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Trends and Factors Influencing Inpatient Prolapse Surgical Costs and Length of Stay in the U.S

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Abstract

Objective—To assess trends and factors affecting inpatient hospital costs and length of stay (LOS) in surgical treatment of pelvic organ prolapse in the U.S.

Methods—A retrospective cross-sectional study along with longitudinal trend analysis from the 2001-2011 National Inpatient Sample included subjects who underwent inpatient prolapse repairs. The primary outcomes were inpatient mean cost per admission and LOS. We compared unadjusted differences in primary outcomes for each patient and hospital characteristic using 2011 data with ANOVA. Multivariable regression estimated proportional change in cost and LOS associated with each characteristic.

Results—Unadjusted analysis revealed increased LOS with age ≥ 80 years, African American race, uninsured status, lower income, lower surgical volume hospitals (< 75%) and increased costs in the West and public hospitals. On multivariable analyses, African-Americans had 1.09 (95% CI, 1.05–1.13, p<0.001) times longer LOS compared to Caucasians, and the uninsured had 1.15 (95% CI, 1.01–1.30, p=0.032) times longer LOS compared to privately insured. Comorbidities associated with 20% increase in LOS and costs were pulmonary circulation disorders, metastatic cancer, weight loss, coagulopathy, and electrolyte/fluid imbalance (p<0.001). Congestive heart failure and blood loss/deficiency anemia lead to 20% longer LOS (p<.001). In 2001-2011, mean LOS declined from 2.42 days (95% CI 2.37-2.47) to 1.79 days (95% CI 1.71-1.87), (p<.001), whereas mean total cost increased from \$6,233 (95% CI: 5,859 - 6,607) to \$9,035 (95% CI 8,632-9,438), (p<.001).

Conclusions—Inpatient surgical costs for prolapse increased despite decreasing LOS. Some patient and hospital characteristics are associated with increased inpatient costs and LOS.

Keywords

inpatient hospital cost; length of stay; prolapse surgery

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Introduction

Pelvic organ prolapse (POP) is present in 25-65% of postmenopausal women and one of the most common surgical indications.^{1,2} POP procedures performed in inpatient settings account for two-thirds (71%-\$714 million) of costs related to POP treatment.^{3,4} Length of stay (LOS) is an outcome frequently evaluated as one of the top factors influencing hospital costs during inpatient stay.⁵ Although economic analyses have been performed comparing different POP procedures, these studies did not address the factors increasing inpatient costs and LOS.⁶⁻⁹ Little is known regarding specific patient and hospital characteristics contributing to increased costs and LOS. This gap in knowledge limits our insight in proactively managing cost containment.

The American Urogynecologic Society Research Summit recommended to conduct relevant economic assessments, including the surgical care costs.¹⁰ Current health care environment mandates the highest quality while minimizing cost of care. The Department of Health and Human Services has identified that improving quality while reducing the costs is a top priority for next several years.¹¹ This will not be possible in surgical specialties unless surgeons analyze expenditures and identify the factors that increase the health care costs related to common surgical procedures.

We tested the hypothesis that patient and hospital characteristics are associated with inpatient costs and LOS during POP surgical treatment. Our objectives were: 1) to assess whether and to what extent patient and hospital characteristics are associated with inpatient costs and LOS; and 2) to evaluate the 2001-2011 trends in inpatient costs and LOS.

Methods

This is a retrospective cross-sectional study using the 2011 National Inpatient Sample (NIS) database of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ). Additionally, we used the 2001-2011 NIS data for longitudinal trend analysis. This study was exempt from Case Western Reserve University Institutional Board Review because only un-identified publicly available data were analyzed.

The NIS is a database of hospital inpatient stays frequently utilized to identify, track, and analyze national trends in health care utilization, access, charges, quality, and outcomes. The NIS is the largest all-payer inpatient care database that is publicly available in the United States. It consists of inpatient stay records from all non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions, Veterans Hospitals, other Federal facilities (Department of Defense and Indian Health Service), and short-term rehabilitation hospitals. The NIS file for 2011 includes 8,023,590 hospital stays from 1,049 non-federal community hospitals in 46 states, representing approximately 20% of all hospital stays and 97% of the U.S. population. The design and sampling techniques used in the NIS have been previously described.¹² Validity and reliability of the NIS has been studied extensively.¹³ Our research team received collected data directly from the AHRQ.

