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Attributable Costs of Surgical Site Infection and Endometritis After Low Transverse Cesarean Section

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Abstract

BACKGROUND—Accurate data on costs attributable to hospital-acquired infections are needed in order to determine their economic impact and the cost-benefit of potential preventive strategies.

OBJECTIVE—Determine the attributable costs of surgical site infection (SSI) and endometritis (EMM) after cesarean section using two different methods.

DESIGN—Retrospective cohort.

SETTING—Barnes-Jewish Hospital, a 1250-bed academic tertiary care hospital.

PATIENTS—1,605 women who underwent low transverse cesarean section from 7/1999 – 6/2001.

METHODS—Attributable costs of SSI and EMM were determined by generalized least squares (GLS) and propensity score matched-pairs using administrative claims data to define underlying comorbidities and procedures. For the matched-pairs analyses, uninfected control patients were matched to patients with SSI or with EMM based on their propensity to develop infection, and the median difference in costs calculated.

RESULTS—The attributable total hospital cost of SSI calculated by GLS was $3,529 and by propensity score matched-pairs was $2,852. The attributable total hospital cost of EMM calculated by GLS was $3,956 and by propensity score matched-pairs was $3,842. The majority of excess costs were associated with room and board and pharmacy costs.

CONCLUSIONS—The costs of SSI and EMM were lower than SSI costs reported after more extensive operations. The attributable costs of EMM calculated using the two methods were very similar, while the costs of SSI calculated using propensity score matched-pairs were lower than the costs calculated by GLS. The difference in costs determined by the two methods needs to be considered by investigators performing cost analyses of hospital-acquired infections.

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INTRODUCTION

Surgical site infections (SSIs) are associated with substantial morbidity, hospital length of stay, and hospital readmission(s).[1–3] Most estimates for the costs of SSI come from older studies using simple statistical methods, or no statistical comparisons with only crude estimates for the attributable costs of infection. Attributable costs can vary depending on the type of statistical method employed, as shown by Hollenbeak and colleagues for the costs of SSI after coronary artery bypass surgery.[4]

In many studies attributable costs were calculated for SSI that occurred after a variety of different operations, rather than calculation of costs for SSI after individual surgical procedures.[5–10] Not all SSI are alike however; SSI after operations involving major organ spaces, such as cardiac or orthopedic surgery, may very well have higher attributable costs than SSI after less extensive operations.[4;11;12] In addition, costs of SSI likely vary according to the depth of the infection. Attributable costs of SSI have been reported to be highest for organ-space infection, compared to deep incisional or superficial incisional SSI.[2;13–15]

Accurate estimates of the attributable costs of SSI are needed from the hospital perspective to weigh the cost benefit of infection prevention strategies and to determine the impact of the Deficit Reduction Act and the ruling by the Centers for Medicare & Medicaid Services (CMS). This ruling, which went into effect in October of 2008, denies upgrade to the higher diagnosis-related group for secondary diagnoses considered “preventable hospital-acquired conditions”, including some SSIs.[16]

Most studies examining hospital costs associated with SSI have determined total hospital costs attributable to infection. More recently an argument has been made to focus on direct costs (primarily consumables), since they are most subject to savings by implementation of effective infection control interventions.[17;18] On the other hand, fixed costs, such as costs for most nursing staff, electricity, maintenance, etc., are not subject to immediate savings through prevention of infection. Therefore, calculation of the attributable direct costs of SSI may be necessary to inform cost-benefit analyses of infection control interventions.

We used administrative claims data from a retrospective cohort of women who underwent low transverse cesarean section at our academic tertiary care hospital and two different statistical methods to determine the attributable total and direct costs for SSI and endometritis (EMM).

