Published in final edited form as:

Int Forum Allergy Rhinol. 2019 January ; 9(1): 23–29. doi:10.1002/alr.22198.

Operative Time and Cost Variability for Functional Endoscopic Sinus Surgery

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Abstract

Introduction: Understanding the variation in costs of endoscopic sinus surgery (ESS) is critical to defining value. Current published costs of ESS have not identified potential sources of variation. Our objective was to analyze ESS costs to identify sources of variance that could guide value-improving decisions.

Methods: ESS cases (n=1,739) performed between 2008 and 2016 were identified from a database of 22 rural to tertiary facilities. Cost and time data were extracted from the database. Medical records were reviewed to confirm procedures. Three bilateral groupings were examined (n=895 cases from 13 facilities): 1) Full ESS (all sinuses); 2) Intermediate ESS (total ethmoid, maxillary); 3) Anterior ESS (anterior ethmoid, maxillary). Cost and operative time were analyzed using multivariable gamma regression.

Results: Median costs for Full, Intermediate, and Anterior ESS were \$4,281, \$3,716, and \$2,549 (p<0.001). Median durations were 87, 60, and 58 minutes (p<0.001). Among patients with no additional procedures, those with full ESS had operative duration, total cost, and supply costs that were 1.37 (95% CI: 1.17, 1.61), 1.52 (95% CI: 1.32, 1.75), and 2.40 (95% CI: 1.76, 3.25) times greater than Anterior ESS, respectively (all p<0.001). Intermediate ESS duration at community urban facilities was 1.87 (95% CI: 1.74, 2.02) times that of community rural facilities (p<0.001).

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Conflict of Interest: Jeremiah A. Alt, is supported by grants from the University of Utah Program in Personalized Health and the National Center for Advancing Translational Sciences of the National Institute of Health under Award Number KL2TR001065 and from the National Institute of Allergy and Infectious Diseases under Award Number 1R43AI126987, and a grant from the National Institute on Deafness and Other Communication Disorders (NIDCD; R01 DC005805). Jeremiah A. Alt is a consultant for Medtronic, Inc. GlycoMira Therapeutics Inc. and Spirox. None of these are affiliated with this research.

Financial Disclosures: None.

Financial Support: None.

Conclusions: Duration of surgery, extent of surgery and location of surgery are sources of significant variation in the cost of ESS. These findings will assist healthcare policy makers, hospitals, and surgeons in optimizing the value of ESS.

Keywords

Health Care Costs; Clinical practice variation; Sinus surgery; Health Care Reform; Delivery of Health Care

Background

Delivery of health care in the United States is moving toward a value-focused model, where value is defined by health outcomes per dollar spent.¹ Value determinations can be challenging in Rhinology due to reliance on subjective outcome measures based on symptoms and quality of life (QoL) scores, versus objective measurements (e.g. blood pressure) or clear outcome events (e.g. survival), as well as a deficiency of specific cost data for the procedures performed. For the cost and outcome data which is available, some variation is always expected as these values will naturally range from minimal value to maximal value. Identifying sources of unwanted variation (e.g. unnecessary healthcare expenditure) is essential to reducing cost and improving value. Defining value in endoscopic sinus surgery (ESS) is daunting due to many sources of variation in both costs and outcomes, but understanding these sources of variation has particularly great potential reward given the high estimated expense and incidence of ESS.²

ESS is commonly performed for chronic rhinosinusitis (CRS) and has been demonstrated to be effective for appropriate patients.^{3,4} CRS is a large source of both direct healthcare costs related to management, estimated to be \$10 billion 2016 U.S. Dollars (USD) annually, and indirect costs such as from lost productivity, estimated to be \$13.2 billion 2016 USD annually.⁵⁻⁸ Given the large direct and indirect costs associated with the disease of CRS, surgical management with ESS has been demonstrated to be cost-effective compared to ongoing medical management for select patients, particularly those with recalcitrant disease.^{2,6-12} ESS is also associated with significant improvements in health state utility values both in the short-term and long-term for patients with CRS.^{3,13} Such data has supported the utility of ESS for the treatment of appropriately selected patients with CRS.^{8,11} However, published literature suggests wide variation in costs of ESS ranging from approximately \$3,600 2016 USD in Canada,^{6,14} to over \$10,500 2016 USD in the U.S.⁶ This wide variation may be due to much of the cost data for ESS being reported from the perspective of a third party payer, which ultimately reflects charges rather than costs. This also highlights the lack of data on the true costs of ESS and makes it difficult to define the true value of ESS.