We identified the study population through both primary and secondary International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) procedure codes on the discharge record. Procedures of interest were ICD-9-CM anterior (70.51, 70.54, 70.79), posterior (70.52, 70.55), apical (70.77, 70.78, 70.92, 70.93) anterior-posterior (70.50, 70.53), and obliterative (70.8) vaginal wall prolapse repairs (Appendix A). The graft augmentation codes were 70.94 and 70.95.

The primary dependent variables were mean cost per admission and LOS. LOS was the number of days from admission to discharge. We used the HCUP Cost-to-Charge Ratio Files to convert hospital total charges to an estimated total cost reflecting specific amounts that hospitals received in payments. These files contained hospital-specific cost-to-charge ratios based on all-payer inpatient costs obtained from the hospital accounting reports collected by the Centers for Medicare and Medicaid Services (CMS).¹⁴

We tested the hypothesis that patient and hospital characteristics were associated with the inpatient costs and LOS during inpatient POP surgical treatment. The patient-level characteristics were age, race, comorbidities, community-level median household income, and insurance status. The NIS contains six race categories: White, Black, Hispanic, Asian/Pacific Islander, other and unknown. We collapsed Asian/Pacific Islander and unknown into the “Other” category due to low counts. Insurance was categorized based on the primary payer: Medicare, Medicaid, private insurance, self-pay or uninsured, and other. Community-level median household income provides a quartile classification of the estimated median household income of residents in the patient's ZIP Code. We used secondary ICD-9 diagnosis codes to measure 29 different comorbidities, based on algorithms developed by AHRQ.¹⁵ AHRQ comorbidities include a comprehensive list of illnesses that allows the evaluation of individual medical conditions and their independent effects on outcomes. Two of these comorbidities from the analysis were subsequently dropped – AIDS and peptic ulcer disease – because very few (10) patients had these conditions.

Hospital-level characteristics included geographic region, bed size, location (urban and rural), teaching status (teaching and non-teaching), hospital ownership structure (public, private nonprofit, private for-profit), and hospital volume of prolapse procedures. Hospital region is based on the four regions defined by the U.S. Census Bureau: Northeast, South, Midwestern, and West. Hospital bed size was classified as small, medium, or large, based on an algorithm developed by HCUP. Bed size cutoff was different and specific to the hospital's region, location, and teaching status. For example, an urban teaching hospital was considered large with +325 beds at West, +375 at Midwest, +425 at Northeast, +450 at South. Hospital volume was measured as the number of hospital stays involving prolapse procedures for each hospital in 2011. We categorized hospital volume into four categories with cut points based on quartiles. Surgeon volume was not included in our analysis as this measure was removed from the NIS due to concerns with reliability.

We calculated trends in the annual mean total cost per admission and LOS for POP surgeries from 2001 to 2011. For trend analysis, costs were adjusted for inflation using Real Gross Domestic Product in chained 2011 dollars.

All analyses were performed using SAS version 9.3 for Unix. We calculated descriptive statistics for all variables in the study. The complex sample design of the study was accounted for using the appropriate procedures in SAS (SURVEYFREQ and SURVEYMEANS). For all descriptive analyses, we applied the discharge weights in the NIS to calculate national estimates. We calculated the mean unadjusted costs and LOS with 95% confidence intervals (CI) for each variable, the association of each variable on cost and on LOS using F-tests. Due to a large sample in the NIS database, we used a p-value threshold of 0.001 and at least 20% change for a statistical test of association to be considered significant in evaluation between comorbidities and LOS or cost. For multivariable analysis, costs and LOS were log transformed and fit to a linear model with a general estimating equations approach and exchangeable correlation structure to account for clustering by hospital.¹⁶ By exponentiation of the parameter estimates in the regression model, we were able to calculate the proportional change and 95% CI for each study variable. The proportional change represents the effect associated with each variable on increasing (or decreasing) the continuous outcome (LOS or cost). The interpretation of proportional change is similar to that of a relative risk, but for continuous outcomes rather than binary. Both models contained all of the independent study variables mentioned earlier including individual comorbidities. We also fit a null random effects model to determine the intraclass correlation coefficient.¹⁷

Results

There were 116,474 inpatient admissions in 2011 where POP surgery was identified as a primary or secondary procedure code on the discharge record. This represented 0.3% of all inpatient admissions in the U.S. Multiple procedures were performed in 43% of all inpatient admissions. This amounted to 155,918 surgical POP repairs and 25,424 graft augmentation procedures. Of 155,918 POP procedures, 61,839 (39.7%) were apical, 29,814 (19.1%) anterior, 18,976 (12.2%) posterior, 42,596 (27.3%) anterior-posterior, and 2,693 (1.7%) obliterative prolapse repairs. The number of inpatient surgical procedures steadily declined by 29.0% over the study period from 219,471 procedures in 2001.

