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Abstract

PURPOSE: To determine whether (1) black and white women with endometrial cancer were treated by different surgical specialties and in different types of hospitals and (2) differences in specialty and hospital type contributed to racial differences in survival.

METHODS: Retrospective cohort study of 12,307 women aged 65 years and older who underwent surgical treatment of endometrial cancer between 1991 and 1999 in the 11 Surveillance Epidemiology and End Results registries.

RESULTS: Black women were more likely to have a gynecologic oncologist to perform their surgery and to be treated at hospitals that were higher volume, larger, teaching, National Cancer Institute centers, urban, and where a greater proportion of the surgeries were performed by a gynecologic oncologist. In unadjusted models, black women were over twice as likely as white women who died because of cancer (hazards ratio [HR]: 2.33), but nearly all of the initial racial difference in survival was explained by differences in cancer stage, and grade as well as age and comorbidities at presentation (adjusted HR: 1.10). Surgical specialty was not associated with survival and, of the hospital characteristics studied, only surgical volume was associated with survival ($P < 0.005$). Adjusting for hospital characteristics did not change the racial difference in survival (HR: 1.10). Adjustment for the specific hospital where the woman was treated eliminated the association between race and surgeon specialty and slightly widened the residual racial difference in survival (HR: 1.23 vs. 1.10).

CONCLUSIONS: In contrast to several studies suggesting that blacks with breast cancer, colon cancer, or cardiovascular disease are treated in hospitals with lower quality indicators, black women diagnosed with endometrial cancer in Surveillance Epidemiology and End Results regions between 1991 and 1999 were more likely to be treated by physicians with advanced training and in high volume, large, urban, teaching hospitals. However, except for a modest association with hospital surgical volume, these provider and hospital characteristics were largely unrelated to survival for women with endometrial cancer. The great majority of the difference in survival was explained by differences in tumor and clinical characteristics at presentation.

Keywords

African Americans, Aged, Cohort Studies, Endometrial Neoplasms, European Continental Ancestry Group, Female, Health Care Surveys, Health Status Disparities, Healthcare Disparities, Hospitalization, Humans, Logistic Models, Practice Patterns, Physicians', Professional Practice Location, Proportional Hazards Models, Retrospective Studies, SEER Program, Socioeconomic Factors, Specialties, Surgical, Survival Rate, United States

Disciplines

Health and Medical Administration | Oncology | Race and Ethnicity | Surgery

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Racial Differences in Surgeons and Hospitals for Endometrial Cancer Treatment

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Abstract

Purpose—To determine if (1) black and white women with endometrial cancer were treated by different surgical specialties and in different types of hospitals; and (2) differences in specialty and hospital type contributed to racial differences in survival.

Methods—Retrospective cohort study of 12,307 women 65 and older who underwent surgical treatment of endometrial cancer between 1991 and 1999 in the 11 SEER registries

Results—Black women were more likely to have a gynecologic oncologist perform their surgery and to be treated at hospitals that were higher volume, larger, teaching, NCI centers, urban and where a greater proportion of the surgeries were performed by a gynecologic oncologist. In unadjusted models, black women were over twice as likely as white women to die from their cancer (HR 2.33), but nearly all of the initial racial difference in survival was explained by differences in cancer stage, and grade as well as age and comorbidities at presentation (adjusted HR 1.10). Surgical specialty was not associated with survival and, of the hospital characteristics studied, only surgical volume was associated with survival ($p < 0.005$). Adjusting for hospital characteristics did not change the racial difference in survival (HR 1.10). Adjustment for the specific hospital where the woman was treated eliminated the association between race and surgeon specialty and slightly widened the residual racial difference in survival (HR 1.23 vs. HR 1.10).

Conclusions—In contrast to several studies suggesting that blacks with breast cancer, colon cancer or cardiovascular disease are treated in hospitals with lower quality indicators, black women diagnosed with endometrial cancer in SEER regions between 1991–1999 were more likely to be treated by physicians with advanced training and in high volume, large, urban, teaching hospitals. However, except for a modest association with hospital surgical volume, these provider and hospital characteristics were largely unrelated to survival for women with endometrial cancer. The great majority of the difference in survival was explained by differences in tumor and clinical characteristics at presentation.