The primary goal of this study was to address this deficiency of true cost data by describing the cost of ESS procedures from the perspective of a healthcare system. Additionally, this study aims to identify factors associated with cost variation in ESS as potential targets for value improvement, such as operative time and extent of surgery. Given the frequency of concurrent procedures such as septoplasty and turbinate reduction, the impact of these additional procedures on costs and time was also assessed. Through an improved

understanding of the costs associated with ESS and sources of unwanted variation, the true value of ESS may be better defined and areas for future value improvement may be identified.

Methods

I. Study Design

This study was a retrospective review of patients who underwent ESS between January 2 2008 and October 31 2016 at Intermountain Healthcare (IHC) facilities. Thirteen different facilities (of 22 total IHC facilities existing at time of publication) were included from this region, including four community rural hospitals, seven community urban centers, and two tertiary care centers. All facilities were hospital based and there were no ambulatory based surgical centers included. Inclusion criteria consisted of all patients who had a hospital visit associated with a *Current Procedural Terminology (CPT) 2014* procedure code for ESS: 31254, 31255, 31256, 31267, 31276, 31287, or 31288.¹⁵ Patients who had non-ESS procedures performed during the same visit (e.g. open septorhinoplasty or adenotonsillectomy) were excluded due to potential confounding; an exception was made for specific intranasal procedures of septoplasty, turbinate reduction, and concha bullosa resection which are commonly concurrent with ESS. Patients were identified using the IHC Enterprise Data Warehouse (EDW), which is a database including patient demographic information, surgery date, operative time (OR time), facility and cost data. This cost data represents true costs, rather than charges billed to third party payers, such as insurance companies.^{16,17} The Institutional Review Board at IHC approved this study (IRB #1040488).

Data was extracted from the EDW for patients who met study criteria. Costs were subdivided into component costs which include: same-day services (SDS), pharmacy, operating room (OR) cost, OR supplies, post-Anesthesia care unit (PACU), and anesthesia supplies. The sum of these cost components represents the total cost associated with the surgical visit. Additional costs beyond those associated with the operative and immediate post-operative phases of care, such as costs related to hospital admission or outpatient post-operative care, were not included in this study. Costs were recorded in U.S. Dollars (USD) and adjusted for inflation to 2016 USD using the consumer price index from the Bureau of Labor Statistics.¹⁸ All costs reported are in 2016 USD. CPT codes were used only for initial identification of patients meeting inclusion and exclusion criteria in the EDW, a chart review was then performed for all cases and procedural data from documentation in the operative report were used instead of procedural information based on CPT code. Where inconsistencies were identified between data from CPT codes and chart review, the chart review data were used. Patients discovered to have additional procedures meeting exclusion criteria not captured by CPT code were excluded at this point. Additional surgical details such as middle turbinate concha bullosa resection, use of image guidance, and revision surgery status were obtained from the operative report to ensure an accurate and extensive account of relevant and potentially confounding variables to use in subsequent analysis.

Due to significant variation in the combinations of ESS procedures performed, an analysis of the 1,739 patients initially identified was performed to identify the most common and

relevant combinations of ESS for subsequent analysis. Unilateral procedures were infrequent (n=258) and excluded. Three combinations of bilateral symmetric procedures were identified: 1) Full ESS (all sinuses); 2) Intermediate ESS (total ethmoid, maxillary); 3) Anterior ESS (anterior ethmoid, maxillary). These groups accounted for 895 total cases, or 60% percent of the total 1,481 bilateral cases in the dataset, and were used in all subsequent analyses. The remaining 586 bilateral cases were of less common and generalizable combinations of ESS. These cases were omitted to focus analyses on our pre-defined groupings of greatest perceived clinical relevance, and potential utility in future efforts to identify and reduce associated costs.

II. Outcome Variables

The primary outcomes of this study were the total cost, component cost and OR time for the three subgroups of Full, Intermediate, and Anterior ESS. Secondary outcomes were the variability in OR time, total cost and OR supply cost associated with factors specifically hypothesized in the study design to contribute to cost and time variation in ESS. These included the effects of additional procedures, such as septoplasty and turbinate reduction. Variables such as sex, age, concha bullosa resection, revision case, and image guidance use were also assessed and controlled for in the analysis. The effect of the facility type (community rural, community, urban, or tertiary) where surgery took place was also assessed.

