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WHO'S BEING LEFT BEHIND? UNINSURED EMERGENCY GENERAL SURGERY ADMISSIONS AFTER THE ACA

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ABSTRACT

Background:

The Affordable Care Act (ACA) increased Medicaid coverage of Emergency General Surgery (EGS). We hypothesized that despite the ACA, racial and geographic disparities persisted for EGS admissions.

Methods:

The Nationwide Inpatient Sample was queried from 2012 through Q3 of 2015 for Non-Medicare patient EGS admissions. Difference-in-Differences analyses compared payors, complications, mortality and costs in pre-ACA years (2012-2013) and post-ACA years (2014-2015Q3).

Results:

EGS cases fell 9.1% from 1,711,940 to 1,555,033 NIS-weighted cases. Hispanics were still most likely to be uninsured but had improved coverage (OR 0.92, 95% CI: 0.88-0.96, $p<0.001$). Risk of uninsured EGS admissions from the South region persisted (OR 1.52, 95% CI: 1.46-1.58, $p<0.001$). Uninsured EGS patients had higher DID increased mortality than insured patients (0.31% higher, P=0.003). Insured group DID costs increased more rapidly than in self-pay Patients (6.0% higher, P=0.008)

Conclusions:

Post ACA, risk of uninsured EGS admissions remained highest in the South, in males, and Hispanics.

KEYWORDS

Affordable Care Act, Uninsured, Emergency general surgery, Difference in Differences

BACKGROUND

American health insurance underwent a major overhaul with the implementation of the Affordable Care Act (ACA) in January 2014. Over 20 million Americans who were previously uninsured obtained insurance through the expansion of coverage provided by the ACA, decreasing the number of uninsured persons to approximately 28.2 million as of 2016.(1, 2) Emergency general surgery cases (EGS) represent surgical cases that must be performed regardless of insurance status. Emergency general surgery patients may be more likely uninsured compared to elective general surgery patients. Need for an EGS procedure may represent a consequence of poor preventative, outpatient or chronic health care, including those without healthcare insurance coverage.

Prior study shows the ACA open enrollment (OE) was associated with a decrease in overall EGS admissions, although this was not equally distributed among all demographics. At the same time, there was an increase in EGS Medicaid patient admissions, and a decrease in EGS uninsured patient admissions.(3) However, the risk factors for those who remain uninsured after the ACA OE is not well characterized. Although uninsured patients generally have lower complications noted in EGS after the ACA OE, mortality has increased compared to a decrease in that of Medicaid patients.(4) In addition to higher mortality, uninsured status is also associated with a longer hospital LOS.(3) Studying the factors that contribute to outcomes and hospital admission costs after the ACA-OE will optimize allocation of limited resources.

This study aims to characterize the demographics and risk factors of the remaining uninsured patients undergoing EGS after the implementation of the ACA. We hypothesized that during

ACA-OE, disparities continue to exist for non-white race groups. We also hypothesize that those in lower zip income quartiles were less likely to gain coverage for EGS.

PATIENTS AND METHODS

Data Source

This is a retrospective analysis using the Healthcare Cost and Utilization Project's (HCUP) Nationwide Inpatient Sample (NIS) database from 2012 to the end of the third quarter of 2015. The NIS is the largest public database of all-payer inpatient discharges in the United States.(5) The NIS is a stratified probability sample of inpatient hospital discharges that are weighted by region, hospital size and teaching status to provide scaled national estimates. Notably, the sampling framework of the NIS changed in 2012.(6) Before 2012, the NIS represented all discharge data from a 20% stratified sample of US hospitals. Beginning in 2012, the NIS changed its sampling method to sample 20% of discharges from all participating hospitals. Patients aged 15-64 undergoing EGS procedures were identified by International Classification of Diseases, 9th Revision (ICD9-CM) codes. The NIS assigns each admission 1 to 25 diagnosis codes and 1 to 25 procedure codes based on ICD-9CM codes. At the beginning of the 4th quarter of 2015, NIS switched to ICD-10 coding, and so that quarter was not included in the 2015 data as consistency in coding and case extraction could not be assured.