METHODS

This study was conducted at Barnes-Jewish Hospital (BJH), a 1250-bed tertiary care hospital affiliated with Washington University School of Medicine in Saint Louis, Missouri. All patients who underwent low transverse cesarean section surgery, defined by an *International Classification of Diseases, 9th Edition, Clinical Modification* (ICD-9-CM) procedure code for low transverse cesarean section (74.1) between July 1, 1999 and June 30, 2001 were eligible for the study. For inclusion, patients were required to have an operative note that indicated use of a low transverse uterine incision. Potential SSI and EMM case patients were identified using ICD-9-CM discharge diagnosis codes consistent with incisional infection (998.50, 998.51, 998.59, 674.32, 674.34) or EMM (670.02, 670.04) during the original surgical admission or at readmission (inpatient, outpatient surgery, or emergency room) to the hospital within 60 days of surgery and/or excess antibiotics utilization post-surgery, as described previously.[19–22] Excess antibiotics utilization was defined as ≥ 2 days of antibiotics beginning with postoperative day 2, or any antibiotics at readmission to the hospital within 60 days of surgery. Hospital medical records were reviewed for all patients that met the ICD-9-CM or antibiotics criteria, and signs and symptoms of infection recorded.

EMM was defined as fever beginning > 24 hours or continuing at least 24 hours after delivery plus fundal tenderness.[22] SSIs were verified by chart review using the Centers for Disease Control and Prevention (CDC) National Nosocomial Infections Surveillance System (NNIS) definitions.[21;23] During the time period of this study routine prophylactic antibiotics (cefazolin or cefotetan) were given at cord clamp.[21]

Demographic information, microbiology and laboratory results, and ICD-9-CM diagnosis and procedure codes were collected for the original surgical admission using the BJH Medical Informatics database. ICD-9-CM diagnosis codes used to identify underlying comorbidities were also collected for the 12 months preceding the date of surgery. Comorbidity and procedure variables were created from claims data using the Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software (accessed at http://www.hcup-us.ahrq.gov/).

Hospital cost data were obtained from the BJH cost accounting database (Trendstar; McKesson Corp, Alpharetta, Georgia) for the surgical admission and any inpatient, outpatient surgery, and emergency readmission to the hospital ≤30 days after surgery, excluding the costs and hospital days before the day of the cesarean section. Costs were calculated for each department (e.g., room and board, pharmacy, etc.) by multiplying the department's actual cost components by the charges for each patient charge code recorded during hospitalizations, divided by total departmental costs. Departmental costs were summed to calculate total hospital costs for each patient. All costs were inflation adjusted to 2008 US dollars using the medical care component of the Consumer Price Index.[24]

Statistical Analysis

Patient characteristics were compared with the Student's t, χ^2 or Fisher's exact test, as appropriate. Crude costs were compared with the Mann-Whitney *U* test. Generalized least squares (GLS) models were fit to estimate the costs associated with SSI and EMM (the primary independent variables), while taking into account the variation of other factors significantly associated with costs. Frequency analyses were performed on the claims data to identify diagnoses and procedures that might be important predictors of cost. Variables that applied to <10 patients were excluded. Linearity assessments were performed for continuous variables. The natural log of total costs was used as the dependent variable in order to normalize the highly skewed distribution, and an estimator ("feasible GLS estimator") was used to weight the observations to account for heteroskedasticity.[25] The multivariate GLS model was determined by evaluating all biologically plausible variables, using $p \leq 0.05$ for entry and $p > 0.20$ for exclusion. All independent variables were checked for collinearity. Models were checked for functional form misspecification using Ramsey's regression specification error test and for heteroskedasticity using the Breusch-Pagan test.[25] Since the GLS model used the natural logarithm of costs as the dependent variable, an intermediate regression was performed to predict costs in US dollars.[25]

Each coefficient obtained in the GLS model represented the mean difference in the natural logarithm of costs between individuals with and without that variable, assuming all other predictors of costs remained constant. To calculate the attributable costs of SSI and EMM, the regression equation was solved separately for 1) patients with SSI; 2) patients with EMM; and 3) patients without infection, and back transformed by exponentiating the result. The attributable costs of SSI and EMM were calculated by subtracting the difference in calculated costs between women with SSI or EMM and women without infection.