III. Statistical Analysis

Continuous variables had skewed distributions and were presented as median and interquartile range (IQR). Categorical variables were presented as count and percentage. Continuous data were analyzed using an exact Wilcoxon rank sum test for two group comparisons or a Kruskal–Wallis test by ranks for comparing multiple groups. Categorical data were evaluated with a chi-squared or a Fisher's exact test if expected cell counts were less than five.

Outcome variables (total cost, component cost and OR time) were compared between the three defined groups of ESS (Full, Intermediate, and Anterior), with or without additional procedures, using multivariable gamma regression models with a log link function due to distribution skew. Anterior ESS was used as the reference procedure for these models. Models included the interaction between main ESS type and additional procedures, and controlled for sex, pediatric age (<18 years old), concha resection, revision case, image guidance, and use of balloon sinuplasty. For comparison of facility type (Community Rural, Community Urban, and Tertiary), a similar framework was used to construct separate models for each of the three bilateral ESS procedure groups. Community rural facilities were used as the reference in these models.

We reported exponentiated coefficients ($e\beta$, interpreted as ratios), and corresponding 95% confidence intervals (CIs) and p-values from the models. Statistical significance was defined as $p < 0.05$ and all tests were two-tailed. Analyses were performed in R v3.2.4 (R Foundation for Statistical Computing, Vienna, Austria)¹⁹ and SAS v9.4 (SAS Institute, Cary, NC, USA).²⁰

Results

I. Comparison of ESS Costs and Time

A total of 895 bilateral cases were included in the final analysis. Intermediate ESS (total ethmoid, maxillary) was the most common, with 543 cases. Full ESS (frontal, total ethmoid, maxillary, sphenoid) was the second most common procedure, with 224 cases. Anterior ESS (anterior ethmoid, maxillary) comprised 128 of these cases. Comparing characteristics of these groups (Table 1) there was a significantly greater median patient age associated with the Full ESS group. The incidence of image guidance use increased significantly with extent of surgery from 9% of Anterior ESS cases to 82% of Full ESS cases ($p<0.001$). There were also significant increases in median operative times and costs with greater extent of surgery. The median total cost of Full ESS was \$4,281, Intermediate was \$3,716, and Anterior was \$2,549 2016 USD ($p<0.001$). The largest individual components of the total cost associated with ESS were the operating room cost (a fixed facility dependent cost calculated based on operative time) and the costs of supplies used for the procedures. Of these cost components the median supply cost demonstrated greatest difference with extent of surgery: \$462 in Anterior ESS, \$1,042 in Intermediate ESS, and \$1,234 2016 USD in Full ESS ($p<0.001$).

II. Analysis of Factors Contributing to Variation in ESS Costs and Time

The results of the multivariate gamma regression models, which describes the differences in costs and time associated with study variables relative to Anterior ESS, are reported in Table 2. The predicted operative time was 1.19 (95% CI: 1.12, 1.25) times greater when image guidance was used, without significant impact on costs. The predicted operative time was 1.74 (95% CI: 1.19, 2.54) times greater when balloon sinuplasty was performed as part of the ESS procedures, but this also was not associated with significant differences in costs. Among patients with no additional procedures, the predicted total operative time, total cost, and supply cost for Full ESS were all significantly greater compared to Anterior ESS ($p<0.001$). For Anterior ESS patients, the predicted total operative time with septoplasty or both septoplasty and turbinate reduction were 1.53 (95% CI: 1.32, 1.79) times and 1.54 (95% CI: 1.21, 1.95) times, respectively, relative to patients who had no additional procedures ($p<0.001$). There was no significant difference in total operative time with addition of turbinate reduction alone, relative to patients who had no additional procedures ($p=0.91$). For Anterior ESS, there were no significant differences in total cost or supply cost associated with additional procedures. Furthermore, there were no statistically significant interactions between ESS type and additional procedures for total operative time, total cost, or supply cost (all $p>0.05$).

The impact of facility type on ESS costs and operative time is described relative to a reference of community rural facilities in Table 3. Operative time for Intermediate ESS is 1.87 (95% CI: 1.74, 2.02) times ($p<0.001$) greater at community urban centers and 1.30 (95% CI: 1.18, 1.42) times ($p<0.001$) greater at tertiary facility compared to a community rural facility. Anterior ESS operative time is 1.43 (95% CI: 1.10, 1.85) times ($p=0.01$) greater at tertiary facilities, but there is no significant difference for community urban facilities. No significant differences were found for Intermediate ESS OR supply costs between these facility types. Total costs of Intermediate ESS and Full ESS at tertiary

facilities were 0.88 (95% CI: 0.81, 0.95, $p=0.002$) times and 0.60 (95% CI: 0.38, 0.97, $p=0.03$) times their respective total costs at community rural facilities.