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INTRODUCTION

Reducing racial disparities in cancer treatment and outcomes is a major focus of national cancer organizations.[1–3] Although differential treatment of patients from different racial groups by the same provider is well known to contribute to racial disparities in health and health care, [3, 4] recent evidence suggests that patients of different racial groups may also be treated by different providers and in different hospitals in the US.[5–8] Furthermore, these providers may have different characteristics including their propensity to deliver certain treatments and ability to achieve certain outcomes. Recognizing and addressing differences in the quality of the providers and hospitals where minority patients are treated has become a growing focus in health disparities research.

The majority of the evidence about differences in the characteristics of providers and hospitals that treat minority patients demonstrates that black patients are more likely to be treated by lower volume providers, with less advanced training and worse outcomes.[5–8] Primary care providers who treat a greater proportion of black patients are less likely to be board certified and more likely to report difficulty accessing resources than providers who treat a greater proportion of white patients.[7] Black patients with acute coronary events are cared for in different hospitals with higher mortality rates than white patients with acute coronary events and black patients.[8] Similar patterns have been found for complex surgery, where black patients are clustered within lower volume hospitals with higher mortality rates. More recently this work has been extended to cancer care with studies demonstrating that breast and colon cancer patients who are black are more likely to undergo surgery in low volume hospitals with higher mortality rates,[9] and that breast cancer patients who are black are also more likely to undergo surgery in hospitals with lower rates of receipt of radiation after breast conserving therapy.[10]

However, it is possible that this pattern may vary across clinical conditions and geographic areas. One of the first studies to examine racial differences in the site of care demonstrated that black patients with a large study of inpatient admissions for congestive heart failure, acute myocardial infarction, pneumonia or stroke found that blacks were more likely than whites to be admitted to a teaching hospital with better outcomes.[11] Furthermore, this difference in the site of care masked racial differences in outcomes within hospitals, so that in the overall population there was no racial difference in quality of care or mortality.[11] In many areas of the US, racial residential segregation results in blacks being clustered within urban neighborhoods, which are often in relatively close proximity to major urban teaching hospitals.[12] These teaching hospitals often have higher volumes and better outcomes for many procedures than community hospitals.[13] Understanding variation in the pattern of minority patients and provider quality is important, both to ensure that efforts to reduce disparities address the correct targets and to identify situations where the clustering of minority patients within hospitals with better outcomes may actually be masking larger disparities in outcomes within those hospitals.

Given this background, the goal of this study was to determine whether black and white women with endometrial cancer are treated by different surgical specialties and in different types of hospitals and whether differences in specialty and hospital type contribute to racial differences in survival. We focused on endometrial cancer because of the substantial racial disparity in endometrial cancer case fatality,[14] the high rate of surgical treatment among incident cases,[15] the demonstrated relationship between surgical specialty (i.e. gynecologic oncologist) and outcome in other gynecologic cancers,[16–19] and the relative paucity of evidence about the causes of racial disparities in this condition.

METHODS

We conducted a cohort study of black and white women with incident endometrial cancer diagnosed between January 1, 1991 and December 31, 1999 who underwent surgical treatment (i.e. hysterectomy). The study data were derived from Surveillance Epidemiology and End Results (SEER) Medicare linked files. These files link information from the SEER national cancer registry, which included 11 sites and approximately 11% of the US population for the study period (1991–1999), to Medicare claims for all individuals 65 years and older with a cancer diagnosis. The SEER sites with a significant proportion of African-Americans tend to be urban areas so that there are differences between the urban/rural distribution of racial groups in the sample and the US population. According to the 2000 US Census, 10% of US blacks lived in rural areas compared to 4% in the study sample and 25% of US whites lived in rural areas compared to 34% in the study sample.[20]

The study cohort included all women who (1) were not diagnosed at autopsy; (2) had been enrolled in Medicare Part A and Part B for at least 6 months at the time of diagnosis; (3) had not been enrolled in an HMO in the 6 months prior to or following the date of diagnosis; (4) were either black or white; and (5) underwent surgical treatment of their tumor. From the 20,012 women with incident endometrial cancer in the SEER-Medicare data between 1991–1999, 14,562 met the first four criteria and 12,307 underwent surgical treatment. (See Appendix for selection of study cohort). 11,286 women could be linked to a surgical specialty, 11,789 could be linked to hospital characteristics and 10,561 had both sets of information. For analyses of hospital characteristics, we further restricted the cohort to women who were treated in a hospital with at least five observations in the study cohort (N=10,073) in order to increase the stability of the estimates. These women did not differ from the overall cohort in race, age, marital status or probability of undergoing surgery by a gynecologic oncologist but were more likely to be stage 3 or 4 ($p < 0.001$).

