mortality	0.13	0.56	<.001	0.16	0.33	2.15 (1.63-2.83)	<.001
Wound complications	0.22	0.31	<.01	0.22	0.29	1.32 (1.01-1.73)	.04
Infectious	0.44	0.56	.002	0.44	0.54	1.22 (1.02-1.46)	.03
Urinary	0.51	0.49	.69	0.52	0.46	0.89 (0.73-1.08)	.22
Pulmonary	1.92	2.37	<.01	2.01	2.05	1.03 (0.93-1.13)	.64
GI tract	2.11	2.26	.14	2.15	2.16	1.01 (0.91-1.11)	.92
Cardiovascular	0.50	0.70	<.001	0.56	0.52	0.93 (0.76-1.12)	.43
Systemic	1.05	1.05	.99	1.14	1.11	1.07 (0.94-1.22)	.29
Procedure related	1.37	1.68	<.001	1.39	1.61	1.17 (1.05-1.30)	<.01
Acute renal failure	0.69	1.51	<.001	0.84	0.99	1.25 (1.07-1.45)	<.01
Conversion	3.48	3.96	<.001	3.73	5.16	1.41 (1.30-1.53)	<.001

Abbreviations: CL, confidence limits; GI, gastrointestinal; OR, odds ratio.

tem, such as the ways in which the system is organized and financed as well as the availability of services, may exert different effects on AC diagnosis and treatment. Institutions serving a higher proportion of Medicaid patients, for example, may have fewer resources for care.

Fourth, differences in comorbid disease may serve as a proxy for larger social and lifestyle influences between Medicaid and private insurance groups. The Medicaid group had a considerably higher rate of comorbid disease and metastatic cancer as well as drug and alcohol abuse. This likely reflects the combined influence of poor health maintenance, deficits in access to care, and delayed diagnosis. Nevertheless, a propensity-matched analysis clearly identified Medicaid status as a highly significant driver of care, and multivariable analysis showed it to be a significant predictor for surgical outcomes.

Fifth, it is plausible that the influence of health care provider and system bias may impact surgical outcomes for Medicaid patients. As outpatients, surgical patients with private insurance are often able to obtain personal referral to more experienced surgeons, while patients with Medicaid are most often referred to a clinic system with less specialized surgeons or self-refer to the emergency department. Studies have shown that Medicaid populations tend to receive the majority of primary care within emergency departments.<sup>17</sup> As for patients presenting to the emergency department with AC, those with private insurance may already be “plugged in” to the system and have ready access to a surgical specialist, while those with Medicaid would be meeting for the first time a surgeon who happened to be responsible for covering the emergency department for that period. This physician most likely has had no contact with the patient and may have only minimal interaction with the patient in the future. Thus, the absence of an established physician-patient relationship may have an adverse effect on treatment decision making and outcomes. While the disparity in surgical therapy between groups remained constant over time, there did seem to be a narrowing of the gap in the laparoscopic approach to AC (Figure 2). This may reflect improvements in technology, training, and/or access to advanced laparoscopy.

While interpreting the results of our analysis, it is important to consider the strengths and limitations of our data set and approach. As with any retrospective study, there is associated selection bias, but the sampling process of the NIS database reduces this bias. Administrative data, in general, have potential for unrecognized miscoding among diagnostic and procedure codes. Though the validity of ICD-9-CM coding has been validated for surgical procedures,<sup>18</sup> errors in administrative codes may occur, which these are most likely nondifferential for insurance status,<sup>19</sup> and the NIS data set is validated both internally and externally for each year. Disease severity is also not accounted for in the NIS database, so we were unable to calculate its effect on outcomes. Additionally, we did not analyze race or socioeconomic status (household income of the patient zip-code area in quartiles) in our study as approximately 23% of discharge level data on race and approximately 3% of discharge-level data on socioeconomic status are unavailable in the NIS database. This lack of availability is likely to be nonrandom and would be expected to result in a bias subset-matched analyses accounting for race/ethnicity and socioeconomic status continued to show surgical disparities by insurance status. Finally, there is the possibility of incomplete risk adjustment due to the presence of comorbidities or other socioeconomic factors that are either partially accounted or unaccounted for in our analyses. The large sample size of the NIS has enabled us to have power for detecting moderate to small associations and permitted us to more precisely estimate the effect of insurance and other covariates on our propensity score-matched and multivariate analyses. Finally, the NIS database contains population-based data and therefore is less affected by referral patterns and other sources of bias that might be associated with hospital-based case series.

In summary, our results indicate that patients with Medicaid who present to the emergency department with AC are less likely to receive cholecystectomy for their condition during that initial hospital visit and have slightly worse surgical outcomes compared with those with private insurance. This disparity is most likely due to a combination of factors, including system and cultural fac-

tors. In an atmosphere of increasing cutbacks in both federal and state support for Medicaid, the gap in medical care for patients dependent on the Medicaid program will most likely widen. Further studies in health disparities are needed to monitor the impact of reduced support on this vulnerable population and to delineate interventions to help eliminate the gap.

Accepted for Publication: October 12, 2011.

Published Online: January 16, 2012. doi:10.1001/archsurg.2011.1702

Correspondence: Alexander J. Greenstein MD, MPH, Department of Surgery, The Mount Sinai Medical Center, 5 E 98th St, Box 1259, 15th Floor, New York, NY 10029 (Alexander.Greenstein@msnyuhealth.org).