Discussion

This study has identified the true cost of ESS within a multihospital network, as well as several sources of variance associated with these costs. Costs and operative times vary significantly in ESS and are influenced by a variety of factors, including extent of ESS performed, additional procedures, and the facility where the surgery is performed. These sources of variance provide targets for cost reduction and the potential for value improvement. Additionally, defining the cost of ESS provides much needed information that may be beneficial in cost-effectiveness evaluations. In Canada, the cost of a routine outpatient ESS from the perspective of the Canadian government payer is \$3,617 2016 USD, which is similar to the median cost for Intermediate bilateral ESS of \$3,716 2016 USD identified in this study.^{6,14} However, this is less than half the average reported cost of ESS from the perspective of third-party payers in the US, which range from \$8,313 to \$10,645 2016 USD.⁶ This discrepancy in “cost” likely reflects the difference between the true costs and previously published costs from a payer perspective which are actually charges from the perspective of healthcare systems.

The existing literature is restricted by this lack of true cost data and the dependence on charges, which has limited its utility for value improvement. Based on the range of published ESS charges,⁶ an average charge of \$8,968 2014 USD has been used in modeling studies to determine cost-effectiveness of ESS.^{10,21,22} Additional studies have used an estimated average charge of \$8,612 2016 USD and \$8,634 2016 USD.^{12,23,24} These specific estimates, and others in the literature, are based on charges billed to health plans (from MarketScan Commercial Claims and Encounters Database).²³ Such studies must be carefully interpreted so as to not confuse cost and charge data – the use of charges to determine cost-effectiveness may lead to an underestimation of the true value of ESS.

Another limitation of the existing literature is the description of ESS as a single entity, without consideration of extent of surgery or concurrent procedures.^{10,21,22,24} This has impacted subsequent studies utilizing inadequate published data, as illustrated by a study on the cost-effectiveness of ESS with or without frontal sinus surgery which uses an identical average charge (\$8,968 2014 USD) for surgery in both groups, likely due to lack of available cost data specific to the two groups.²¹ The true costs for three different common combinations of ESS reported in the present study may be useful in future cost-effectiveness models. The significant variation in cost associated with the extent of surgery additionally highlights the importance of considering extent of surgery when assessing the value of ESS.

Factors associated with variances in costs and operative time for ESS may provide targets for potential value improvement. More extensive surgery was generally associated with higher cost and longer duration, but other relationships were less intuitive. Among patients who had no additional procedures, Anterior and Intermediate ESS had similar operative times, but Intermediate ESS was more costly largely due to greater supply costs (1.51 times total cost and 2.23 times OR supply cost, both $p<0.001$; Table 2). Image guidance was

associated with more extensive surgery and with significantly increased operative time, but not with increases in cost. However, only the supply costs related to disposable items for image guided navigation were included in the cost accounting, not reusable components of the technology. Balloon sinuplasty was associated with significantly greater operative time, without differences in cost, though the clinical significance of this finding is unclear. Balloon use was controlled for in our analysis as a regression model variable, but we did not attempt to make conclusions about the individual relationship of balloon use to operative time and cost given the many potential confounding factors. Concurrent procedures were considered as potential factors influencing ESS cost and time, but the only significant relationship identified was a 1.53 times increase in total operative time with the addition of septoplasty to Anterior ESS ($p < 0.001$). Concurrent septoplasty did not impact costs of any of the three groups assessed. Concurrent turbinate reduction did not impact time or costs for any of these ESS procedures (Table 2). Concurrent septoplasty during primary ESS is associated with a significant reduction in the risk for revision surgery.^{25,26} As there was no significant increase in costs associated with concurrent septoplasty, the value of a septoplasty may be significant when the reduced incidence of revision ESS is considered.

Facility type where ESS was performed also influenced operative time and costs (Table 3). Total cost was significantly less for Intermediate and Full ESS at tertiary compared to community rural facilities. Identifying the factors responsible for this cost difference may reveal areas for future cost reduction. Some of the increased costs at community rural facilities is beyond surgeons' control and likely due to higher fixed costs at these lower volume rural centers. Duration of Intermediate ESS at community rural facilities was significantly less than at community urban or tertiary facilities. This difference is likely multifactorial and may include differences in patient population, surgeon efficiency, and OR efficiency.