Table 1 depicts baseline patient and hospital characteristics. The mean age of subjects was 59.0 years with the majority of Caucasian (68.5%) and privately insured (53.0%) women. Over 60% of the population had at least one comorbid condition. The frequencies of specific medical comorbidities are noted in Figure 1. More than 80% of all inpatient admissions occurred in urban teaching and non-teaching hospitals. Large bed-size and private non-profit hospitals had the majority of all inpatient admissions. The inpatient mortality rate was 4.29 per 10,000 (95% CI: 1.72 - 6.79) in 2011 and remained similarly low through 2001-2011. The unadjusted mean cost per admission and LOS for inpatient surgical prolapse repair was \$9,035 (95% CI 8,632-9,438) and 1.79 days (95% CI 1.71-1.87) respectively, in 2011.

Table 2 shows the unadjusted mean LOS and mean total costs for each admission by patient and hospital characteristics. With respect to age, women ages 80 and older had the longest LOS (2.13 days, $p<0.001$). With respect to race, African American women had longest LOS (2.61 days, $p=0.023$). With respect to insurance status, uninsured women had longest LOS (3.19 days, $p<0.001$). There was a dose-response relationship between higher comorbidity

count and increased LOS and hospital costs. Women who had 3 comorbidities had longest LOS (2.40 days) and highest inpatient hospital costs per admission (\$10,294) than women with no comorbidities (LOS 1.61 days and costs \$8,642, all p-values <0.001). LOS was shortest in urban non-teaching hospitals, small hospitals as measured by bed size, and hospitals with a highest (>75 percentile) volume of POP surgeries. Inpatient surgical treatment was most costly in the Western region hospitals and in publicly owned hospitals.

The intraclass correlation coefficient of patients within hospitals was 0.19 for LOS and 0.48 for average total cost, meaning that 19% and 48% of the variation in LOS and total cost, respectively, can be explained at the hospital level. There was only slight variance in cost by different types of surgical procedures. Table 3 demonstrates multivariable analyses of all patient and hospital characteristics associated with increased costs or prolonged hospitalization. Controlling for all variables, some patient characteristics were associated with longer LOS. African-Americans had a 9% longer LOS compared to Caucasians (proportional change, 1.09, 95% CI, 1.05–1.13). In addition, compared to women with private insurance, Medicaid patients had a 7% (1.07, 95% CI, 1.04–1.10) and the uninsured had a 15% (1.15, 96% CI, 1.01–1.30) longer LOS. Select medical comorbidities associated with at least 20% higher mean costs (p<.001) controlling for all other variables included: pulmonary circulation disorders, 1.37, 95% CI, 1.20–1.58, (37% higher costs compared to those without this disorder), metastatic cancer, 1.51 (95% CI, 1.28–1.77), coagulopathy, 1.26 (95% CI, 1.12–1.41), weight loss 1.83 (95% CI, 1.45–2.32), and electrolyte/fluid imbalance, 1.36 (95% CI, 1.29–1.43). Comorbidities associated with at least 20% longer LOS (p<.001) controlling for all other variables were: congestive heart failure, 1.25 (95% CI 1.14–1.36) (25% longer LOS compared to those without heart failure), pulmonary circulation disorders 1.52 (95% CI, 1.25–1.85), metastatic cancer 1.81 (95% CI, 1.42–2.32), coagulopathy 1.37 (95% CI, 1.22–1.54), weight loss 3.04 (95% CI, 2.41–3.84), electrolyte/fluid disorders 1.76 (95% CI, 1.66–1.88), blood loss anemia 1.21 (95% CI, 1.12–1.31) and deficiency anemia 1.21 (95% CI, 1.17–1.26).

Figure 2 shows annual trends in the mean LOS and costs per admission for inpatient surgery. The mean LOS declined steadily from a high of 2.42 days (95% CI 2.37–2.47) in 2001 to 1.79 days (95% CI 1.71–1.87) in 2011 (p<.001). However despite decreasing LOS, the mean total cost per admission increased from \$6,233 (95% CI: 5,859 - 6,607) in 2001 to \$9,035 (95% CI 8,632–9,438) in 2011 (p<.001).