Patient Population

EGS admissions were identified from the NIS database as non-elective, emergency procedures with ICD9-CM procedure codes for appendectomy (47.01, 47.09, 47.11, 47.19, 47.20, 47.91, 47.92, 47.99), cholecystectomy (51.01, 51.02, 51.03, 51.04, 51.21, 51.22, 51.23, 51.24), hernia repair (17.11, 17.12, 17.13, 17.21, 17.22, 17.23, 53.00, 53.01, 53.02, 53.03, 53.04, 53.05, 53.10, 53.11, 53.12, 53.13, 53.14, 53.15, 53.16, 53.17, 53.21, 53.29, 53.31, 53.39, 53.41, 53.42, 53.43, 53.49, 53.51, 53.59, 53.61, 53.62, 53.63, 53.69, 53.90), bowel resections, ostomy creations (17.31, 17.32, 17.33, 17.34, 17.35, 17.36, 17.39, 45.02, 45.03, 45.33, 45.41, 45.61, 45.62, 45.63,

45.71, 45.72, 45.73, 45.74, 45.75, 45.76, 45.79, 45.81, 45.82, 45.83, 45.90, 45.91, 45.92, 45.93, 45.94, 45.95, 46.01, 46.02, 46.03, 46.04, 46.10, 46.11, 46.13, 46.14, 46.20, 46.21, 46.22, 46.23, 46.24, 46.31, 46.39, 46.40, 46.41, 46.42, 46.43, 46.93, 46.94) and incision of perirectal abscess (49.01).

Admissions with missing information on surgical procedures were excluded. Patients under 15 or over 64 were excluded, as were patients with Medicare, because they were either not directly affected by ACA expansion or were already had insurance coverage available by other programs.

ACA OE expansion occurred in January 2014, admissions from 2012 and 2013 were defined as pre-ACA OE and post-ACA OE if they occurred in 2014 or Quarters 1-3 of 2015.

Variables Collected

The following data points were collected from the database: patient demographics (age, race and sex), date of admission, admission diagnosis, hospital length of stay, payer status, hospital charges, comorbidities, Charlson Comorbidity Index (CCI), in-hospital complications, median income quartile by zip code, urban/rural status, hospital teaching status and in-hospital mortality.

In-hospital complications were defined as urinary tract infection, surgical site infection, pneumonia, sepsis, stroke (CVA), pulmonary embolism, deep venous thrombosis (DVT), myocardial infarction (MI), renal failure, respiratory failure, retained gallstone, ileus, postoperative shock, cardiac arrest, complications during procedure, acute post-hemorrhagic anemia, central line infections and reoperation. Hospital cost was analyzed using hospital charges data provided in NIS converted to wage-index adjusted cost using the hospitals'

provided annual charge-cost ratios adjusted by the Centers for Medicare & Medicaid Services (CMS) local wage index.(7)

Variables

The primary outcome measures were mortality, complications (defined as an admission with one or more complication codes) and wage-index adjusted costs. The secondary outcome measure was insurance payer, coded as either insured [private, Medicaid or other (worker's compensation, TRICARE, Indian Health Service, other government insurance and miscellaneous insurance)], or uninsured (self-pay).

The covariates included patient demographics of age, sex and race/ethnicity (as White, Black, Hispanic, Asian/Pacific Islander, American Indian or other, comorbidities as defined below and urban/rural status. Facility factors included teaching status and rural/urban geographic location. Also included was the ordinal ranking of community income provided by NIS in quartiles by ranking the patients' home zip code from 1 to 4 (highest) based on annual national zip code median income.

Comorbidities were measured via calculated Charlson Comorbidity Index (CCI) from the NIS provided comorbidities. Urban/rural status was based on the Core Based Statistical Area (CBSA) as defined by the US Office of Management and Budget. Hospitals in "metropolitan" counties defined as urban and hospitals with a CBSA type of "micropolitan" or "non-core" defined as rural. Since 2012, NIS does not disclose the state of the admitting hospital.