Findings from this study should be interpreted in the context of the following limitations. As a retrospective review of data from a single healthcare system, these findings may not be generalizable to other patient populations and healthcare systems. Although several potential confounding factors were identified and adjusted for, there are likely additional factors which were not accounted for. The lack of corresponding outcome data for cost data limits the current study from making conclusions about value of these procedures, but should be a topic for future study. However, the robust review of the database values and comparison to chart documentation strengthens the accuracy of this data. Additionally, this study was able to define the true costs associated with ESS as well as examine the impact of extent of surgery and other variables that have not been previously described, which will help address the paucity of information in this area.

Conclusion

This study defined the true costs associated ESS and evaluated a variety of factors impacting costs and operative time associated with ESS. The median total costs for bilateral Anterior ESS was \$2,550, Intermediate ESS was \$3,716 and Full ESS was \$4,281. Extent of surgery, location of surgery and the addition of concurrent septoplasty were identified as sources of variation, and may represent potential areas for variation reduction and value improvement.

This data helps to better define the costs associated with ESS, which may be used to clarify value of ESS. To inform value-improving actions, future studies should investigate the relationship of ESS costs to appropriate outcome measures.

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Table 1.

Patient characteristics, costs and surgical characteristics.

Variable	Anterior: N=128	Full: N=224	Intermediate: N=543	p-value
Age (years) - median (IQR)	35 (28, 48.8)	43 (29, 59)	36 (24, 52)	0.001
Surgery Duration (minutes) - median (IQR)	58 (41.5, 80)	87 (69.8, 108)	60 (43, 79)	<0.001
Sex - N (%)				
Female	65 (51%)	108 (48%)	285 (52%)	0.56
Male	63 (49%)	116 (52%)	258 (48%)	-
Surgery Characteristics – N (%)				
Concha Resection	27 (21%)	33 (15%)	82 (15%)	0.22
Revision Case	0 (0%)	6 (3%)	6 (1%)	0.11
Image Guidance	11 (9%)	183 (82%)	190 (35%)	<0.001
Cost [†] (USD) - median (IQR)				
Total Cost	2549.6 (2024.4, 3202.3)	4281.2 (3270.6, 5043.2)	3716.4 (3045.6, 4609.3)	<0.001
Same Day Services Cost	329.4 (199.6, 471.8)	497 (410, 616.5)	469.8 (335.5, 606.6)	<0.001
Pharmacy Cost	167.8 (142.1, 222.6)	255.8 (189.4, 346.7)	218.4 (175.6, 294.2)	<0.001
Operating Room Cost	1119.8 (806.9, 1464.3)	1437.8 (864.5, 2093.6)	1456.4 (1018.2, 1868)	<0.001
Operating Room Supply Cost	461.8 (282.6, 727.8)	1234.3 (880, 2130.9)	1042.4 (558.1, 1757.6)	<0.001
PACU Cost	142.8 (95.6, 222)	174.4 (128.3, 249.1)	154.5 (115.6, 209.3)	<0.001
Anesthesia Supply Cost	97.6 (71.4, 174.4)	140.1 (103.3, 191.7)	107.5 (80.5, 141.3)	<0.001
Additional Procedures – N (%)				
Both Septoplasty and Turbinate Reduction	12 (9%)	39 (17%)	104 (19%)	0.014
No Septoplasty and Turbinate Reduction	33 (26%)	63 (28%)	(19%)	-
Septoplasty	68 (53%)	95 (42%)	255 (47%)	-
Turbinates	15 (12%)	27 (12%)	81 (15%)	-

[†] Adjusted for inflation to year 2016.

IQR; interquartile range, USD; United States Dollar, PACU; post anesthesia care unit

Table 2.

Regression coefficients for predicted operative time and costs accounting for outcome variables.