To identify the surgical providers for the study cohort, we searched the claims files for CPT and ICD-9 codes for relevant surgical procedures for the time period from 30 days prior to diagnosis to 90 days after diagnosis. Surgical procedures included hysterectomy (CPT codes 58180, 56308), hysterectomy and node sampling (CPT codes 56311, 58200), or hysterectomy and extensive resection (CPT codes 58210, 58240, 58285). Surgeon specialty was determined by linking UPIN numbers from the surgical procedure (n=19,486) to the AMA masterfile. To identify the treating hospitals, the hospital ID numbers from the inpatient admission for the relevant surgical procedures (n=587) were linked to AHA information about each hospital. The hospital characteristics of interest were selected based upon the existing literature and a priori hypotheses. These included size, urban vs. rural location, academic affiliation, NCI Cancer Center status and receipt of Disproportionate Share payments from Medicare. Disproportionate Share payments are based upon the proportion of Medicare inpatient days attributable to recipients of Supplemental Security Income and the proportion of all hospital days with Medicaid as the primary payor.

Both disease specific and overall mortality were examined. Women were categorized as dying from their cancer if the death certificate cause of death was gynecological cancer. Of the 5,575 women who died, 1,547 did not have death certificate information; separate analyses were conducted excluding these women and categorizing them as dying from other causes. Because the results of these analyses were very similar, we present the disease specific mortality models excluding women without death certificate information.

Sociodemographic characteristics and tumor characteristics (stage, grade and histology) were obtained from SEER data. Stage was coded according to modified AJCC staging (I, II, III and IV). Grade was categorized as 1, 2, and 3/4. Histologic types were grouped into four

categories according to their aggressiveness: adenocarcinoma, endometriod, papillary +/− serous and sarcoma/other. Comorbidities were determined by reviewing inpatient and outpatient claims during the 90 days and 2 years prior to diagnosis for a prespecified list of conditions. This list included all comorbidities included in Elixhauser et al.[21] Median household income of the patient's zipcode was used as a proxy for individual income.

Statistical Analysis

Characteristics of black and white women were compared using t-tests or ANOVA for continuous variables and chi-square tests for categorical variables. Logistic regression was used to investigate the associations between race and surgical specialty after adjusting for covariates. Surgical specialty was initially categorized as: gynecologist only, gynecologic oncologist only, general surgeon only, gynecologist and gynecologic oncologist, gynecologist and general surgeon, gynecologic oncologist and general surgeon, and other. Based upon the initial results across these categories, subsequent models combined these categories into the presence or absence of a gynecologic oncologist. Independent variables included in each model were age, marital status (married vs. unmarried), stage, grade, histology, and comorbidities. Models were run with individual variables for all comorbidities, with a summary variable for the presence of any comorbidity vs. no comorbidities, as well as with the 90 day comorbidity measures and the 2 year comorbidity measures and among the cohort 65 years and older and the cohort 66 years and older. Because the results of all of these models were essentially the same and the concern for right censoring creating bias in comorbidity assessment and for loss of observations by excluding women under 66 years of age, we present the models with the summary comorbidity variable from the 90 day measures for the cohort of women 65 years and older. Subsequent models also assessed the impact of adjusting for zip code median household income (< $25,000, $25,000–$50,000, >$50,000). Missing categories were included in the analysis as dummy variables. Interaction terms were tested for each variable with race using a bonferroni cutpoint of 0.05 for inclusion in the final model.

Hospital characteristics were compared between racial groups and specialist categories (gynecologic oncologist vs. no gynecologic oncologist) using chi-square tests. Hospital case volume was calculated as the number of cases per hospital in the data and was divided into quartiles for analysis. The proportion of endometrial cancer surgeries performed by a gynecologic oncologist at each hospital was calculated and analyzed as a continuous measure and in quartiles. Additional hospital characteristics that were associated with either patient race or surgeon specialty included medical school affiliation, bed size (<300 vs 300–599 vs. ≥600), NCI Cancer Center status, and receipt of Disproportionate Share payments. The contribution of the hospital where the patient was treated to the association between race and surgeon specialty was assessed by examining the effect on the race coefficient of adjusting for hospital characteristics or of including hospital fixed effects in the models. 392 hospitals (2,377 patients) were excluded from the fixed effect model because of lack of variation in the outcome within the hospital.