Statistical Analysis

Odds ratios for self-pay (uninsured) status were calculated for pre- and post-ACA OE periods by logistic regression for the age, gender, race, comorbidities, Hospital Type, Hospital Region, Urban/Rural status. Zip Code income quartile and transfer status. Logistic regression was used to compare odds ratios before and after ACA OE to determine which variables had predictive odd ratios for continued self-Pay status.

The study exploited the implied experimental nature of the 2014 ACA OE expansion and used difference-in-differences (DID) analyses to evaluate differential changes in outcomes in the insured group (private, Medicaid or other) with the uninsured (self-pay) group. DID was used to examine the difference in risk adjusted mortality, risk adjusted complications as well as risk adjusted calculated hospital costs before and after implementation of the ACA OE. A second DID analysis to examine EGS bowel resections and ostomy creations cases only was done as this subgroup was expected to have higher risks of mortality, complications and costs than overall EGS patients.

All models were weighted to account for variations in sampling and clustering of patients within systems. Analyses were conducted using IBM SPSS Statistics 25. Two-sided P-values less than .05 were considered significant. The study was exempted from further review by the UC San Diego Human Research Protections Program and conducted in accordance with the data use agreement for the Nationwide Databases from the Healthcare Cost and Utilization Project Agency for Healthcare Research and Quality.

Risk Adjustment

An adjusted DID analysis was done by multivariate analyses controlling for patient and hospital-level factors including patient age, sex, race/ethnicity, comorbidities using the Charlson Comorbidity Index, hospital type, region and median income quartile by zip code. Race/ethnicity was included as a covariate in analyses examining changes in outcomes. Cohorts were stratified as being either White, Black, Hispanic, American Indian, Asian/Pacific Islander or other. Hospital type was classified as either rural, urban teaching or urban non-teaching. Hospital regions were the NIS-designated Northwest, Midwest, South and Western states. Transfer status was either not transferred in, transfer in from acute care hospital or transfer in from non-acute care hospital.

The primary independent variable of interest was the intervention group (insured) vs the control group (uninsured) before and after the 2014 ACA expansion.

Sensitivity Analyses

To determine the appropriateness of using the DID model, two separate sensitivity analyses were performed. To ensure parallel trends in study outcomes before the pre-ACA OE period (2012 and 2013 only), a DID analysis of insured and uninsured groups was performed. To detect non-parallel trends in other payer groups, a second DID analysis was performed on Medicare patients compared to non-Medicare patients age 15 and up for the pre-ACA and post-ACA periods.

RESULTS

NIS-weighted EGS cases fell 9.1% after ACA-OE, from 1,711,940 in 2012-2013, to 1,555,033 cases in 2014-2015(Q1-Q3). There was a gradual increase in mean age of EGS admissions from 38.7 ± 18.4 years) in 2012 to 40.1 ±18.5 years in 2015 (Table 1, Figure 1). Women represented 55.0% of EGS admissions, falling to 54.2% in 2015. There was a gradual decrease in EGS admissions for white race from (60.2% to 57.0%, P<0.001) over the period, while increases were seen in black (10.7% to 11.4%, p<0.001) and Hispanic (20.9% to 22.6%, P<0.001) EGS admissions. Admissions with comorbidities were seen to increase from a mean of 26.4% of EGS admissions in the pre-ACA OE period to 29.3% in the post-ACA period (P<0.001).

In the post-ACA OE period, there was a significant increase in admissions with Medicaid (25.8% to 32.0%, P<.001) and a significant reduction in self-pay (uninsured) patients (15.5% vs. 11.0%, P<.001, Table 1, Figure 2). EGS appendectomy (138,910) and cholecystectomy (151,287) were the two most commonly performed procedures, appendectomies decreased over the study period (38.1% to 33.4%, P<0.001) while EGS cholecystectomies increased (37.8% to 39.3%, P<0.001). The proportion of EGS admissions from Zip code median income upper half quartiles increased significantly during the study period (51.8% to 54.4%, P<0.001). EGS admissions also increased significantly at teaching hospitals from 2012 to 2015 (49.6% to 69.4%, P<0.001).