The second method for determining attributable costs of SSI and EMM was a propensity-score matched-pairs analysis.[26] A logistic regression model was created to predict the probability to develop SSI. The model was adjusted for all variables suspected to impact the risk of developing SSI, as defined by $p < 0.20$ in univariate analysis or biologic plausibility. SSI case patients and controls were matched 1:1 based on their propensity to develop SSI using the nearest-neighbor method within calipers of 0.10 standard deviations.[27] SSI case patients without a suitable control were excluded from the analysis. Comparisons were performed between unmatched and matched SSI case patients using the χ^2 or Fisher's exact test, with correction for multiple testing (α/number of tests). These methods were repeated to create propensity-score matched-pairs for EMM case patients and controls. Attributable costs were calculated as the median of the differences in cost between matched-pairs. The median difference in cost was compared with the Wilcoxon signed-rank test, with 95% confidence intervals calculated in Stata.

Statistical analyses were performed using SPSS version 14.0 (SPSS Inc, Chicago, IL) and Stata version 9.2 (Stata Corp, College Station, TX). Approval for this study was obtained from the Washington University Human Research Protection Office.

RESULTS

Of 1605 patients who underwent low transverse cesarean section during the study period, complete cost data was available for 1,597 (99.5%) patients. Cost data was missing for 1 patient with both SSI and EMM, 2 patients with EMM, and 5 patients without infection. Characteristics of the low transverse cesarean section cohort with complete cost data are shown in Table 1. Eighty (5.0%) patients developed SSI and 121 (7.6%) developed EMM, including 19 (1.2%) patients with both SSI plus EMM. SSI case patients had significantly higher body mass index, and were significantly more likely to have ICD-9-CM diagnosis codes for chorioamnionitis, mild pre-eclampsia, fetal distress, pulmonary collapse or insufficiencies (atelectasis, pulmonary edema, acute respiratory distress syndrome, or respiratory failure), group B S*treptococcus* infection, sepsis, and to have ICD-9-CM procedure codes for an ovarian operation, laparotomy, or tracheostomy/mechanical ventilation. Compared to patients without infection, women with EMM were younger, more likely to be African-American, and less likely to have private medical insurance. Patients with EMM were significantly more likely to have ICD-9-CM diagnosis codes for chorioamnionitis, sepsis, mild pre-eclampsia, fetal distress, premature rupture of membranes, failed labor, and to have ICD-9-CM procedure codes in the surgical admission for amnioinfusion, labor induction, and laparotomy. EMM occurred significantly less often in patients who had undergone a previous cesarean section or had tubal ligation at the time of the cesarean section. The median length of surgical stay, beginning with the day of cesarean section, was significantly longer for women with SSI (4.5 days) and EMM (5.4 days) compared to uninfected control patients (4.0 days; $p < 0.001$ for both).

Table 2 presents crude hospital costs for SSI and EMM case patients and uninfected patients. Patients with SSI or EMM had significantly higher unadjusted costs for the surgical admission plus any readmission within 30 days of surgery compared to uninfected patients ($p < 0.001$ for both). Room and board, pharmacy and laboratory departmental costs were also significantly higher for SSI and EMM case patients compared to uninfected patients (all $p < 0.001$). The crude increases in length of hospital stay (beginning with the date of surgery and including length of stay during hospital readmissions beginning ≤ 30 days after surgery) were 2.2 days for SSI and 1.8 days for EMM ($p < .001$ for both, Mann-Whitney U test).

Both SSI and EMM were independent predictors of hospital costs ($p < 0.001$) in the GLS model (Table 3). Procedures associated with significantly increased costs included labor induction, ovarian procedures, and placement of a central venous catheter. Other medical conditions that strongly impacted costs included severe complications of delivery, pneumonia, pulmonary collapse or insufficiencies, intrauterine fetal death, chorioamnionitis,

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maternal cardiac conditions, and obstetric laceration and/or trauma. There was an increasing dose-response relationship between costs and mild pre-eclampsia, severe pre-eclampsia, and eclampsia, as indicated by the progressively larger values for the β coefficients.