Author Contributions: Study concept and design: Greenstein, Moskowitz, Gelijns, and Egorova. Acquisition of data: Moskowitz and Egorova. Analysis and interpretation of data: Greenstein, Gelijns, and Egorova. Drafting of the manuscript: Greenstein and Egorova. Critical revision of the manuscript for important intellectual content: Moskowitz and Egorova. Statistical analysis: Greenstein and Egorova.

Financial Disclosure: None reported.

Online-Only Material: The eTable is available at <http://www.archsurg.com>.

## REFERENCES

1. Giacobelli JK, Egorova N, Nowygrod R, Gelijns A, Kent KC, Morrissey NJ. Insurance status predicts access to care and outcomes of vascular disease. *J Vasc Surg*. 2008;48(4):905-911.
2. LaPar DJ, Bhamidipati CM, Mery CM, et al. Primary payer status affects mortality for major surgical operations. *Ann Surg*. 2010;252(3):544-551.
3. Rosen H, Saleh F, Lipsitz S, Rogers SO Jr, Gawande AA. Downwardly mobile: the accidental cost of being uninsured. *Arch Surg*. 2009;144(11):1006-1011.
4. Lai PB, Kwong KH, Leung KL, et al. Randomized trial of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Br J Surg*. 1998;85(6):764-767.

5. Lo CM, Liu CL, Fan ST, Lai EC, Wong J. Prospective randomized study of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Ann Surg*. 1998;227(4):461-467.
6. Gurusamy KS, Samraj K. 2006 Early vs delayed laparoscopic cholecystectomy for acute cholecystitis. *Cochrane Database Syst Rev*(4). CD005440.
7. Siddiqui T, MacDonald A, Chong PS, Jenkins JT. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis of randomized clinical trials. *Am J Surg*. 2008;195(1):40-47.
8. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care*. 1998;36(1):8-27.
9. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373-383.
10. Kleinman LC, Norton EC. What's the risk? a simple approach for estimating adjusted risk measures from nonlinear models including logistic regression. *Health Serv Res*. 2009;44(1):288-302.
11. Townsend CM, Beauchamp RD, Evers BM, Mattox KL, eds. *Sabiston Textbook of Surgery, Internet Edition*. Saunders, an imprint of Elsevier; 2007. <http://www.mdconsult.com/books/about.do?about=true&eid=4-u1.0-B978-1-4160-3675.3..X5001-1--TOP&isbn=978-1-4160-3675-3&uniqid=303618935-2>. Accessed June 10, 2011.
12. Kelz RR, Gimotty PA, Polsky D, Norman S, Fraker D, DeMichele A. Morbidity and mortality of colorectal carcinoma surgery differs by insurance status. *Cancer*. 2004;101(10):2187-2194.
13. Sabharwal S, Zhao C, McClemens E, Kaufmann A. Pediatric orthopaedic patients presenting to a university emergency department after visiting another emergency department: demographics and health insurance status. *J Pediatr Orthop*. 2007;27(6):690-694.
14. Greenberg CC, Regenbogen SE, Studdert DM, et al. Patterns of communication breakdowns resulting in injury to surgical patients. *J Am Coll Surg*. 2007;204(4):533-540.
15. Wallace LS, Cassada DC, Rogers ES, et al. Can screening items identify surgery patients at risk of limited health literacy? *J Surg Res*. 2007;140(2):208-213.
16. Baker DW, Parker RM, Williams MV, et al. The health care experience of patients with low literacy. *Arch Fam Med*. 1996;5(6):329-334.
17. Cohen JW. Medicaid policy and the substitution of hospital outpatient care for physician care. *Health Serv Res*. 1989;24(1):33-66.
18. Quan H, Parsons GA, Ghali WA. Validity of procedure codes in *International Classification of Diseases, Ninth Revision, Clinical Modification* administrative data. *Med Care*. 2004;42(8):801-809.
19. Grimes DA, Schulz KF. Bias and causal associations in observational research. *Lancet*. 2002;359(9302):248-252.

## INVITED CRITIQUE

### ONLINE FIRST

# Impact of Payer Status on Treatment Options for Acute Cholecystitis

## Will Health Care Reform Help Us Close the Gap?

The aim of the Greenstein et al<sup>1</sup> study was to demonstrate that the Medicaid population has inferior access to undergo a cholecystectomy for acute cholecystitis (AC) when compared with those that have private insurance (PI). Using a Nationwide Inpatient Sample database from 1998 through 2008, the authors reviewed a total of 843 179 patients who had emergent hospitalizations under the diagnosis of AC. Hospitalizations were stratified by primary payer status (Medicaid [n=219 326] or private [n=623 853]), and insurance type was analyzed against cholecystectomy in propensity score-matched cohorts. Approximately 200 000 patients were

matched in each cohort. The authors arrived at the following results:

- While 89% of the PI cohort received a cholecystectomy during their hospitalization, only 83% of the Medicaid population received equivalent care ( $P < .001$ ).
- The Medicaid cohort also had reduced rates of laparoscopic surgery (78% vs 69%;  $P < .001$ ), and there was an increased conversion rate from laparoscopic to open surgery (3.9% vs 3.0%;  $P < .001$ ).

Greenstein et al concluded that Medicaid payer status confers inferior access to surgical treatment because