Odds ratios obtained by unadjusted difference in differences analysis for predictors of uninsured (self-pay) admission status are shown at Table 2. Male gender, Blacks, Hispanics, those from the Southern US and those from lower-half Zip code income quartiles were most likely by unadjusted odds ratios to be uninsured before the ACA OE. Comparison of odds ratios before and after the ACA OE demonstrated showed a significantly faster decrease in risk for uninsured

status for Hispanics, although they remained the most likely group to be uninsured. The ACA OE did decrease the number of self-insured in all racial groups, but the decrease in proportional risk was greatest for Hispanics. Although their total numbers decreased, the proportion of the uninsured represented by Whites, Blacks, Native Americans and Others did not significantly decrease (Figure 2a.) For those living in the southern US, the ACA OE did not decrease risk of self-pay status in those groups compared to other regions (Figure 2b and 2c.).

Table 3 and Figure 4 shows the impact of the ACA expansion on EGS admissions, mortality, complications and mean wage-index adjusted costs using differences-in-differences analysis. There was an overall 4.8% decrease in uninsured EGS admissions after the ACA expansion. Mortality increased in both insured and self-pay EGS groups. Using risk-adjusted DID estimates, there was a small but significant attributable increase in mortality in self-pay EGS patients compared to insured patients (0.31%, P=.003). Complications increased in both insured and self-pay groups, however the risk-adjusted DID increased for insured patients by only 0.1 percentage points and was not significant (P=0.375). An increase in mean wage-index adjusted costs was observed in both insured and self-pay groups, but more it was more rapid in the Insured group. The risk adjusted DID in mean wage-index adjusted costs between the self-pay and insured groups was 3.6% (P=0.008).

Table 4 and Figure 5 looks at the effect of the ACA expansion on the subgroup of EGS bowel resections and ostomy creations admissions, mortality, complications and mean wage-index adjusted costs using DID analysis. Mortality, complications and costs were all higher in both groups compared to overall EGS patients. After risk adjustment, the DID analysis shows a there was a significant attributable increase in mortality in self-pay EGS bowel resection patients

compared to insured patients (1.2%, P=0.012). Admissions with complications did not significantly change for insured and self-pay EGS Bowel Resection groups over the study period (P=0.764). An increase in mean wage-index adjusted costs was observed in both insured and self-pay EGS bowel resection groups, but at a significantly higher rate in the insured group. The risk adjusted DID in mean wage-index adjusted costs between the self-pay and insured groups was 6.0% (P<0.001).

Sensitivity analysis demonstrated parallel trends in study outcomes only during the pre-ACA OE period which were not statistically significant. Parallel outcome trends on Medicare patients under 18 and over 64 years-old during the study period were also observed, as expected as these groups were not expected to be affected by the ACA OE (Table 5).

DISCUSSION

The ACA OE improved health insurance enrollment and decreased the overall rate of EGS admissions. Previously it has been shown that uninsured patients are more likely than Medicaid and private insurance patients to undergo EGS(4). EGS is an interesting model for effects of insurance status on health outcomes, as emergency admission for a surgical procedure might suggest a "come-as-you are" event, with less chance for uninsured persons to avoid healthcare encounters or to obtain needed coverage.

Mortality increased in both insured and self-pay groups in both overall EGS and bowel resection EGS cases, indicating as the number of EGS cases decreases, the mortality risk of EGS surgery may be increasing. Insurance coverage has been shown to decrease the need for EGS, this may mean a higher proportion of EGS cases are truly emergent. Uninsured patients were seen to have a more rapid increase in mortality in both overall EGS and bowel resection EGS cases. This finding likely represents an altered risk profile among those left uninsured after the ACA OE, with increased insurance shifting low-risk patients from the uninsured to the insured group, leaving a higher-risk group behind in the uninsured group. Uninsured patients may only be able to access general surgery via EGS. The association between the expansion in insurance coverage and decreased mortality is consistent with prior studies of insurance policy changes. (8, 9)

Slow Medicaid expansion in the Southern US may be the explanation for the highest regional rates of uninsured EGS admissions. In 2015, 11 out of the 17 state governments in this NIS region had chosen to not expand Medicaid, the lowest rate in any NIS region (Figure 6).(10)

Two states in this region are expected to expand Medicaid in the near future, which may improve coverage for EGS admissions..