The attributable costs of SSI and EMM estimated by GLS are presented in Table 4. After adjustment for the variables listed in Table 3, the attributable total costs estimated by GLS were $3,529 for SSI and $3,956 for EMM. In a separate analysis, the estimated attributable direct cost was $2,054 (95% CI: $1,797-$2,347) for SSI and $2,726 (95% CI: $2,386-$3,116) for EMM.

In the propensity score matched-pairs analyses, 68 of the 80 SSI case patients were matched with control patients and 110 of the 121 EMM case patients were matched with control patients. Twelve SSI case patients and 11 EMM case patients were excluded because a nearest-neighbor control was not available. All covariates were balanced between matched SSI cases and controls and matched EMM cases and controls after controlling for multiple comparisons. Unmatched SSI case patients had significantly higher median total costs compared to matched SSI case patients ($16,088 vs. $9,973, respectively, $p = 0.008$). Costs were not significantly different for unmatched compared to matched EMM case patients ($10,262 vs. $11,346, respectively; $p = 0.540$).

The median difference in total costs between the matched SSI case and control pairs was $2,852 and the median difference in direct costs was $1,675 ($p < 0.001$, Wilcoxon signed ranks test). The median difference in total costs between the matched EMM case and control pairs was $3,842 and the median difference in direct costs was $2,357 ($p < 0.001$, Wilcoxon signed ranks test). The median difference in the hospital length of stay (beginning with the date of surgery through the date of discharge, plus inpatient readmissions beginning ≤ 30 days after surgery) for the matched pairs was equal to 2.0 days for SSI, and 1.8 days for EMM ($p < .001$ for both, Wilcoxon signed-rank test).

DISCUSSION

We used two different statistical methods to calculate attributable total and direct costs associated with SSI and EMM. We found that the attributable costs of EMM calculated by GLS and propensity score matched pairs were virtually the same (approximately $3,900), whereas the attributable costs of SSI calculated by GLS ($3,529) were higher than the costs calculated using the matched-pairs method ($2,852).

GLS modeling is commonly used for econometric analyses, but relies on the careful specification of the model and inclusion of factors associated with both hospital costs and infection to reduce bias of the estimates. The advantage of the propensity score matched-pairs method is that costs are compared for individuals with similar likelihood of developing infection, and the difference in costs should therefore represent the true incremental costs of diagnosing and treating the infection. The disadvantage of this method is the loss of infected case patients due to the inability to find suitable matched controls with equivalent likelihood of developing infection. The unmatched case patients tend to be individuals with very high probability of infection, since not as many uninfected patients have high probabilities of infection. Thus the attributable costs calculated with this method exclude the sicker patients with more underlying comorbidities, and the calculated costs tend to be lower that the costs calculated by GLS. This was true for the attributable costs of SSI, but in contrast the attributable costs of EMM calculated with the two methods were remarkably similar.

The attributable total costs of SSI after cesarean section calculated in this study (approximately $3,500) were lower than costs of SSI reported in most previous studies following other operations (range approximately $3,400-$17,700).[3–6;11;12;28] It is not surprising that the total costs we calculated for cesarean section SSI are on the low end of the scale of reported SSI costs, since the SSI were primarily superficial incisional infections treated with antibiotic therapy and/or local wound care. To our knowledge there is only one other report of the crude costs of SSI after cesarean section. Mugford et al. found that SSI added £716 (1986-7 British pounds),[29] which translates to $2435 US 2008 dollars,[30] consistent with our findings.

Our calculation of $3,956 in attributable total costs due to EMM was higher than the costs estimated in previous studies. To our knowledge there are only two published reports of costs associated with EMM; one reported in 1980 calculated costs of $850 in a matched-pairs analysis (approximately $3085 in US 2008 dollars[24]), and the other more recent study estimated costs of $815 in 2001 US dollars ($688 for treatment of EMM plus $126 for fever work-up, approximately $1087 in US 2008 dollars) due to EMM after elective cesarean section based on decision tree analysis.[31] It is unclear from this analysis however whether costs associated with excess length of stay were included in the attributable costs.