Discussion

This study revealed patient and hospital characteristics that are associated with increased inpatient costs and LOS in surgical POP treatment. Medical comorbidities (pre-existing conditions or surgical complications) including fluid/electrolyte imbalance, coagulopathy, pulmonary circulation disorders, weight loss, and metastatic cancer are associated with both 20% increased costs and prolonged LOS. Congestive heart failure, blood loss and deficiency anemia are associated with 20% increase in LOS. Age 80 years, African American race, uninsured status, lower income, and lower surgical volume hospitals (< 75%) are risk factors associated with increased LOS. The cost of inpatient prolapse procedures is higher in public

hospitals after multivariable adjustment. In 2001-2011, the mean total cost per admission significantly increased despite decreasing LOS.

Findings from this report add to the literature regarding the economics of inpatient surgical POP treatment focusing on risk factors associated with increased inpatient hospital costs and prolonged hospitalization. Data as these are especially important, as physicians and hospitals begin to receive their payments linked to bundled as opposed fee-for-service payment models.¹¹ Pelvic surgeons, hospitals, and health care policy makers are the three key players to deliver high quality surgical care for women with prolapse and to contain the costs. The knowledge about what leads to increased costs will allow these players to plan accordingly for necessary steps and resources. Although our study established the associations but not causality, it suggests that pelvic surgeons have pre-surgical attentiveness and consider careful preoperative planning. Patients with risk factors (age ≥ 80 years, African American race, uninsured status, lower income, and certain medical comorbidities) may have prolonged hospitalization or increased costs (or both) during surgical treatment. Based on prior reports that high volume hospitals and surgeons have fewer postoperative complications and lower mortality rates along with our findings which showed that highest surgical volume hospitals had the lowest LOS, we suggest that the hospitals develop high surgical volume programs or centers of excellence to treat women with pelvic floor disorders.^{18,19} Furthermore, the hospitals should evaluate the factors increasing costs of inpatient POP repairs based on the ownership as well as beyond patient and hospital characteristics. Finally, the knowledge about modifiable and non-modifiable factors leading to longer hospitalization and higher costs is necessary to make an appropriate health care resources allocation for vulnerable population subgroups that would require higher expenditures and prolonged hospitalization.

The literature indicates contradictory results on comorbidities and surgical outcomes in women with prolapse.^{20, 21} These differences may be due to utilization of a comorbidity index rather than evaluation of individual comorbidities. Most common medical conditions did not have a significant negative impact on primary outcomes in our cohort. Although, frequencies of medical comorbidities negatively affecting the costs and LOS are low, knowledge about these conditions during preoperative patient selection will help with treatment planning. If medical comorbidity is not modifiable, non-surgical treatment should be considered as an alternative. Additionally, modifiable medical comorbidities or surgical complications such as deficiency/blood loss anemia, weight loss, coagulopathy, or fluid/electrolyte abnormalities could be corrected before surgical treatment or aggressively managed in the immediate postoperative period.

This study has some limitations inherent to the use of administrative databases and the ICD-9-CM procedure codes. However, HCUP analysis has concluded that the NIS provides reliable national estimates of average LOS and costs. To minimize a bias related to better hospital accounting, our findings are based on the cost-to-charge ratio analysis. This ratio provides a better estimate of the actual cost burden an inpatient stay compared to charges. The cross-sectional design of our study cannot evaluate the causality of increased inpatient costs or prolonged hospitalization. While our report reveals inpatient increasing costs despite decreasing LOS over time, our study design is not able to explain why this occurs.

This dataset did not allow us to analyze the cost and the length of hospitalization related to outpatient surgeries or any specific prolapse procedure. We were not able to assess the impact of complex surgical procedures on primary outcomes. As the number of outpatient POP surgical procedures significantly increased in recent years, the evaluation of factors affecting the costs and LOS in outpatient surgery is necessary. Despite inability to evaluate outpatient POP surgeries, this analysis is important since inpatient POP surgeries account for a significant proportion of costs related to POP treatment.⁴

The study strengths include evaluation of the trends and factors increasing inpatient costs and LOS in prolapse surgical treatment. This study reports on costs reflecting true hospital payments rather than hospital charges. The large sample size and the NIS representativeness across all insurer types and demographics of the U.S. are unmatched by any other database. The data from this study is necessary for physicians, hospital administrations, and health policy agencies to develop strategies and initiatives to decrease the costs and the length of hospitalization during inpatient stay. This is especially important since our analysis revealed rising cost for inpatient prolapse surgical procedures despite decreasing LOS between 2001 and 2011. Some modifiable factors such as preoperative planning, perioperative management of medical conditions (pre-existing or surgical complications), and high-volume surgical programs may lead to decreased costs and LOS. On another hand, the knowledge about non-modifiable factors that lead to increased expenditures and prolonged hospitalization will allow the physicians and hospitals advocate and plan for necessary health care recourse allocation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Figure shows the frequencies of specific comorbidities in the cohort.