Complications increased for insured EGS admissions more rapidly than in uninsured admissions. The rise in overall complications was paralleled between insured and non-insured EGS cases by DID analysis, suggesting a systemic effect, which has been seen in other studies, this may be due to increased regulatory requirements for complication coding and documentation. EGS is often the only means to operate on the uninsured. The newly insured population with improved access to elective surgery via a primary care doctor and specialty referral (11, 12) may filter out less complex and lower risk patients from EGS, increasing complications for uninsured patients left undergoing EGS.

While hospital costs increased in both self-pay and insured groups, the provision of increased insurance coverage via the ACA OE has not controlled inpatient EGS costs, as seen by the more rapid increase in hospital costs in the insured group.

Reasons for the higher rates of non-insurance in Hispanics and Blacks beyond lack of state Medicaid expansion are not provided directly by NIS studies. Failure to enroll after the ACA OE has been attributed to disparities arising from poor healthcare knowledge, mistrust of authorities, behavioral or social issues, language or geographic isolation, and lack of internet access, literacy, or transportation.(13) The affordability of basic insurance coverage under the ACA despite the risk of a financial penalty may also be an issue. Relative decreased mortality for insured EGS patients may also be secondary to them presenting earlier, perhaps with less complex pathology. Uninsured persons have previously been reported to have a longer

duration of symptoms before presentation.(14-16) This factor may put these patients at a higher risk for adverse outcomes associated with their delayed presentation.(15, 17, 18) Non-documented immigrants are excluded from most state's ACA coverage, are known to suffer issues with access and may have a lack of trust of authority, resulting in a delay seeking EGS care (15, 33).

Urban teaching hospitals saw the largest increase in EGS admissions. Many teaching hospitals expanded ambulatory care in anticipation of the ACA OE to solicit these patients in anticipation of increased demand (19, 20). Additionally, the insurance coverage available on the health insurance marketplaces (HIMs) has been criticized for leaving patients under-insured and with narrow networks. It may be that urban teaching centers are the only facilities that will accept this limited insurance coverage for EGS patients. The increased emergency department utilization and admissions after Medicaid and ACA OE have been identified in prior studies, so it is perhaps not surprising this effect exists for EGS patients as well (21, 22).

We had hypothesized that admission living in lower half zip income quartiles would lead to higher risk of self-pay EGS status and this was not shown, indicating that income alone may not be the only factor in obtaining health insurance coverage for EGS.

This study has several limitations. HCUP NIS is an administrative database that has potential for coding errors, however, our results are consistent with previous HCUP NIS studies looking at insurance and surgical outcomes.(23, 24) In addition, the implied experimental design identifies an effect but it is possible that there are other confounding factors that occurred in 2014 and 2015 not identified by the study. We also identified 2014 as the start of the ACA open

enrollment, but the open enrollment launch was not uniform across all states. Other ACA programs such as the Dependent Coverage Provision provided coverage to some patients age 26 and younger since 2010. Since 2012, NIS has deliberately excluded state identifying data, making it impossible to select for states that implemented the ACA during the study period, which probably diluted the measured effects of the ACA OE. There are known differences in ACA OE implementation between states, many of which did not expand Medicaid in 2014 or 2015 or already had expanded Medicare in previous years.(25) Some specific changes in healthcare may have not have been controlled completely by DID analysis such as increased interest medical management of appendicitis that happened concurrently over this same time period and may have had greater effect in some socioeconomic groups. In this study we could not specifically examine the differences in the uninsured population between Medicaid expansion states versus non expansion states, thus the exact impact of Medicaid expansion by state on EGS remains unclear. A better understanding of the relationship between Medicaid expansion, persistent lack of insurance in some groups and EGS outcomes could provide better understanding of the failure of the ACA OE to further reduce disparities in healthcare. We were also unable to ascertain the exact reasons for persisting non-insurance after the ACA-OE in populations and cannot state exactly why people remain uninsured. Those reasons when found, could provide opportunity for targeted, cost-effective policy interventions.

