

Reoperation rates of stress incontinence surgery in rural vs urban hospitals



Saniya Ablatt, MD; Xi Wang, MS; Suman Sahil, MBA; An-Lin Cheng, PhD; Jonathan P. Shepherd, MD; Gary Sutkin, MD

BACKGROUND: XXX.

OBJECTIVE: This study aimed to determine the impact of a rural vs urban hospital location on the risk of undergoing a second surgery for stress urinary incontinence.

STUDY DESIGN: Using the Cerner Health Facts nationwide electronic medical record database, we identified patients who underwent surgeries for stress incontinence between January 1, 2010 and November 30, 2018. Stress incontinence surgeries included synthetic midurethral slings, fascial slings, retropubic urethral suspension, and other surgeries for stress urinary incontinence, such as the laparoscopic sling or the Pereyra procedure. Patients were divided into 2 cohorts, namely those who had a single operation and those who had a reoperation, defined as any second stress incontinence surgery or revision after initial incontinence surgery. Logistic regression analysis was performed to determine whether urban vs rural hospital location impacted reoperation rates. We adjusted for significant sociodemographic variables identified in the univariate analysis with a P value $<.1$.

RESULTS: Of the 25,085 women who underwent stress incontinence procedures, 669 (2.7%) underwent a second surgery. Of these, 346 (51.7%) patients underwent a second stress incontinence procedure, 307 (45.9%) underwent revisions of the index case, and 16 (2.4%) underwent both. Women in the single surgery cohort were older (median age, 54 vs 53 years; $P=.029$). In the total sample, 85.5% identified as White and 4.5% identified as Black. Of the study cohort, 7720 (30.8%) had obesity and 2660 (10.6%) had diabetes. There was a higher rate of reoperation among patients with obesity (3.0% vs 2.5%; $P=.017$). Among patients who underwent a concomitant prolapse surgery with their index surgery, there were fewer reoperations (2.2% vs 2.8%; $P=.012$). In the univariate analysis, we did not detect a difference between women who lived in rural vs urban areas (3.0% vs 2.6%; $P=.16$). After adjusting for confounders, we still did not see a significant association between rural hospital location and the risk for repeat surgery (odds ratio, 1.00; 95% confidence interval, 0.76–1.31). In this multivariable regression, obesity increased the risk for having a reoperation (odds ratio, 1.20; 95% confidence interval, 1.02–1.41), whereas patients who had concomitant prolapse procedures with their index surgery had a reduced risk for having a reoperation (odds ratio, 0.80; 95% confidence interval, 0.66–0.98).

CONCLUSION: We did not detect an association between hospital location (rural vs urban) and the risk for reoperation among women undergoing stress incontinence surgery. With low reoperation rates, patients can be reassured that they are receiving excellent care in either setting.

Key words: hospital status, incontinence, reoperation, repeat operation, rural, stress incontinence, urban, urogynecology

From the University of Missouri—Kansas City School of Medicine, Kansas City, MO (Dr Ablatt, Ms Wang, Ms Sahil, and Drs Cheng and Sutkin); and University of Connecticut Health Center, Farmington, CT (Dr Shepherd).

The authors report no conflict of interest.

This study was presented at the 47th annual scientific meeting of the Society for Gynecologic Surgery, Palm Springs, CA, June 27–30, 2021.

Cite this article as: Ablatt S, Wang X, Sahil S, et al. Reoperation rates of stress incontinence surgery in rural vs urban hospitals. *Am J Obstet Gynecol Glob Rep* 2022;2:100059.

Corresponding author: Gary Sutkin, MD.
sutking@umkc.edu

2666-5778/\$36.00

© 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

<http://dx.doi.org/10.1016/j.xagr.2022.100059>

Introduction

Approximately 180,000 surgeries are performed annually in the United States for urinary incontinence.¹ Reoperation is not uncommon and can be caused by postoperative complications such as pain, mesh exposure, recurrent urinary tract infection (UTI), dysfunctional voiding including urinary retention, and recurrent urinary incontinence. The risks for these long-term complications include a 4.1% risk for pain,² 0.8% to 2.5% risk for mesh exposure,^{2–5} 7.3% risk for recurrent UTI,² 1.3% to 2.5% risk for dysfunctional voiding including urinary retention,^{2,4,5} and a 2.4% to 3.7% risk for recurrent urinary incontinence requiring surgery.^{4,6,7} One study concluded that 6.9% of patients who underwent midurethral sling (MUS) surgery will have to return to the operating room within a 7 year period.⁸

Recent female pelvic medicine and reconstructive surgery (FPMRS) research has focused on patient perception and patient-centered outcomes. For stress incontinence surgery (SUI), previous publications show that patient quality of life is equally impacted by a second operation for a revision of the index surgery and a second operation for recurrence of SUI.⁷ Patients will likely consider any reoperation an adverse outcome regardless of whether it is a repeat surgery for recurrent SUI or a revision of the index surgery.