Figure 2.

LOS, Length of Stay.* Weighted national estimates derived from the Nationwide Inpatient Sample (NIS), 2001 – 2011. Mean costs derived from cost-to-charge ratio supplied by NIS, and adjusted for inflation using Real GDP in 2011 chained dollars. Vertical lines at each point represent the 95% confidence interval

Table 1
Baseline patient and hospital characteristics: Inpatient surgical treatment for pelvic organ prolapse in the United States, 2011*

Variables	Number (N)	Percent (95% CI)
Inpatient Admissions	116,474	100%
Patients characteristics		
<i>Age Group, years</i>		
<40	10,168	8.7% (7.7–9.7)
40 - 49	20,647	17.7% (16.9–18.5)
50 - 59	26,506	22.8% (22.6–23.4)
60 - 69	30,236	26.0% (25.2–26.8)
70 - 79	21,787	18.7% (17.9–19.5)
80+	7,130	6.1% (5.7–6.5)
<i>Race</i>		
Caucasian	79,790	68.5% (64.5–72.5)
African-American	4,931	4.2% (3.6–5.0)
Hispanic	13,898	11.9% (9.5–14.3)
Other	4,477	3.9% (3.3–4.5)
Missing	13,378	11.5% (7.5–15.5)
<i>Household Income[‡]</i>		
\$1-38,999	26,203	22.5% (20.1–24.9)
\$39,000-47,999	27,737	23.8% (21.8–25.8)
\$48,000-63,999	31,959	27.4% (25.4–29.4)
\$64,000	28,649	24.6% (21.4–27.8)
Missing	1,926	1.7% (1.5–1.9)
<i>Insurance</i>		
Medicare	42,612	36.6% (35.2–38.0)
Medicaid	6,544	5.6% (4.8–6.4)
Private	61,716	53.0% (51.2–54.8)
Uninsured	1,475	1.3% (0.7–1.9)
Other	4,127	3.5% (2.7–4.3)
<i>Comorbidities</i>		
None	44,352	38.1% (36.7–39.5)
One	35,984	30.9% (30.1–31.7)
Two	21,834	18.7% (18.1–19.3)
Three or more	14,304	12.3% (11.5–13.1)
Hospitals characteristics		
<i>Location / Teaching</i>		

Variables	Number (N)	Percent (95% CI)
Rural	12,781	11.0% (9.2–13.8)
Urban, non-teaching	50,999	43.8% (39.4–46.2)
Urban, teaching	51,389	44.1% (39.5–48.7)
Missing	1,305	1.1% (0.1–2.1)
<i>Region</i>		
Northeast	17,686	15.2% (12.2–18.2)
Midwest	24,651	21.2% (19.4–23.0)
South	42,157	36.2% (33.8–40.6)
West	31,980	27.4% (25.6–29.2)
<i>Bed Size</i>		
Small	14,678	12.6% (9.8–15.4)
Medium	29,286	25.1% (21.6–28.9)
Large	71,205	61.1% (56.9–65.3)
Missing	1,305	1.1% (0.1–2.1)
<i>Hospital Volume</i>		
1 – 186 (1 st quartile)	28,834	24.8% (21.4–28.2)
187 – 416 (2 nd quartile)	29,288	25.1% (20.3–29.9)
417 – 712 (3 rd quartile)	29,057	24.9% (22.1–27.7)
713+ (4 th quartile)	29,295	25.2% (17.9–32.6)
<i>Hospital Ownership</i>		
Public	8,055	6.9% (5.1–8.7)
Private nonprofit	88,485	76.0% (73.8–78.2)
Private for-profit	18,629	16.0% (14.2–17.8)
Unspecified	1,305	1.1% (0.1–2.1)
Mean cost per admission	\$9,035 (95% CI 8,632-9,438)	
Average LOS	1.79 days (95% CI 1.71-1.87)	
Inpatient mortality	4.29 per 10,000 (95% CI: 1.72 - 6.79)	

LOS, Length of Stay; CI, Confidence Interval.

* Weighted national estimates derived from the Nationwide Inpatient Sample (NIS), 2011.

[‡] Median household income of the zip code patient resides in.