In conclusion, while the ACA decreased overall rate of EGS admissions, presumably as more patients had access to care in the early phases of their disease course, disparities remain in the remaining uninsured population. Understanding these disparities could lead to better health care policy implementation as well as optimization of resource allocation to improve outcomes. Efforts to create a national EGS outcomes database to better identify effects of health care

policy on EGS patient processes and outcome should be accelerated.

Author contributions:

Albini: Literature search, study design, data interpretation, writing.

Cochran-Yu: Critical revision, Literature search, study design.

Godat: Study design, critical revision.

Costantini: Critical revision.

Doucet: Literature search, study design, data collection, data analysis, data interpretation, writing, critical revision.

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Table 1. Comparison of Non-Medicare EGS Patient Demographics Before and After Implementation of the 2014 ACA OE.

	Pre-ACA OE†		Post-ACA OE		*P**
Calendar Year	2012	2013	2014	2015 Q1-3	
Population	100,427	94,160	90,365	64,581	
Mean Age (y) (SD)	42.5 (15.6)	43.0 (15.6)	43.6 (15.6)	43.8 (15.6)	<.001
Sex (%)					
Male	43.0%	43.0%	43.6%	44.1%	<.001
Female	57.0%	57.0%	56.4%	55.9%	
Race/Ethnicity					
White	61.7%	60.9%	59.4%	58.5%	<.001
Black	11.0%	11.6%	11.8%	12.4%	<.001
Hispanic	19.4%	20.1%	21.1%	21.1%	<.001
Asian or Pacific Islander	2.8%	2.9%	3.1%	3.3%	<.001
Native American	0.8%	0.7%	0.6%	0.7%	0.003
Other	4.3%	3.9%	4.0%	4.0%	0.092
Patient Comorbidities (Charlson Index)					
None	71.4%	70.4%	68.4%	68.2%	<.001
≥ 1	28.6%	29.6%	31.6%	31.8%	
Insurance Payor					
Medicaid (%)	22.4%	23.1%	28.7%	29.7%	<.001
Private insurance (%)	60.8%	60.0%	58.6%	59.1%	<.001
Self-pay (%)	16.8%	17.0%	12.7%	11.2%	<.001
Type of Surgery					
Appendectomy	33.2%	31.0%	28.8%	28.5%	<.001
Cholecystectomy	42.1%	42.9%	43.5%	43.5%	<.001
Hernia Repair	11.6%	12.0%	12.4%	12.8%	<.001
Bowel Resection	19.1%	20.2%	21.7%	21.6%	<.001
Zip Income Quartile %					
Upper half	48.5%	47.9%	44.9%	45.9%	<.001
Lower half	51.5%	52.1%	55.1%	54.1%	
Facility Characteristics					
Nonteaching	52.9%	51.5%	37.3%	37.6%	<.001
Teaching	47.1%	48.5%	62.7%	62.4%	<.001
Facility Region					
Northeast	21.0%	19.8%	19.1%	18.9%	<.001
Midwest	18.2%	18.3%	17.9%	17.7%	0.001
South	35.9%	37.3%	37.2%	38.1%	<.001
West	24.9%	24.6%	25.8%	25.3%	<.001

†Pre-ACA OE is years 2012-2013, Post-ACA OE is year 2014 and Quarters 1-3 of 2015.

*P Calculated for the combined Pre-ACA OE years Vs Post-ACA OE years

ACA: Affordable Care Act OE: Open Enrollment

Table 2. Difference-in-Differences Odds-ratios for EGS Self-pay admission status before and after Implementation of the 2014 ACA OE.