Intuitively, the need for a repeat surgery is inversely related to surgeon experience, and this holds true for MUS surgery.^{9–11} However, it is unknown what role hospital characteristics play in reoperation after stress incontinence surgery. In one study from Taiwan, hospital attributes, such as accreditation

AJOG Global Reports at a Glance

Why was this study conducted?

Little is known about the role of hospital location (urban vs rural setting) in predicting reoperation after stress incontinence surgery.

Key findings

Rural vs urban hospital status does not increase the risk for reoperation after stress incontinence surgery. Obesity does increase this risk.

What does this add to what is known?

Our data suggest that rural vs urban hospital status where surgery for stress urinary incontinence is performed does not impact the risk of undergoing a second operation.

level, government vs private ownership, and for-profit status, were not predictive of reoperation.¹² We would like to further explore the role hospital characteristics may play in operative outcomes. In general, practitioners at urban hospitals have a more specialized practice with higher acuity, and those at rural hospitals have a broader practice with lower acuity.¹³ Although procedural volume and other hospital characteristics may be associated with lower rates of perioperative complications, urban vs rural status may have a role in this association, especially in areas where high volume centers are more likely to be in urban areas.¹⁴ In the current literature, there are no studies that primarily seek to explore this relationship in urogynecologic surgery. This study aimed to examine whether rural vs urban hospital status affects the risk of having a second operation, such as a revision or repeat SUI procedure, after stress incontinence surgery.

Materials and Methods

Using the Cerner Health Facts (HF) database (Cerner Corporation, North Kansas City, MO), we compared 2 cohorts of women who underwent surgery for SUI. The first cohort underwent a second surgery that was either a repeat procedure for recurrence of SUI or a revision of their index surgery. The second cohort did not undergo a second surgery. The HF database was established by Cerner Corporation and uses de-identified patient data from health systems involved in a data use agreement with

Cerner. These data are then compiled and can be used for quality improvement or patient safety measures or for health sciences research. For the purposes of our study, we used the HF database available to the University of Missouri—Kansas City. More than 519 million total encounters are recorded in this electronic medical record. HF data are extracted from both Cerner and non-Cerner systems. The extracted data are securely transferred to a Cerner data center from where these are loaded, and Cerner operations staff is alerted to data holes. The data are cleansed, which includes de-duplication, date range checks, confirmation of data within acceptable ranges, etc. Terms are standardized by automapping to a common nomenclature. Experienced clinical staff review and map unmapped terms. Finally, de-identification of clinical and financial data is carried out to comply with the Health Insurance Portability and Accountability Act. The use of these de-identified data was determined to not be human subjects research.

We identified all patients who underwent procedures for SUI between January 1, 2010 and November 30, 2018. To identify these patients, we used current procedural technology codes for sling operations for stress incontinence (57,288, 59.4), retropubic urethral suspension surgeries (51,990, 59.5), and other surgeries for SUI (51,922, 59.71, 59.79, 57,289, and 59.50). This population did not include any patients undergoing an SUI surgery before 2010. To define those with a reoperation, we used the data from any patient who underwent an initial

SUI procedure and who received a repeat SUI operation >30 days later or who underwent a revision of their index surgery, such as removal or revision of sling (57,287) or urethrolysis (53,000). Revisions could occur at any point after the index surgery. Our second cohort was defined as those patients who underwent an initial SUI surgery but who did not undergo reoperation.