Unadjusted length of stay and costs associated with patient and hospital characteristics: Inpatient surgical treatment for pelvic organ prolapse in the United States, 2011 (These results are not adjusted for other factors)

Table 2

	LOS, days	95% CI*	p-value [†]	Cost,\$	95% CI	p-value [†]
Patient characteristics						
<i>Age Group, years</i>			<.001			0.267
<40	1.94	(1.78 - 2.11)		\$9,093	(\$8,278 - \$9,907)	
40 - 49	1.83	(1.68 - 1.98)		\$9,144	(\$8,669 - \$9,620)	
50 - 59	1.71	(1.64 - 1.78)		\$9,217	(\$8,766 - \$9,668)	
60 - 69	1.68	(1.61 - 1.75)		\$8,942	(\$8,503 - \$9,380)	
70 - 79	1.84	(1.75 - 1.93)		\$8,853	(\$8,428 - \$9,279)	
80+	2.13	(1.98 - 2.28)		\$8,917	(\$8,285 - \$9,550)	
<i>Race</i>			0.023			0.202
Caucasian	1.74	(1.67 - 1.80)		\$8,911	(\$8,470 - \$9,351)	
African-American	2.61	(2.03 - 3.19)		\$9,822	(\$8,662 - \$10,983)	
Hispanic	1.84	(1.70 - 1.98)		\$9,401	(\$8,500 - \$10,303)	
Other	1.84	(1.71 - 1.97)		\$9,535	(\$8,785 - \$10,286)	
Missing	1.77	(1.53 - 2.01)		\$8,976	(\$8,014 - \$9,939)	
<i>Household Income[‡]</i>			<.001			0.001
\$1-38,999	1.94	(1.82 - 2.05)		\$8,239	(\$7,758 - \$8,721)	
\$39,000-47,999	1.87	(1.75 - 1.98)		\$8,900	(\$8,486 - \$9,314)	
\$48,000-63,999	1.75	(1.68 - 1.82)		\$9,195	(\$8,705 - \$9,686)	
\$64,000	1.64	(1.56 - 1.72)		\$9,704	(\$9,012 - \$10,395)	
Missing	1.91	(1.72 - 2.11)		\$9,291	(\$8,563 - \$10,019)	
<i>Insurance</i>			<.001			0.098
Medicare	1.86	(1.79 - 1.94)		\$8,897	(\$8,468 - \$9,327)	
Medicaid	2.08	(1.89 - 2.27)		\$9,682	(\$8,937 - \$10,427)	
Private	1.68	(1.61 - 1.74)		\$8,967	(\$8,535 - \$9,399)	
Uninsured	3.19	(1.38 - 5.01)		\$12,135	(\$8,680 - \$15,591)	

	LOS, days	95% CI *	p- value [†]	Cost,\$	95% CI	p- value [†]
Other	1.89	(1.69 - 2.09)		\$9,265	(\$8,379 - \$10,152)	
<i>Comorbidities</i>						
None	1.61	(1.56 - 1.66)	<.001	\$8,642	(\$8,223 - \$9,060)	<.001
One	1.70	(1.63 - 1.77)		\$8,888	(\$8,460 - \$9,316)	
Two	1.93	(1.77 - 2.08)		\$9,265	(\$8,761 - \$9,770)	
Three or more	2.40	(2.23 - 2.56)		\$10,294	(\$9,786 - \$10,801)	
<i>Hospital characteristics</i>						
<i>Location</i>			0.044			0.123
Rural	1.75	(1.65 - 1.85)		\$8,295	(\$7,635 - \$8,955)	
Urban, non-teaching	1.71	(1.63 - 1.78)		\$8,923	(\$8,370 - \$9,476)	
Urban, teaching	1.87	(1.74 - 2.00)		\$9,263	(\$8,547 - \$9,978)	
<i>Region</i>			0.063			<.001
Northeast	1.64	(1.51 - 1.78)		\$8,123	(\$7,310 - \$8,935)	
Midwest	1.80	(1.64 - 1.95)		\$8,713	(\$8,024 - \$9,402)	
South	1.90	(1.76 - 2.04)		\$8,213	(\$7,661 - \$8,765)	
West	1.74	(1.63 - 1.84)		\$10,911	(\$9,950 - \$11,872)	
<i>Bed size</i>			<.001			0.620
Small	1.56	(1.46 - 1.66)		\$8,856	(\$8,203 - \$9,509)	
Medium	1.81	(1.70 - 1.92)		\$9,145	(\$8,504 - \$9,786)	
Large	1.82	(1.73 - 1.92)		\$8,965	(\$8,380 - \$9,551)	
<i>Hospital volume</i>			0.003			0.257
1 – 186 (1 st quartile)	1.95	(1.86 - 2.04)		\$9,061	(\$8,618 - \$9,505)	
187 – 416 (2 nd quartile)	1.86	(1.71 - 2.01)		\$9,166	(\$8,387 - \$9,945)	
417 – 712 (3 rd quartile)	1.71	(1.59 - 1.83)		\$8,362	(\$7,646 - \$9,078)	
713+ (4 th quartile)	1.66	(1.48 - 1.83)		\$9,550	(\$8,384 - \$10,715)	
<i>Ownership</i>			0.157			0.021
Public	2.17	(1.72 - 2.62)		\$10,286	(\$8,491 - \$12,082)	