In the study by Mugford et al.,[29] 76% of the excess costs due to SSI resulted from staffing due to longer length of hospital stay in patients with infection. In our study, room and board costs were also the biggest driver of increased crude costs for women with SSI, while pharmacy costs made the largest contribution to increased costs for women with EMM. Excess room and board costs were responsible for 48% of the increased crude costs in patients with SSI compared to uninfected women, and 29% of the increased crude costs in women with EMM. Pharmacy costs made up 32% of the increased costs for women with SSI and 47% of the increased crude costs for women with EMM compared to women without infection. Thus although the attributable costs of the two infections were very similar, the cost centers driving the increase for the two infections were different. In contrast to the 12% higher attributable total costs of EMM compared to SSI ($3,956 vs. $3,529, respectively), the attributable direct costs of EMM estimated with GLS was 33% higher than the direct costs of SSI ($2,726 vs. $2,054 direct costs for SSI). This is consistent with the finding that pharmacy costs (74% of which were direct costs) contributed more to the total crude costs of EMM. In contrast, room and board costs made up a higher percentage of the total crude costs of SSI, and a much smaller proportion of the room and board costs were in the direct cost category (40% direct costs).

The limitations of this study are the focus on hospital costs of infection, rather than total costs from a societal perspective, including costs of additional clinic visits, outpatient antibiotic therapy, home health visits, etc. We excluded SSI diagnosed and treated solely in the outpatient setting, since those infections would not be associated with increased hospital costs. We expect that the exclusion of outpatient infections would have minimal impact on the costs of EMM, since patients with EMM are almost always hospitalized for intravenous antibiotic therapy.

In summary we used two different methods to calculate hospital costs attributable to SSI and EMM after low transverse cesarean section. The costs of EMM calculated by the two methods were very similar, whereas the cost of SSI calculated by GLS was higher than the cost calculated using propensity-score matched pairs. Investigators can use these results to determine the most appropriate method for calculation of attributable costs based on the goal of their cost analyses. The results of this study can be used to determine the cost-benefit of routine prophylactic antibiotic administration and other infection control interventions to prevent postoperative infection after cesarean section.

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Table 1

Selected Characteristics of the Low Transverse Cesarean Section Cohort at Barnes-Jewish Hospital Between 1999–2001 (n = 1597)

	No SSI or EMM (n = 1415)	SSI (n = 80)	SSI vs. controls[a]	EMM (n = 121)	EMM vs. controls[a]
Characteristic	**n (%)**	**n (%)**	***p***	**n (%)**	***p***
Age (years) mean (SD)	27.2 (6.5)	26.7 (6.4)	0.498	23.2 (5.8)	<0.001
BMI (kg/m^2) mean (SD)	33.7 (7.8)	36.9 (9.1)	<0.001	34.9 (8.6)	0.105
Race					
White	471 (33.3)	29 (36.3)	--	22 (18.2)	--
Black	870 (61.5)	46 (57.5)	0.532	97 (80.2)	<0.001
Other	74 (5.2)	5 (6.3)	0.853	2 (1.7)	0.465
Non-private health insurance (Public aid, Medicare, Medicaid, or no insurance)	825 (58.3)	50 (62.5)	0.459	94 (77.7)	<0.001
Antepartum hemorrhage	42 (3.0)	2 (2.5)	1.000	5 (4.1)	0.412
Postpartum hemorrhage	57 (4.0)	7 (8.8)	0.078	6 (5.0)	0.630
Coagulation and hemorrhagic disorders	27 (1.9)	1 (1.3)	1.000	1 (0.8)	0.720
Chorioamnionitis	133 (9.4)	17 (21.3)	0.001	26 (21.5)	<0.001
Pelvic inflammatory disease	23 (1.6)	1 (1.3)	0.787	0 (0)	0.250
Gonorrhea or syphilis	16 (1.1)	0 (0)	1.000	1 (0.8)	1.000
Group B *Streptococcus*	57 (4.0)	8 (10.0)	0.020	4 (3.3)	1.000
Sepsis	7 (0.5)	3 (3.8)	0.013	4 (3.3)	0.008
Urinary tract or kidney infection[b]	44 (3.1)	4 (5.0)	0.321	8 (6.6)	0.060
Renal disease	12 (0.8)	0 (0)	1.000	0 (0)	0.615
Pneumonia	15 (1.1)	3 (3.8)	0.067	3 (2.5)	0.164
Pulmonary collapse or insufficiencies[c]	20 (1.4)	4 (5.0)	0.036	0 (0)	0.396
Maternal cardiac conditions	40 (2.8)	4 (5.0)	0.292	7 (5.8)	0.090
Diabetes mellitus	59 (4.2)	4 (5.0)	0.576	7 (5.8)	0.400
Gestational diabetes	104 (7.3)	4 (5.0)	0.430	6 (5.0)	0.328
Pre-eclampsia (mild)	96 (6.8)	10 (12.5)	0.053	19 (15.7)	<0.001
Pre-eclampsia (severe)	126 (8.9)	6 (7.5)	0.667	13 (10.7)	0.499
Eclampsia	11 (0.8)	1 (1.3)	0.484	1 (0.8)	1.000