We used a Wilcoxon rank-sum test to compare the median time to reoperation between the 2 cohorts. Using Student's *t* tests for continuous variables and chi-square tests for categorical variables, we compared the sociodemographic and other known risk factors for the most common causes of reoperation after surgery for SUI that were available in the HF database to evaluate their effect on the risk for reoperation. These included age, location (rural vs urban), hospital bed size, race, tobacco use, history of heart failure or stroke, steroid drug use, diabetes, obesity, anti-coagulant use, anticholinergic use, and concomitant prolapse surgery at the time of index SUI procedure. Rural vs urban hospital status was defined in the HF database according to categories defined by the US Census Bureau. The US Census Bureau defines rural as populations, housing, and territories with <2500 people. We then performed a multivariate logistic regression to identify risk factors for reoperation, including sociodemographic variables, with $P < .1$ in the univariate regression analysis considered significant. Rural vs urban status was included in the final regression despite having a univariate analysis P value $> .1$ because it was the variable of interest in this study. After identifying independent risk factors, we included unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs). This study was approved and categorized by our institutional review board as not being human subjects determination.

Results

We identified 25,085 patients who underwent SUI procedures between January 1, 2010 and November 30, 2018. Of these, 669, or 2.7%, were

identified to have undergone a second operation. Of these 669 reoperations, 346 (51.7%) were a second procedure for recurrence of stress incontinence and 307 (45.9%) were revisions of the index case. The remaining 16 patients (2.4%) underwent both revision to the index case and a second procedure for recurrence of stress incontinence. **Table 1** displays the baseline demographic characteristics of both cohorts. Women in the single surgery group were older (median age, 54; range, 45–66 years vs 53; range, 44–65 years; $P=.029$). The majority identified as White race (85.5%) with African Americans comprising 4.5%, which did not differ by group ($P=.28$). Other characteristics that did not differ among the 2 groups were tobacco use (7.4%), history of diabetes (10.6%), and history of heart failure or stroke (0.1%). Concomitant prolapse surgeries were more common in the single surgery group than in the reoperation group (24.3% vs 20.2%; $P=.012$). Among all the patients in the sample, hospital location did not differ by group. In total, 85.9% received their index SUI surgery at an urban hospital, whereas 14.1% received their index SUI surgery at a rural hospital ($P=.16$). The median time to the reoperation (median; interquartile range [IQR]) was not statistically significantly different between the 2 cohorts (urban, 182 days; IQR, 55–453; rural 233 days; IQR, 60–699; $P=.20$). Therefore, length of follow-up did not meet the criteria for inclusion in the final regression model and we did not need to account for any differences between the groups for this variable.

The 5 variables with a P value $<.1$ in the univariate analysis included age, hospital bed size, obesity, anticholinergic use, and concomitant prolapse surgery. Rural vs urban status did not differ significantly between the 2 cohorts (the rate of reoperation was 16.0% in rural locations vs 84.0% in urban locations, whereas the rate of index surgery alone was 14.1% in rural locations and 85.9% in urban locations;

$P=.16$). All 6 variables were included in our multivariate analysis.

In the multivariate analysis, rural vs urban hospital status still did not impact the risk for reoperation significantly (OR, 1.00; 95% CI, 0.76–1.31) after adjusting for confounders. The complete regression analysis results are presented in **Table 2**. Obesity increased the risk for reoperation (OR, 1.20; 95% CI, 1.02–1.41), and a concomitant prolapse surgery (OR, 0.80; 95% CI, 0.66–0.98) decreased the risk for a repeat operation. When compared with the smallest hospitals with 0 to 5 beds (reference group), hospitals with a bed size of 200 to 299 had a decreased risk for a second operation (OR, 0.58; 95% CI, 0.41–0.82), but no other hospital bed size had a significant impact. Age and anticholinergic use were no longer significant in the multivariate analysis after adjusting for confounders.

Discussion

Principal findings and results

Using a large, nationwide electronic medical record database, we were unable to show any significant impact of rural vs urban hospital location on the risk for having a reoperation after SUI surgery. However, we found that obesity increased the risk for reoperation, whereas a concomitant prolapse surgery and a hospital bed size of 200 to 299 decreased this risk. Our data suggest that rural vs urban hospital status where the SUI surgery is performed does not impact the risk for having a second operation.

The only study we are aware of that examined the relationship between rural hospital status and surgical outcomes in urogynecology is by Brenndand et al¹⁰ who found that rural vs urban status did not affect the risk for reoperation. Although studies for nongynecologic procedures did not have the same design as ours, they do have relevance. In a study of cleft palate repair, high volume centers, which generally had better outcomes, were more likely to be located in an urban rather than a rural area.¹⁴ Studies in gynecologic oncology include 1 in which ovarian cancer

survivors from rural locations experienced a higher mortality rate than their urban counterparts.¹⁵ This study looked at the residence of the patient, not the location of the hospital. Patients with endometrial cancer treated in rural hospitals experienced lower rates of minimally invasive surgical approaches and lower rates of lymph node dissections but comparable rates of perioperative complications.¹⁶ Despite geographic remoteness, rural patients generally had equal access to specialized surgeons.¹⁷ Patients in urban locations might have better access to centers that perform repeat SUI surgeries. Likewise, postoperative surveillance may differ by urban vs rural status, which could impact the detection of complications or recurrence and that could bias our results.