Predictors	Total Operative Time			Total Cost [†]			OR Supply Cost [†]		
	e β	95% CI	p-value	e β	95% CI	p-value	e β	95% CI	p-value
Individual model variables									
Anterior ESS	Reference			Reference			Reference		
Full ESS	1.37	(1.17, 1.61)	<0.001	1.52	(1.32, 1.75)	<0.001	2.40	(1.76, 3.25)	<0.001
Intermediate ESS	0.87	(0.75, 1)	0.06	1.51	(1.33, 1.72)	<0.001	2.23	(1.69, 2.94)	<0.001
Male	1.04	(0.99, 1.09)	0.11	0.97	(0.93, 1.01)	0.12	0.90	(0.82, 0.99)	0.03
Age < 18 years	1.13	(1.05, 1.22)	0.002	0.98	(0.92, 1.05)	0.61	1.03	(0.89, 1.21)	0.67
Concha Resection	1.03	(0.96, 1.1)	0.37	1.06	(1, 1.12)	0.06	1.05	(0.92, 1.19)	0.48
Revision Case	1.03	(0.83, 1.27)	0.82	1.11	(0.92, 1.34)	0.26	1.12	(0.75, 1.68)	0.59
Image Guidance	1.19	(1.12, 1.25)	<0.001	1.01	(0.97, 1.07)	0.57	1.00	(0.9, 1.12)	0.94
Balloon Use	1.74	(1.19, 2.54)	0.004	1.17	(0.84, 1.65)	0.35	1.21	(0.58, 2.51)	0.62
No Additional Procedures	Reference			Reference			Reference		
Septoplasty and Turbinate Reduction	1.54	(1.21, 1.95)	<0.001	1.04	(0.84, 1.29)	0.70	1.06	(0.67, 1.69)	0.80
Septoplasty	1.53	(1.32, 1.79)	<0.001	0.97	(0.85, 1.11)	0.63	0.84	(0.63, 1.13)	0.24
Turbinate Reduction	1.01	(0.81, 1.27)	0.91	1.03	(0.84, 1.25)	0.80	1.15	(0.75, 1.76)	0.53
Interaction of model variables: (ESS type) $\times$ (additional procedures)									
Full ESS									
x Septoplasty and Turbinate Reduction	0.85	(0.64, 1.13)	0.27	1.01	(0.79, 1.29)	0.96	1.00	(0.58, 1.71)	0.99
x Septoplasty	0.84	(0.7, 1.02)	0.08	1.08	(0.92, 1.28)	0.35	1.25	(0.86, 1.8)	0.24
x Turbinate Reduction	1.09	(0.83, 1.44)	0.53	1.00	(0.78, 1.28)	0.99	0.92	(0.54, 1.57)	0.76
Intermediate ESS									
x Septoplasty and Turbinate Reduction	0.87	(0.67, 1.13)	0.29	0.94	(0.75, 1.18)	0.58	0.91	(0.55, 1.5)	0.71
x Septoplasty	1.13	(0.95, 1.34)	0.18	0.98	(0.84, 1.14)	0.79	1.03	(0.74, 1.44)	0.86
x Turbinate Reduction	1.27	(0.99, 1.63)	0.06	0.89	(0.72, 1.11)	0.29	0.77	(0.48, 1.24)	0.28

[†]Adjusted for inflation to year 2016.

Anterior ESS was used as reference for all reported regression coefficients.

CI; confidence interval, ESS; endoscopic sinus surgery, e β ; exponentiated coefficient, OR; operating room

TABLE 3.

Regression coefficients for predicted operative time and costs accounting for location of procedure.

Procedures	Facility type	Total Operative Time			Total Cost [‡]			OR Supply Cost [‡]		
		e ^β	95% CI	p-value	e ^β	95% CI	p-value	e ^β	95% CI	p-value
Reference Facility: Community Rural										
Intermediate ESS	Community Urban	1.87	(1.74, 2.02)	<0.001	0.99	(0.92, 1.06)	0.77	1.02	(0.87, 1.2)	0.78
	Tertiary	1.30	(1.18, 1.42)	<0.001	0.88	(0.81, 0.95)	0.002	0.83	(0.68, 1)	0.052
Anterior ESS	Community Urban	1.12	(0.88, 1.43)	0.34	1.11	(0.95, 1.29)	0.21	1.02	(0.72, 1.44)	0.92
	Tertiary	1.43	(1.1, 1.85)	0.01	1.05	(0.88, 1.25)	0.59	0.90	(0.62, 1.32)	0.58
Full ESS	Community Urban	1.04	(0.65, 1.66)	0.85	0.67	(0.43, 1.06)	0.09	0.72	(0.29, 1.81)	0.48
	Tertiary	0.71	(0.44, 1.15)	0.16	0.60	(0.38, 0.97)	0.03	0.59	(0.23, 1.53)	0.28

[‡] Adjusted for inflation to year 2016.

Community Rural was used as the reference facility type for all reported regression coefficients.

CI; confidence interval, ESS; endoscopic sinus surgery, e β ; exponentiated coefficient, OR; operating room