	No SSI or EMM (n = 1415)	SSI (n = 80)	SSI vs. controls[a]	EMM (n = 121)	EMM vs. controls[a]
Characteristic	**n (%)**	**n (%)**	***p***	**n (%)**	***p***
Premature rupture of membranes	58 (4.1)	2 (2.5)	0.768	11 (9.1)	0.011
Multiple gestation	89 (6.3)	6 (7.5)	0.666	3 (2.5)	0.090
Obstetric laceration and/or trauma	24 (1.7)	1 (1.3)	1.000	2 (1.7)	1.000
Severe complication of delivery	19 (1.3)	2 (2.5)	0.311	4 (3.3)	0.101
Fetal distress	589 (41.6)	43 (53.8)	0.033	68 (56.2)	0.002
Intrauterine fetal death	9 (0.6)	1 (1.3)	0.424	1 (0.8)	0.561
Failed labor	288 (20.4)	20 (25.0)	0.317	44 (36.4)	<0.001
Malposition and malpresentation of fetus	367 (25.9)	25 (31.3)	0.293	28 (23.1)	0.499
Previous cesarean section	446 (31.5)	25 (31.3)	0.960	16 (13.2)	<0.001
Amnioinfusion	131 (9.3)	12 (15.0)	0.089	29 (24.0)	<0.001
Labor induction	249 (17.6)	20 (25.0)	0.094	37 (30.6)	<0.001
Ovarian procedure	8 (0.6)	3 (3.8)	0.018	1 (0.8)	0.523
Tubal ligation	269 (19.0)	17 (21.3)	0.620	10 (8.3)	0.003
Laparotomy	3 (0.2)	5 (6.3)	<0.001	3 (2.5)	0.008
Tracheostomy ventilation	5 (0.4)	3 (3.8)	0.007	1 (0.8)	0.389
Central venous catheter[d]	17 (1.2)	1 (1.3)	1.000	4 (3.3)	0.077

Note. SSI, surgical site infection; EMM, endometritis.

[a]Comparison vs. uninfected control group.

[b]Diagnosed on or after the day of cesarean section

[c]Atelectasis, pulmonary edema, acute respiratory distress syndrome, or respiratory failure.

[d]Inserted before the onset of SSI and/or EMM in case patients.

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Table 2

Crude Costs Associated With Surgical Site Infection and Endometritis in the Cohort Population

Cost	Median US $2008 (Range)[a b]		
	SSI (n = 80)	EMM (n = 121)	No SSI or EMM (n = 1,415)
Total	10,317 (4,703–140,478)	11,141 (4,248–57,263)	6,829 (1,642–277,573)
Room and board	7,419 (3,054–73,447)	7,015 (2,960–25,455)	5,762 (1,192–87,004)
Pharmacy	1,722 (200–28,571)	2,627 (343–13,012)	593 (0–39,632)
Laboratory	398 (44–32,908)	618 (43–10,771)	227 (0–32,908)
Other[c]	503 (0–22,296)	498 (0–4,505)	115 (0–41,172)

[a] $p < 0.001$ for all comparisons using the Mann-Whitney U test.