In a study examining the operative outcomes for urban and rural surgeons across multiple surgical specialties, it was found that both groups had very low rates of readmission and reoperation after hysterectomies.¹³ Among 2765 patients, there were only 9 (0.3%) readmissions and 7 (0.3%) reoperations.¹³ In this study, we also found low reoperation rates with only 669 patients (2.7%) undergoing reoperation among 25,085 patients. We recognize that the difference in outcomes for urban vs rural centers may involve multiple patient risk factors. For this reason, we adjusted for confounders including age, obesity, concomitant prolapse surgeries, anticholinergic use, and hospital bed size. No effect was seen for rural vs urban location in either the univariable or multivariable analysis. Regarding the decreased risk for reoperation with concomitant prolapse surgery, this may be related to patients with occult SUI or no evidence of SUI before treatment who underwent an anti-incontinence surgery at the time of prolapse repair.

A nationwide study conducted in Taiwan reviewed reoperations in a sample of 14,613 Taiwanese patients who underwent primary SUI procedures.¹² Reoperation rate was 3.85% with no significant differences between hospital-related variables such as accreditation level and ownership.¹² There was no

TABLE 1
Baseline demographics and potential confounders

Characteristics	Index SUI surgery only (n=24,416)	Reoperation (either repeat SUI procedure or revision of index surgery) (n=669)	Total (N=25,085)	P value
Age (y)				
Median (IQR)	54.0 (45.0–66.0)	53.0 (44.0–65.0)	54.0 (45.0–66.0)	.029 ^a
Location, n (%)				
Rural	3437 (97.0)	107 (3.0)	3544 (14.1)	.16
Urban	20,979 (97.4)	562 (2.6)	21,541 (85.9)	
Bed size				
≥500	4910 (97.2)	140 (2.8)	5050 (20.1)	.001 ^a
300–499	5712 (96.9)	184 (3.1)	5896 (23.5)	
200–299	5487 (98.0)	110 (2.0)	5597 (22.3)	
100–199	4114 (97.5)	105 (2.5)	4219 (16.8)	
6–99	2529 (97.3)	70 (2.4)	2599 (10.4)	
0–5	1664 (96.5)	60 (3.5)	1724 (6.9)	
Race				
White	20,853 (97.3)	583 (2.7)	21,436 (85.5)	.28
Black	1096 (98.0)	22 (2.0)	1118 (4.5)	
Other	2467 (97.5)	64 (2.5)	2531 (10.1)	
Tobacco use				
No	22,612 (97.4)	615 (2.7)	23,227 (92.6)	.51
Yes	1804 (97.1)	54 (2.9)	1858 (7.4)	
Heart failure or stroke				
No	24,386 (97.3)	669 (2.7)	25,055 (99.9)	1.00
Yes	00030 (100.0)	0 (0.0)	30 (0.1)	
Steroid drug use				
No	24,364 (97.3)	666 (2.7)	25,030 (99.8)	.18
Yes	52 (94.6)	3 (5.5)	55 (0.2)	
Diabetes				
No	21,833 (97.4)	592 (2.6)	22,425 (89.4)	.44
Yes	2583 (97.1)	77 (2.9)	2660 (10.6)	
Obesity				
No	16,930 (97.5)	435 (2.5)	17,365 (69.2)	.017 ^{a*}
Yes	7486 (97.0)	234 (3.0)	7720 (30.8)	
Anticoagulant use				
No	24,186 (97.3)	666 (2.7)	24,852 (99.1)	.19
Yes	230 (98.7)	3 (1.3)	233 (0.9)	
Anticholinergic use				
No	9211 (97.1)	275 (2.9)	9486 (37.8)	.08
Yes	15,205 (97.5)	394 (2.5)	15,599 (62.2)	
Concomitant prolapse surgery				
No	18,458 (97.2)	534 (2.8)	18,992 (75.7)	.012 ^{a*}
Yes	5958 (97.8)	135 (2.2)	6093 (24.3)	

IQR, interquartile range; SUI, stress urinary incontinence.