The contributions of racial differences in surgeon specialty and hospitals to racial differences in survival were examined using Cox proportional hazards models adjusting for hospital characteristics and surgeon specialty or including hospital fixed effects. To determine if hospital or provider characteristics had differential effects by patient race, interaction terms for race and each characteristic were tested using likelihood ratio statistics. All models using hospital characteristics adjusted for clustering of patients within hospital. Final models were checked by examining generalized residuals.

RESULTS

The characteristics of the study cohort are reported in Table 1. Compared to white women, black women were more likely to be diagnosed at an advanced stage, to have higher grade tumors and unfavorable histology. In addition, black women were slightly younger at the time of diagnosis, lived in zip codes with lower household income, and were less likely to be married. Types of surgical treatment differed between black and white women with black women more likely to have undergone extensive resection and less likely to have undergone simple hysterectomy than white women.

Surgeon specialty differed by race with black women being more likely than white women to have a gynecologic oncologist and less likely to have a general gynecologist perform their surgery. A significant proportion of women (16.3%) had two types of specialist involved in their surgery, and this proportion was higher for white women (16.7%) than black women (9.1%). Black women remained significantly more likely to have a gynecologic oncologist perform their surgery after adjusting for sociodemographic characteristics, tumor characteristics and comorbidities (Table 2).

Black women were more likely to die from their cancer than white women (median survival 4.7 years for black women vs. 6.4 years for white women). At the end of follow up, 31.2% of black women had died from their cancer compared to 16.3% of white women (HR 2.33, 95% CI 1.97–2.77). The racial difference in survival was largely explained by differences in clinical and sociodemographic characteristics. Adjustment for age, tumor characteristics and comorbidities substantially reduced the racial difference in survival (HR 1.22, 95% 1.03–1.45), and further adjustment for marital status and zip code derived mean household income essentially eliminated the disparity in survival (HR 1.10, 95% 0.91–1.32). (Table 3) Surgeon specialty was not associated with survival and adjustment for surgeon specialty did not change the racial disparity in survival.

To examine the contribution of hospital characteristics, the sample was limited to the subgroup of patients with hospital information and who were treated in hospitals with more than 5 patients in the sample (N=10,073). The pattern of associations between race and surgical specialty and race and survival in this sample did not differ from the overall sample. For example, the unadjusted HR for black race and mortality was 2.35 (95% CI 1.93–2.86) and the HR adjusted for patient clinical and sociodemographic characteristics was 1.16 (95% CI 0.97–1.39).

Both patient race and surgical specialty were associated with the characteristics of the hospital where the surgery was performed. (Table 4) Black women were more likely to be treated at hospitals with medical school affiliations, higher volume of endometrial cancer cases, larger numbers of beds, urban location, NCI Cancer Center status and receipt of Disproportionate Share payments. These hospital characteristics were also associated with a greater likelihood of having a gynecologic oncologist as the surgeon. Adjusting for these hospital characteristics, substantially reduced the association between patient race and surgeon specialty. (Table 2) Adjustment for the proportion of endometrial cancer surgeries performed by a gynecologic oncologist at the hospital eliminated the association between patient race and surgeon specialty as did inclusion of a hospital fixed effects (OR 1.09, 95% CI 0.81–1.46).

Survival differed substantially across hospitals ($p<0.0001$) and was associated with surgical volume but not with hospital teaching status, receipt of Disproportionate Share payments, rural vs. urban location, NCI cancer center status or the proportion of the surgeries performed by a gynecologic oncologist (Table 4). Adjustment for hospital characteristics did not change the association between race and survival but inclusion of a hospital indicator

variable led to a small increase in the residual racial difference in survival after adjusting for patient characteristics (Model 2, HR 1.23, 95% CI 0.95–1.59). None of the interaction terms for patient race and provider and hospital characteristics were statistically significant (p-values for all interaction terms >0.05).