[b] Median costs for the radiology, respiratory therapy and physical therapy departments were equal to zero for all SSI cases, EMM cases, and uninfected control patients.

[c] Included all costs not allocated to room and board, pharmacy, laboratory, radiology, respiratory therapy, or physical therapy departments.

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Table 3

Results of the Generalized Least-Squares Model for Determining Attributable Costs of Surgical Site Infection and Endometritis After Low Transverse Cesarean Section (n = 1597)[a]

Variable	Proportion of Patients	Estimated β Coefficient	SE	*p*
Variables of Interest				
Surgical site infection	0.05	0.36	0.03	<0.001
Endometritis	0.08	0.39	0.03	<0.001
Demographics				
Age < 18 years	0.05	0.06	0.03	0.088
Age > 35 years	0.13	0.04	0.02	0.106
Non-private insurance (Public aid, Medicare, Medicaid, or no health insurance)	0.60	0.02	0.02	0.192
Procedures				
Labor induction	0.19	0.04	0.02	0.040
Ovarian procedure	0.01	0.26	0.08	0.002
Central venous catheter[b]	0.01	0.51	0.07	<0.001
Medical Conditions				
Antepartum hemorrhage	0.03	0.09	0.04	0.032
Postpartum hemorrhage	0.04	0.10	0.04	0.008
Coagulation and hemorrhagic disorders	0.02	0.08	0.06	0.135
Chorioamnionitis	0.11	0.15	0.02	<0.001
Pelvic inflammatory disease	0.02	0.12	0.06	0.049
Gonorrhea or syphilis	0.01	0.13	0.07	0.060
Urinary tract or kidney infection[c]	0.03	0.11	0.04	0.009
Pneumonia	0.01	0.37	0.07	<0.001
Pulmonary collapse or insufficiencies[d]	0.02	0.16	0.06	0.010
Maternal cardiac conditions	0.03	0.13	0.04	0.002
Diabetes mellitus or gestational diabetes	0.11	0.05	0.02	0.022
Pre-eclampsia (mild)	0.08	0.10	0.03	<0.001
Pre-eclampsia (severe)	0.09	0.23	0.03	<0.001
Eclampsia	0.01	0.62	0.08	<0.001
Multiple gestation	0.06	0.10	0.03	0.001
Obstetric laceration and/or trauma	0.02	0.20	0.06	0.001
Severe complication of delivery	0.02	0.53	0.06	<0.001
Fetal distress	0.43	0.02	0.02	0.149
Intrauterine fetal death	0.01	0.19	0.09	0.040

[a]Adjusted R^2 = 0.24 for the model after accounting for natural log transformation of costs.

[b]Inserted before the onset of SSI and/or EMM in case patients.

[c]Diagnosed on or after the day of cesarean section.

[d] Atelectasis, pulmonary edema, acute respiratory distress syndrome, or respiratory failure.

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Table 4

Attributable Total Costs of Surgical Site Infection and Endometritis After Low Transverse Cesarean Section Calculated by Two Different Methods

	Adjusted Cost in US $2008 (95% CI)	
Method	**Surgical Site Infection**	**Endometritis**
GLS	$3,529 ($3,105 – $4,011)[a]	$3,956 ($3,481 – $4,496)[a]
Matched-pairs	$2,852 ($2,006 – $4,378)[b]	$3,842 ($3,254 – $5,111)[b]

Note. CI, confidence interval.

[a]Estimates adjusted for covariates in Table 3.

[b]Costs are the medians and 95% confidence intervals based on the binomial distribution. The medians were used for the matched-pairs analyses since the cost differences were not normally distributed.