	LOS, days	95% CI [*]	p-value [‡]	Cost,\$	95% CI	p-value [‡]
Private nonprofit	1.77	(1.69 - 1.84)		\$9,065	(\$8,585 - \$9,545)	
Private for-profit	1.71	(1.58 - 1.84)		\$8,122	(\$7,436 - \$8,809)	

LOS, Length of Stay; CI, Confidence Interval.

^{*} The point estimate and 95% confidence interval are shown for the average length of stay and average total cost among the patients with each characteristic.

[‡] Anova test.

[‡] Median household income of the zip code patient resides in.

Table 3
Multivariable-adjusted correlates of length of stay and costs: Inpatient surgical treatment for pelvic organ prolapse in the United States, 2011

Variable	LOS		Total Costs	
	Proportional change* (95% CI)	p-value ^{\$}	Proportional change (95% CI)	p-value ^{\$}
Patient characteristics				
<i>Age Group, years</i>				
<40	REFERENT		REFERENT	
40 - 49	0.97 (0.94–1.01)	0.133	1.05 (1.02–1.08)	<.001
50 - 59	0.96 (0.93–1.00)	0.055	1.05 (1.02–1.08)	0.001
60 - 69	0.95 (0.91–0.98)	0.005	1.04 (1.01–1.08)	0.005
70 - 79	0.97 (0.93–1.01)	0.137	1.02 (0.98–1.05)	0.306
80+	1.02 (0.98–1.08)	0.330	0.98 (0.94–1.02)	0.226
<i>Race</i>				
Caucasian	REFERENT		REFERENT	
African-American	1.09 (1.05–1.13)	<.001	1.01 (0.98–1.04)	0.569
Hispanic	1.00 (0.98–1.03)	0.819	0.99 (0.96–1.01)	0.360
Other	1.01 (0.97–1.04)	0.622	0.97 (0.95–1.00)	0.039
<i>Household Income[#]</i>				
\$1-38,999	1.04 (1.02–1.07)	0.001	0.99 (0.97–1.01)	0.279
\$39,000-47,999	1.04 (1.02–1.07)	<.001	1.00 (0.99–1.02)	0.713
\$48,000-63,999	1.02 (1.00–1.04)	0.046	1.01 (1.00–1.03)	0.144
\$64,000	REFERENT		REFERENT	
<i>Insurance Status</i>				
Medicare	1.03 (1.01–1.05)	0.001	1.01 (0.99–1.03)	0.528
Medicaid	1.07 (1.04–1.10)	<.001	1.01 (0.98–1.03)	0.646
Private	REFERENT		REFERENT	
Uninsured	1.15 (1.01–1.30)	0.032	1.05 (0.99–1.11)	0.088
Other	1.00 (0.96–1.05)	0.904	1.02 (0.97–1.08)	0.479
<i>Comorbidities</i>				
Congestive heart failure [‡]	1.25 (1.14–1.36)	<.001	1.12 (1.04–1.20)	0.002
Valvular disease	0.99 (0.94–1.03)	0.496	1.00 (0.97–1.04)	0.803
Pulmonary circulation disorders [‡]	1.52 (1.25–1.85)	<.001	1.37 (1.20–1.58)	<.001
Peripheral vascular disease	0.99 (0.92–1.07)	0.867	1.01 (0.95–1.08)	0.660
Hypertension	0.99 (0.98–1.00)	0.092	1.00 (0.98–1.01)	0.660
Paralysis	1.19 (1.01–1.40)	0.042	1.00 (0.89–1.13)	0.954
Neurological disorders	1.05 (1.00–1.10)	0.033	1.03 (1.00–1.07)	0.086
Chronic lung disease	1.03 (1.01–1.05)	0.006	1.01 (1.00–1.03)	0.121