DISCUSSION

Understanding differences in quality of care between blacks and whites in the US is a national priority. Endometrial cancer is an important target for these efforts as the racial difference in endometrial cancer case fatality is larger than any other cancer in the US. This study demonstrates that the characteristics of surgeons and hospitals differ between black and white women undergoing surgery for endometrial cancer, but that these differences lead to black women being more likely to be treated by the more specialized provider and in the larger, teaching hospital than white women. However, surgeon specialty and the observable hospital characteristics (teaching status, case volume, bed size, NCI status, receipt of Disproportionate Share payments, percent of surgeries performed by a gynecologic oncologist) have relatively little correlation with patient survival, so that adjusting for these characteristic has little impact on the racial difference in survival.

Differences in provider characteristics by patient race have been described in multiple clinical settings but the complexity of these patterns is only beginning to be understood. [7–12, 22] In the current study, we found differences in both the types of surgeons and the types of hospitals between black and white women who underwent surgery for endometrial cancer in these 11 SEER sites in the 1990s. In contrast to the patterns seen for primary care providers over that same period, black women were more likely to be treated by the more specialized provider than were white women. However, these differences appear to be driven by the hospital where the patient was treated rather than by racial differences in surgical specialty within hospital. Black patients were more likely to be treated in hospitals that had higher case volume and were larger, affiliated with medical schools, urban and NCI centers- characteristics that were also associated with undergoing surgery by a gynecologist oncologist. These findings are similar to the results of the study by Kahn et al. and may reflect the overlapping geographic distributions of blacks and of large, urban, teaching hospitals within certain areas of the US.[11]

Despite the strong relationship between patient race and provider characteristics, these associations had little effect on the racial disparity in survival. Unlike studies that have demonstrated a relationship between surgical specialty and outcomes in ovarian cancer[16, 17, 19], surgical specialty was not associated with differences in outcomes for endometrial cancer in our data; thus, the preferential use of a gynecologic oncologist by black women did not influence the size of the racial disparity in survival. Similarly, except for case volume, the observable hospital characteristics in our data were not associated with survival and adjusting for these characteristics did not influence the size of the racial disparity in survival- as was seen with a recent analysis of racial disparities in prostate cancer mortality. [23] However, adjusting for the specific hospital where the patient was treated (hospital fixed effects) increased the size of the racial disparity in survival slightly with a change in the race coefficient greater than the 15% often used as a threshold for confounding.[17]

While the primary focus of this study was on racial differences in the providers and hospitals, the study also confirms prior studies demonstrating that the vast majority of the racial difference in endometrial cancer survival is explained by differences in cancer stage and grade at presentation, as well as patient age and cormorbidities.[15, 24, 25] The reasons for the marked racial differences in stage and grade are unknown but may relate to racial

differences in the use of hormone replacement therapy (as use of hormone replacement therapy is associated with early stage, low grade cancer) as well as racial differences in access to primary or gynecological care for timely evaluation of symptoms such as vaginal bleeding that may be the first sign of endometrial cancer. Furthermore, while not the focus of this analysis, we have previously demonstrated that African American women were substantially less likely to undergo hysterectomy, the recommended treatment for all women with endometrial cancer.[15] Thus, any attention that is paid to the role of differences in providers in either ameliorating or exacerbating disparities needs to be in context of the importance of these other factors as the major sources of the greater mortality among black women with endometrial cancer.

These findings have several implications for future research. Although studies of breast cancer, colon cancer and cardiovascular disease have found that blacks tend to be treated in hospitals with lower quality indicators than whites, we found a very different pattern for endometrial cancer. This difference highlights the growing recognition that causes of disparities are complex and are likely to vary by clinical condition, population and geography. While there are clearly critical national policy issues that influence disparities, eliminating disparities in a given area will also require understanding the specific factors underlying that disparity. Just as all health care is local, disparities are local and results from one area should not be assumed to generalize to another. For endometrial cancer, eliminating the racial disparity in survival will requires understanding the factors that lead to differences in tumor characteristics at presentation and rates of surgery and then implementing strategies to address these factors.