Variable	Group	Pre-ACA 2012-2013	Post-ACA 2014-2015 Q1-3	Pre-Post ACA Difference
Age	15-24	REF	REF	REF
	25-64	1.10 (95% CI: 1.07-1.14)	1.11 (95% 1.06-1.16)	0.98 (95% CI: 0.93-1.03) p=0.47
	>64	0.31 (95% CI: 0.28-0.34)	0.48 (95% CI: 0.44-0.53)	1.55 (95% CI: 1.37-1.74) p<0.001
Gender	Female	REF	REF	1.01 (95% CI: 0.97-1.05) p=0.58
	Male	1.36 (95% CI: 1.33-1.39)	1.34 (95% CI 1.30-1.39)	0.99 (95% CI: 0.95-1.03) p=0.58
Race	White	REF	REF	REF
	Black	1.53 (95% CI:1.47-1.59)	1.54 (95% CI 1.47-1.61)	1.02 (95% CI: 0.96-1.08) p=0.567
	Hispanic	2.34 (95% CI:2.28-2.41)	2.15 (95% CI (2.08-2.32)	0.92 (95% CI: 0.88-0.96) p<0.001
	Asian	0.92 (95% CI: 0.85-1.00)	0.87 (95% CI 0.79-0.97)	0.95 (95% CI: 0.84-1.09) p=0.47
	Native American	1.22 (95% CI: 1.06-1.42)	1.22 (95% CI 1.0-1.50)	1.01 (95% CI: 0.78-1.29) p=0.97
	Other	1.63 (95% CI: 1.53-1.72)	1.59 (95% CI 1.48-1.72)	0.98 (95% CI: 0.90-1.08) p=0.73
Hospital Region	Northeast	REF	REF	REF
	Mid-West	1.62 (95% CI 1.55-1.60)	1.58 (95% CI 1.49-1.69)	0.91 (95% CI: 0.86-0.96) p=0.001
	South	3.18 (95% CI 3.06-3.30)	4.00 (95% CI 3.80-4.22)	1.52 (95% CI: 1.46-1.58) p<0.001
	West	1.75 (95% CI 1.68-1.82)	1.12 (95% CI 1.05-1.19)	0.54 (95% CI: 0.51-0.56) p<0.001
Hospital Type	Rural	REF	REF	REF
	Urban-Non-Teaching	0.80 (95% CI: 0.77-	0.79 (95% CI: 0.75-	0.98 (95% CI: 0.92-1.05)

	Urban Teaching	0.83) 0.86 (95% CI: 0.82-0.89)	0.84) 0.82 (95% CI: 0.78-0.87)	p=0.59 0.96 (95% CI: 0.92-1.00) p=0.04
Comorbidities	None 1 or more	REF 0.54 (95%CI: 0.50-0.57)	REF 0.53 (95% CI: 0.49-0.57)	REF 0.98 (95% CI: 0.89-1.09) p=0.78
Transfer Status	Not Transferred in Transferred from Acute Hosp Transfer from other type Hosp	REF 0.85 (95% CI: 0.79-0.91) 0.60 (95% CI: 0.53-0.69)	REF 0.79 (95% CI: 0.73-0.86) 0.49 (95% CI: 0.40-0.59)	REF 0.93 (95% CI: 0.84-1.04) p=0.22 0.81 (95% CI: 0.64-1.03) p=0.08
Zip-Income Quartiles	Upper Half Lower Half	REF 1.95 (95% CI: 1.90-2.00)	REF 1.96 (95% CI: 1.90-2.03)	REF 1.00 (95%CI: 0.96-1.04) p=0.82

Table 4: Impact of the ACA OE on Rates of Admissions and Outcomes in EGS patients.

	Self-pay			Insured			Unadjusted Difference in Differences†	Adjusted Difference in Differences‡	***P*** for between-group differences
	Pre-ACA OE§	Post-ACA OE	Change	Pre-ACA OE	Post-ACA OE	Change			
Admissions %‖	16.9	12.1	-4.8	83.1	87.9	4.8	- -	- -	
Mortality %	0.90	1.25	0.35	1.1	1.20	0.09	0.26	0.31	0.003*
Complications %	20.8	25.1	4.3	25.2	29.9	4.7	0.4	0.1	0.375
Mean wage-index adjusted costs US$ (SD)	14306 (21716)	14856 (23376)	3.7	19779 (46546)	21900 (48057)	9.7	6.0	3.6	0.008*

*p<0.01

†Difference in Differences (DID), calculated by subtracting the pre/post ACA OE difference of the Uninsured Group from the Insured Group.