Variable	LOS		Total Costs	
	Proportional change* (95% CI)	p-value ^{\$}	Proportional change (95% CI)	p-value ^{\$}
Diabetes, uncomplicated	1.02 (1.00–1.04)	0.110	1.01 (1.00–1.03)	0.117
Diabetes, complicated	1.12 (1.00–1.25)	0.050	1.03 (0.97–1.11)	0.347
Hypothyroidism	1.01 (0.99–1.02)	0.493	1.00 (0.99–1.02)	0.819
Renal failure	1.07 (0.99–1.16)	0.088	1.04 (0.98–1.09)	0.189
Liver disease	1.09 (0.97–1.22)	0.138	1.04 (0.97–1.13)	0.279
Lymphoma	0.99 (0.87–1.12)	0.891	1.06 (0.92–1.22)	0.449
Metastatic cancer[†]	1.81 (1.42–2.32)	<.001	1.51 (1.28–1.77)	<.001
Solid organ tumor	1.20 (1.08–1.33)	<.001	1.06 (0.96–1.17)	0.228
Rheumatoid arthritis	1.03 (0.99–1.07)	0.169	0.99 (0.96–1.03)	0.749
Coagulopathy[†]	1.37 (1.22–1.54)	<.001	1.26 (1.12–1.41)	<.001
Obesity	1.04 (1.02–1.07)	0.002	1.04 (1.02–1.06)	<.001
Weight loss[†]	3.04 (2.41–3.84)	<.001	1.83 (1.45–2.32)	<.001
Electrolyte/fluid imbalance[†]	1.76 (1.66–1.88)	<.001	1.36 (1.29–1.43)	<.001
Blood loss anemia[†]	1.21 (1.12–1.31)	<.001	1.14 (1.07–1.21)	<.001
Deficiency anemia[†]	1.21 (1.17–1.26)	<.001	1.09 (1.06–1.12)	<.001
Alcohol abuse	1.07 (0.89–1.30)	0.457	0.96 (0.84–1.09)	0.501
Drug abuse	1.10 (0.93–1.30)	0.269	1.04 (0.93–1.17)	0.450
Psychosis	1.12 (1.05–1.19)	<.001	1.03 (0.99–1.08)	0.138
Depression	1.02 (1.00–1.04)	0.122	1.01 (0.99–1.03)	0.173
Hospital characteristics				
<i>Hospital Location / Teaching Status</i>				
Urban, teaching	0.98 (0.93–1.04)	0.532	1.03 (0.74–1.45)	0.849
Urban, non-teaching	REFERENT		REFERENT	
Rural	1.09 (1.04–1.14)	<.001	0.81 (0.51–1.30)	0.385
<i>Hospital Region</i>				
Northeast	0.95 (0.89–1.00)	0.062	0.69 (0.42–1.14)	0.145
Midwest	0.98 (0.93–1.04)	0.555	1.69 (1.07–2.68)	0.024
South	1.03 (0.98–1.08)	0.203	1.62 (1.07–2.43)	0.022
West	REFERENT		REFERENT	
<i>Hospital Bed Size</i>				
Small	REFERENT		REFERENT	
Medium	1.06 (1.00–1.12)	0.034	1.19 (0.77–1.83)	0.432
Large	1.07 (1.02–1.13)	0.006	0.85 (0.56–1.29)	0.446
<i>Hospital Volume</i>				
1 – 186 (1 st quartile)	REFERENT		REFERENT	
187 – 416 (2 nd quartile)	0.91 (0.87–0.96)	<.001	0.69 (0.42–1.14)	0.145
417 – 712 (3 rd quartile)	0.87 (0.82–0.92)	<.001	1.05 (0.56–1.98)	0.884

Variable	LOS		Total Costs	
	Proportional change* (95% CI)	p-value [§]	Proportional change (95% CI)	p-value [§]
713+ (4 th quartile)	0.86 (0.79–0.93)	<.001	1.73 (0.91–3.28)	0.095
<i>Hospital Ownership/Control</i>				
Public	REFERENT		REFERENT	
Private, not-for-profit	0.99 (0.93–1.06)	0.765	0.69 (0.54–0.88)	0.003
Private, for-profit	0.95 (0.88–1.02)	0.140	0.57 (0.42–0.79)	0.001

LOS, Length of Stay; CI, Confidence Interval.

All patient and hospital characteristics were used in multivariable analysis.

* Multivariable linear regression models show the proportional change and 95% CI total mean cost per admission or LOS for each variable.

Median household income of the zip code patient resides in.

† Comorbidities associated with both 20% increase in LOS and cost per admission.

‡ Comorbidities associated with 20% increase in LOS.

§ Wald Chi-Square Test.