This study has several limitations. We could not assess racial differences in surgeons and hospitals amongst women who did not undergo surgery for endometrial cancer. Thus, the study sample represents a selected subsample of the overall population of women with endometrial cancer. While this focus on treated/hospitalized patients is common to studies of racial differences in provider characteristics, it does not take into account any of the selection processes that lead to treatment- some of which may vary across providers or patient racial/ethnic group. For example, if gynecologic oncologists are more likely to operate on black patients than are general gynecologists, the racial difference in surgeon specialty seen in the current analyses may reflect, in part, differences in how providers select patients for surgery rather than which providers are seen by different patients. We were able to account for some differences in disease severity, comorbidity and sociodemographic characteristics but it is possible that unmeasured differences in severity may contribute to black women being seen at different hospitals than white women in our sample. Missing data restricted the numbers of patients included in some analyses (e.g. disease specific mortality). However, results of secondary analyses including the full sample (e.g. all cause mortality) supported the robustness of the findings. Similarly, hospitals with small numbers of patients were unable to be included in the hospital fixed effects models, but the results of these models did not differ from those including the percent of surgeries done by a gynecologic oncologist as a hospital level variable.

The sample included only the geographic area included in the SEER registry. While this includes 11 states, it is not a random sample of the US population and differs in the distribution of racial groups across urban and rural areas as noted previously. Thus, the results of this analysis are not generalizable to areas of the country not represented in the SEER data, including the rural South, which encompasses a significant proportion of elderly Black women in the US. Importantly, because we focused this analysis on the 1990s corresponding to prior studies of racial differences in primary care and cardiac care providers, it is not clear the degree to which these patterns persist in 2010. Census data suggest that the level of racial residential segregation geographic distribution of races in the

SEER areas did not change substantially between 200 and 2010 but it is possible that other forces have influenced racial differences in providers for endometrial cancer.[26]

In summary, this study suggests that black women with endometrial cancer are more likely to be treated by surgeons with more advanced training, largely because they are more likely to go to hospitals where these surgeons are more prevalent. Racial differences in treating hospitals favor black women, so that adjusting for the specific treating hospital leads to a greater disparity in survival between black and white women. However, observable hospital characteristics such as teaching status, case volume, and surgeon specialty explain very little of these hospital level differences in survival.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of women 65 and older who underwent surgical treatment of endometrial cancer between 1991 and 1999 in the 11 SEER registries

	Black N=527	White N=11,780	p-value
Mean age **at diagnosis** (range)	73.9	74.7	0.001
Married (%)	25.1	46.5	<0.001
Mean **annual** household income (%)			
<$25,000	62.4	16.7	<0.001
$25,000–$50,000	33.8	60.4	
>$50,000	3.6	20.9	
Unknown	0.2	2.0	
Stage (%)			
I	57.7	74.8	<0.001
II	10.8	7.7	
III	13.3	7.7	
IV	13.3	6.4	
Unknown	4.9	3.4	
Grade (%)			
1	16.1	33.5	<0.001
2	24.1	35.0	
3/4	38.5	23.3	
Unknown	21.3	8.2	
Histology (%)			
Adenocarcinoma	35.7	58.4	<0.001
Endometriod	22.6	25.9	
Papillary +/−serous	23.7	9.5	
Unknown	18.0	6.2	
Type of surgery (%)			
Supracervical hysterectomy	0.8	0.2	<0.001
Total abdominal hysterectomy (TAH)	40.2	53.8	
TAH + node sampling	28.7	25.4	
TAH + extensive resection	30.4	20.6	
Surgeon specialty (%)			
Gynecologic oncologist only	38.2	15.6	<0.001
Gynecologist only	42.5	56.5	
General surgeon only	2.5	5.6	
Gynecologic oncologist + gynecologist	12.2	14.0	
Gynecologic oncologist + general surgeon	0.7	0.4	
Gynecologist +general surgeon	3.4	6.7	
Other	0.5	1.2	

Table 2

Adjusted Associations between Gynecologic Oncologist as Treating Surgeon and Patient and Hospital Characteristics for Women who Underwent Surgical Treatment of Endometrial Cancer