‡Risk adjusted for patient factors (age, sex, race, comorbidities, zip code income) and hospital factors (urban/rural status teaching status, region).

§Pre-ACA OE is mean of years 2012-2013, Post ACA OE is years 2014 and 1st through 3rd quarters 2015.

Table 5: Impact of the ACA OE on Rates of Admissions and Outcomes in EGS patients with Bowel Resection.

	Self-pay			Insured			Unadjusted Difference in Differences†	Adjusted Difference in Differences‡	***P*** for between-group differences
	Pre-ACA OE§	Post-ACA OE	Change	Pre-ACA OE	Post-ACA OE	Change			
Admissions %‖	13.4%	9.8%	-3.6%	86.6%	90.2%	3.6%	- -	- -	
Mortality %	4.3%	4.2%	-0.1%	4.4%	5.7%	1.3%	1.4%	1.2%	P=0.012
Complications %	56.9%	56.5%	-0.4%	53.0%	53.3%	0.3%	0.7%	0.4%	P=0.764
Mean wage-index adjusted costs US$ (SD)	14306 (21716)	14856 (23376)	3.7	19779 (46546)	21900 (48057)	9.7	6.0%	6.0%	P<0.001*

*p<0.01

†Difference in Differences (DID), calculated by subtracting the pre/post ACA OE difference of the Uninsured Group from the Insured Group.

‡Risk adjusted for patient factors (age, sex, race, comorbidities, zip code income) and hospital factors (urban/rural status teaching status, region).

§Pre-ACA OE is mean of years 2012-2013, Post ACA OE is years 2014 and 1st through 3rd quarters 2015.

Table 6: Sensitivity Analysis

A. Comparison of Rates of Admissions and Outcomes 2012-2013 in Pre-ACA OE period

	Self-pay			Insured			Unadjusted Difference in Differences†	Adjusted Difference in Differences‡	***P*** for between-group differences
	2012	2013	Change	2012	2013	Change			
Admissions %‖	16.8	17.0	0.2	83.2	83.0	0.2	- -	- -	
Mortality %	0.9	0.9	0.01	1.1	1.1	0.04	-0.03	0.0	0.847
Complications %	20.1	21.6	1.5	24.4	25.4	1.0	0.5	0.0	0.237
Mean wage-index adjusted costs US$ (SD)	13595 (12181)	14248 (20532)	4.8	16437 (27183)	17563 (31990)	6.9	2.1	0.1	0.940

B. Comparison of the ACA OE on Medicare Rates of Admissions and Outcomes in EGS patients.

	Medicare			Non-Medicare			Unadjusted Difference in Differences†	Adjusted Difference in Differences‡	***P*** for between-group differences
	Pre-ACA OE§	Post-ACA OE	Change	Pre-ACA OE	Post-ACA OE	Change			
Admissions %‖	32.4	34.2	1.8	67.6	65.8	-1.8	- -	- -	
Mortality %	5.4	5.1	-0.3	1.1	1.2	0.1	-0.2	0.004	0.620
Complications %	57.2	58.2	2.0	25.5	28.5	3.0	1.0	0.02	0.519
Mean wage-index adjusted costs US$ (SD)	33455 (12181)	35730 (20532)	6.8	25842 (61897)	28566 (74187)	6.9	-0.1	0.1	0.835

†Difference in Differences (DID), calculated by subtracting the pre/post ACA OE difference of the Uninsured Group from the Insured Group.

‡Risk adjusted for patient factors (age, sex, race, comorbidities, zip code income) and hospital factors (urban/rural status teaching status, region).

§Pre-ACA OE is mean of years 2012-2013, Post ACA OE is years 2014 and 1st through 3rd quarters 2015.