^a Indicates a significant difference with $P \leq .05$.

Ablatt. Hospital location and reoperation for stress incontinence. *Am J Obstet Gynecol Glob Rep* 2022.

TABLE 2
Multivariate regression for risk of reoperation

Variable		OR (unadjusted)	95% CI	P	OR (adjusted— multilevel)	95% CI	P value
Urban		0.95	0.72–1.24	.684	1.00	0.76–1.31	.998
Age (y)		0.99	0.99–1.00	.046	0.99	0.99–1.00	.134
Obesity		1.22	1.02–1.41	.026	1.20 ^a	1.02–1.41	.030
Concomitant prolapse surgery		0.79	0.65–0.96	.015	0.80 ^a	0.66–0.98	.029
Anticoagulant	Yes	0.85	0.72–1.00	.050	0.87	0.73–1.04	.124
Bed size (ref, 0–5 beds)	500+ beds	0.69	0.49–0.96	.026	0.75	0.53–1.06	.108
	300–499 beds	0.99	0.72–1.35	.954	1.04	0.75–1.44	.807
	200–299 beds	0.54	0.38–0.76	<.001	0.58 ^a	0.41–0.82	.002
	100–199 beds	0.71	0.51–0.99	.044	0.76	0.54–1.08	.124
	6–99 beds	0.77	0.54–1.09	.146	0.81	0.56–1.18	.275

CI, confidence interval; OR, odds ratio; ref, reference interval.

^a $P < 0.05$.

Ablatt. Hospital location and reoperation for stress incontinence. Am J Obstet Gynecol Glob Rep 2022.

difference in reoperation between different types of medical centers, including regional and local hospitals.¹² These results, in conjunction with the results from our study, suggest that SUI procedures have become standardized among hospitals and can be performed at multiple different types of institutions with low risk for reoperation.

Clinical and research implications

Although we were unable to detect a difference in urban vs rural centers, future research on hospital characteristics should investigate if other procedures or other outcomes demonstrate significantly different results. Our experience is that although SUI procedures are frequently still performed by community-based gynecologists, fewer are performing more involved prolapse procedures and we plan to investigate whether there is a rural vs urban difference for this separate class of procedures. There is no obvious explanation for the reduction in

reoperation rates observed for a hospital bed size of 200 to 299, especially because there is no bed-size dose effect with a continuous decrease in the risk as bed size further increases. However, it is possible that there is an ideal bed size in the middle of the category range, which reduces risks for reoperation in a way not seen with hospital bed sizes at the far ends of the size spectrum. Hospital bed size should be investigated in future analyses.

It may also be important to determine if there are differences between SUI and prolapse outcomes in surgeries performed by general gynecologists and those performed by FPMRS subspecialists regardless of hospital location. Potentially, these outcomes may change based on surgeon volume as discussed in literature.^{9,10,12} Ultimately, these questions may elucidate differences in risks that can help patients make informed decisions about their care. Alternatively, they may offer patients reassurance that there is likely no

differences in the outcomes as shown by our study. Our analysis did not consider the urban vs rural status of the patient.

Strengths and limitations

The greatest strength of our study was the use of the HF database, which provided a large sample size and greater power to detect any differences. The HF database is a validated nationwide database that includes quality-checked data input from 69 million patients. It represents a sample with strong external validity. Based on annual estimates of 180,000 cases in the United States, our analysis captured approximately 1% to 2% of all procedures performed.¹ Small absolute differences between cohorts were statistically significant because of our large sample size that increased power ($N=25,085$). Even with this increased power, we were unable to see a difference in reoperations between urban and rural hospitals.

Limitations of our research include the inability to collect outcomes for

patients who had reoperation procedures not capture in the Cerner database. However, there is no evidence that this potential misclassification error would be unequally seen in rural vs urban centers and thus our primary research question is less likely to be impacted by this. In addition, we did not have data about surgeon identity or surgeon volume. Surgeon volume may have been related to the hospital location variable. However, if we had been able to include this in our multivariable regression it would have been more likely to dilute out the effect of hospital location. Because we were unable to show a difference between urban and rural locations without including this variable, it is doubtful that our conclusions would be changed by including surgeon volume. We did not include periurethral bulking injections, because these are mostly performed as an outpatient procedure. However, there is no data to suggest that these were more likely performed in either an urban or rural location, so it is unlikely to bias our results. This study also suffers from limitations inherent to all database-based studies. The confounders that we included were limited to those variables available in the database, and this study was susceptible to the potential for coding errors. Despite this, the database has been quality-checked to assure that the outcome data are valid. HF was specifically designed to limit these weaknesses, and a large database such as HF is the only feasible way to research differences in rare outcomes such as reoperation in urban vs rural hospitals.