	Model 1				**Model 2**				**Model 3**			
	OR	**95% CI**		**p-value**	**OR**	**95% CI**		**p-value**	**OR**	**95% CI**		**p-value**
Black (vs. white)	2.21	1.80	2.71	0.001	1.68	1.13	2.50	0.01	1.08	0.81	1.45	0.59
Age at **diagnosis**	0.99	0.98	0.99	0.001	0.99	0.98	1.00	0.04	0.99	0.98	1.00	0.21
Married (vs. not married)	1.00	0.91	1.09	0.88	1.06	0.95	1.17	0.30	1.02	0.90	1.15	0.77
Stage												
I (ref)	1.00				1.00				1.00			
II	1.23	1.06	1.43	0.006	1.19	1.01	1.41	0.03	1.30	1.05	1.60	0.02
III	1.54	1.33	1.79	0.001	1.39	1.16	1.66	0.001	1.46	1.19	1.78	0.001
IV	1.33	1.12	1.58	0.001	1.17	0.96	1.42	0.12	1.13	0.89	1.44	0.32
Grade (%)												
1 (ref)	1.00				1.00				1.00			
2	1.45	1.31	1.62	0.001	1.57	1.37	1.80	0.001	1.69	1.46	1.96	0.001
3/4	2.25	1.99	2.55	0.001	2.52	2.10	3.02	0.001	2.86	2.40	3.41	0.001
Histology (%)												
Adenocarcinoma (ref)	1.00				1.00				1.00			
Endometriod	1.52	1.38	1.67	0.001	1.18	0.92	1.53	0.19	1.52	1.32	1.74	0.001
Papillary +/−serous	1.53	1.32	1.77	0.001	1.42	1.17	1.71	0.001	1.62	1.32	2.01	0.001
Annual household Income												
<$25,000 (ref)	1.00				1.00				1.00			
$25,000–$50,000	1.19	1.06	1.33	0.004	0.83	0.65	1.06	0.13	1.04	0.87	1.25	0.65
>$50,000	1.54	1.34	1.76	0.001	1.03	0.74	1.42	0.87	1.02	0.83	1.26	0.83
Comorbidity	0.95	0.87	1.04	0.29	0.90	0.79	1.02	0.09	0.97	0.86	1.10	0.66
Hospital characteristics												
Teaching status					0.90	0.58	1.37	0.61	0.81	0.68	0.96	0.01
Case volume												
1st quartile **(lowest)**					1.00				1.00			
2nd quartile					1.22	0.81	1.86	0.34	1.01	0.83	1.23	0.89

	Model 1			Model 2			Model 3			
	OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**		**p-value**
3rd quartile				1.44	0.85	2.45	0.18	0.95	0.77	1.16	0.61
4th quartile **(highest)**				2.93	1.47	5.84	0.001	1.26	1.02	1.57	0.04
Bed size										
Less than 300 (ref)				1.00				1.00			
300–599				1.30	0.75	2.24	0.35	1.06	0.90	1.24	0.48
600 or m ore				1.28	0.56	2.95	0.56	0.96	0.75	1.21	0.71
Urban vs rural				14.8	3.95	55.6	0.001	2.61	1.55	4.42	0.00
NCI Cancer Center status				1.66	0.42	6.63	0.47	0.98	0.78	1.23	0.84
Disproportionate share **payments**				1.09	0.77	1.53	0.64	1.17	1.04	1.33	0.01
% Surgeries performed by										
gynecologic oncologist (10% increase)								1.81	1.77	1.86	0.001

Model 1 includes patient characteristics
Model 2 includes patient and hospital characteristics
Model 3 includes patient and hospital characteristics including the proportion of surgeries perform ed by a gynecologic oncologist

Table 3

Adjusted Associations between Survival and Patient, Surgeon and Hospital Characteristics for Women who Underwent Surgical Treatment of Endometrial Cancer

	Model 1				Model 2				Model 3			
	OR	95% CI		p-value	OR	95% CI		p-value	OR	95% CI		p-value
Black (vs. white)	1.10	0.91	1.32	0.32	1.13	0.85	1.51	0.40	1.10	0.88	1.37	0.40
Age at **diagnosis**	1.03	1.03	1.04	0.001	1.04	1.03	1.05	0.001	1.04	1.03	1.05	0.00
Married (vs. not married)	1.03	0.94	1.14	0.50	1.07	0.95	1.21	0.28	1.07	0.96	1.20	0.21
Stage												
I (ref)	1.00				1.00				1.00			
II	2.62	2.24	3.07	0.001	2.66	2.25	3.14	0.001	2.67	2.24	3.19	0.001
III	4.74	4.15	5.42	0.001	4.41	3.80	5.12	0.001	4.41	3.80	5.12	0.001
IV	9.23	8.14	10.47	0.001	8.84	7.51	10.40	0.001	8.86	7.67	10.24	0.001
Grade												
1 (ref)	1.00				1.00				1.00			
2	2.53	2.07	3.09	0.001	2.60	2.07	3.26	0.001	2.61	2.09	3.26	0.001
3/4	6.65	5.27	8.40	0.001	6.37	5.11	7.94	0.001	6.26	5.02	7.80	0.001
Histology												
Adenocarcinoma (ref)	1.00				1.00				1.00			
Endometriod	0.92	0.80	1.05	0.23	0.99	0.84	1.16	0.88	0.98	0.84	1.14	0.76
Papillary +/−serous	1.44	1.27	1.65	0.001	1.46	1.26	1.70	0.001	1.43	1.23	1.66	0.001
Annual household income												
<$25,000 (ref)	1.00				1.00				1.00			
$25,000–$50,000	0.83	0.74	0.94	0.003	0.83	0.71	0.97	0.02	0.83	0.72	0.95	0.01
>$50,000	0.74	0.64	0.86	0.001	0.71	0.57	0.87	0.001	0.71	0.59	0.85	0.001
Comorbidity	1.17	1.06	1.30	0.002	1.25	1.10	1.42	0.001	1.25	1.11	1.41	0.001
Surgical specialty												
Gynecologic oncologist vs. other surgeon					0.99	0.87	1.12	0.87	1.19	1.02	1.39	0.02
Hospital characteristics												
Medical school affiliation					1.02	0.88	1.18	0.78	1.09	0.92	1.39	0.08
Case volume												

	Model 1			Model 2			Model 3		
	OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
1st quartile **(lowest)**				1.00					
2nd quartile				0.78	0.66 0.92	0.00	0.78	0.66 0.91	0.001
3rd quartile				0.84	0.71 0.99	0.04	0.86	0.73 1.01	0.07
4th quartile **(highest)**				0.84	0.68 0.98	0.04	0.79	0.66 0.95	0.01
Bed size									
Less than 300 (ref)				1.00					
300–599				1.00	0.86 1.18	0.95	0.98	0.85 1.13	0.77
600 or more				0.92	0.75 1.15	0.47	0.82	0.66 1.03	0.08
Urban vs rural				1.10	0.86 1.40	0.45	1.06	0.84 1.34	0.62
NCI Cancer Center				0.95	0.79 1.14	0.57	0.94	0.75 1.16	0.54
Disproportionate share **payments**				0.92	0.81 1.04	0.20	0.94	0.83 1.06	0.29
% Surgeries performed by **gynecologic oncologist** (10% increase)							1.01	0.99 1.04	0.32

Model 1 includes patient characteristics
Model 2 includes patient and hospital characteristics
Model 3 includes patient and hospital characteristics including the proportion of surgeries performed by a gynecologic oncologist

Table 4

Hospital Characteristics for Women who Underwent Surgical Treatment of Endometrial Cancer by Patient Race and Surgical Specialty

	Black	White	p-value	Gynecologic Oncologist	No Gynecologic Oncologist	p-value
Medical school affiliation (%)	80.5	59.2	<0.001	70.8	55.1	<0.001
Case volume (%)						
1st quartile **(lowest)**	25.7	25.3	0.004	14.2	30.6	<0.001
2nd quartile	21.4	25.4		22.1	26.6	
3rd quartile	21.7	25.3		26.0	24.8	
4th quartile **(highest)**	31.2	24.0		37.7	18.0	
Bed size (%)						
Less than 300	9.8	35.7	<0.001	22.6	40.2	<0.001
300–599	55.7	44.4		46.6	44.0	
600 or more	34.5	20.9		30.8	15.8	
Urban vs rural (%)	99.8	91.1	<0.001	99.4	87.8	<0.001
NCI Cancer Center (%)	0.08	0.06	<0.001	11.4	4.3	<0.001
Disproportionate share **payments** (%)	0.38	0.30	<0.001	34.5	28.7	<0.001
% surgeries performed by gynecologic oncologist	41.9	29.2	<0.001	57.0	19.1	<0.001