Conclusion

Our study was unable to show a difference between urban and rural hospitals in the risk for reoperation among patients who undergo SUI procedures. Obesity was found to increase this risk, whereas a concomitant prolapse procedure and a hospital bed size of 200 to 299 were protective against reoperation. From these results, we suggest that the rural vs urban hospital status where an operation for SUI is performed may not impact the risk for having a second operation. ■

REFERENCES

1. Jonsson Funk M, Levin PJ, Wu JM. Trends in the surgical management of stress urinary incontinence. *Obstet Gynecol* 2012;119:845–51.
2. Blaivas JG, Purohit RS, Benedon MS, et al. Safety considerations for synthetic sling surgery. *Nat Rev Urol* 2015;12:481–509.
3. Walters M, Karram M. *Urogynecology and Reconstructive pelvic Surgery*. 4th ed. Amsterdam, Netherlands: Elsevier; 2014.
4. Jonsson Funk M, Siddiqui NY, Pate V, Amundsen CL, Wu JM. Sling revision/removal for mesh erosion and urinary retention: long-term risk and predictors. *Am J Obstet Gynecol* 2013;208:73. e1–7.
5. Nguyen JN, Jakus-Waldman SM, Walter AJ, White T, Menefee SA. Perioperative complications and reoperations after incontinence and prolapse surgeries using prosthetic implants. *Obstet Gynecol* 2012;119:539–46.
6. Gaddi A, Guaderrama N, Bassiouni N, Bebchuk J, Whitcomb EL. Repeat midurethral sling compared with urethral bulking for recurrent stress urinary incontinence. *Obstet Gynecol* 2014;123:1207–12.
7. Shepherd JP, Lowder JL, Jones KA, Smith KJ. Retropubic and transobturator midurethral slings: a decision analysis to compare outcomes including efficacy and complications. *Int Urogynecol J* 2010;21:787–93.
8. Sharif F, Mahmud F, Suman S, Cheng AL, Shepherd JP, Sutkin G. Risk factors for returning to the operating room for a second surgery after midurethral sling for stress urinary incontinence. *Female Pelvic Med Reconstr Surg* 2020;26:443–6.
9. Berger AA, Tan-Kim J, Menefee SA. Surgeon volume and reoperation risk after midurethral sling surgery. *Am J Obstet Gynecol* 2019;221:523. e1–8.
10. Brennand EA, Quan H. Evaluation of the effect of surgeon's operative volume and specialty on likelihood of revision after mesh midurethral sling placement. *Obstet Gynecol* 2019;133:1099–108.
11. Welk B, Al-Hothi H, Winick-Ng J. Removal or revision of vaginal mesh used for the treatment of stress urinary incontinence. *JAMA Surg* 2015;150:1167–75.
12. Wu MP, Long CY, Liang CC, Weng SF, Tong YC. Trends in reoperation for female stress urinary incontinence: a nationwide study. *Neurourol Urodyn* 2015;34:693–8.
13. Galandiuk S, Mahid SS, Polk HC, Jr Turina M, Rao M, Lewis JN. Differences and similarities between rural and urban operations. *Surgery* 2006;140:589–96.
14. Wu RT, Shultz BN, Peck CJ, Smetona JT, Steinbacher DM. Hospital volume improves primary, revision, and delayed cleft palate repair. *J Craniofac Surg* 2019;30:1201–5.
15. Lutgendorf SK, Ramirez E, Schrepf A, et al. Rural residence is related to shorter survival in epithelial ovarian cancer patients. *Gynecol Oncol* 2021;163:22–8.
16. Nguyen DB, Czuzoj-Shulman N, Alshaya A, Gottlieb WH, Abenheim HA. The effect of rural vs. urban setting on the management and outcomes of surgery for endometrial cancer. *J Gynecol Obstet Hum Reprod* 2019;48:745–9.
17. Mell MW, Bartels C, Kind A, Levenson G, Smith M. Superior outcomes for rural patients after abdominal aortic aneurysm repair supports a systematic regional approach to abdominal aortic aneurysm care. *J Vasc Surg* 2012;56:608–13.