Healthcare Access Dimensions and Guideline-Concordant Ovarian Cancer Treatment: SEER-Medicare Analysis of the ORCHiD Study

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ABSTRACT

Background: Racial disparities exist in receipt of guideline-concordant treatment of ovarian cancer (OC). However, few studies have evaluated how various dimensions of healthcare access (HCA) contribute to these disparities. **Methods:** We analyzed data from non-Hispanic (NH)–Black, Hispanic, and NH-White patients with OC diagnosed in 2008 to 2015 from the SEER-Medicare database and defined HCA dimensions as affordability, availability, and accessibility, measured as aggregate scores created with factor analysis. Receipt of guideline-concordant OC surgery and chemotherapy was defined based on the NCCN Guidelines for Ovarian Cancer. Multivariable-adjusted modified Poisson regression models were used to assess the relative risk (RR) for guideline-concordant treatment in relation to HCA. **Results:** The study cohort included 5,632 patients: 6% NH-Black, 6% Hispanic, and 88% NH-White. Only 23.8% of NH-White patients received guideline-concordant surgery and the full cycles of chemotherapy versus 14.2% of NH-Black patients. Higher affordability (RR, 1.05; 95% CI, 1.01–1.08) and availability (RR, 1.06; 95% CI, 1.02–1.10) were associated with receipt of guideline-concordant surgery, whereas higher affordability was associated with initiation of systemic therapy (hazard ratio, 1.09; 95% CI, 1.05–1.13). After adjusting for all 3 HCA scores and demographic and clinical characteristics, NH-Black patients remained less likely than NH-White patients to initiate systemic therapy (hazard ratio, 0.86; 95% CI, 0.75–0.99). **Conclusions:** Multiple HCA dimensions predict receipt of guideline-concordant treatment but do not fully explain racial disparities among patients with OC. Acceptability and accommodation are 2 additional HCA dimensions which may be critical to addressing these disparities.

J Natl Compr Canc Netw 2022;20(11):1255–1266.e11
doi: 10.6004/jnccn.2022.7055

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Background

Ovarian cancer (OC) is the fifth leading cause of cancer-related death and the deadliest gynecologic cancer in the United States, with an estimated 5-year survival rate of 49.1%.[1,2] White women experience the highest incidence of OC (11.3/100,000), followed by Hispanic (10.3/100,000) and Black (9.0/100,000) women.[2] Although survival rates improved for White women from 1973 to 2007 (36%–44%), they worsened for Black women (42%–36%),[2,3] partly due to lack of receipt of guideline-concordant treatment.

Racial disparities in receipt of guideline-concordant care have been well described. Black women are less likely to receive care that is concordant with the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for OC, including cancer-directed surgery and chemotherapy.[3–8] National guidelines for the treatment of advanced-stage OC recommend surgical staging and cytoreduction plus systemic chemotherapy.[9] Maximal cytoreductive surgery correlates with improved survival outcomes, and lack of concordance with the NCCN Guidelines is an independent predictor of worse survival.[6,10,11] Some evidence suggests that equal care leads to similar outcomes among Black and White women with advanced OC[12,13]; however, other large analyses have reported that although receipt of guideline-concordant treatment was associated with substantially improved outcomes in both Black and White women, some racial disparities in OC survival persist.[6,10,11]

Given the well-documented survival advantage associated with receipt of guideline-concordant treatment and the reduced rates of guideline-concordant treatment receipt among Black patients, elucidating the healthcare access (HCA) factors driving racial inequities in receipt of guideline-concordant care is imperative to help narrow the survival disparity in OC.

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The Penchansky and Thomas framework describes 5 dimensions of HCA: affordability (ability to pay), availability (type, quality, and volume of services), accessibility (geographic location of services), accommodation (organization of services, patient resources), and acceptability (patient experience, quality of patient–provider interaction).[14] Although prior studies have examined the association of individual components of HCA dimensions (eg, socioeconomic status [SES], facility volume, and insurance status) with guideline-concordant care,[15–18] none have comprehensively evaluated multiple dimensions simultaneously among a diverse group of patients with OC. This study evaluated the association of 3 HCA dimensions measurable in the SEER-Medicare linked database (affordability, availability, and accessibility) in relation to racial/ethnic disparities in receipt of guideline-concordant treatment of OC.

Methods

Overview

We conducted an observational cohort study of the association between HCA dimensions and receipt of recommended OC treatment based on clinical guidelines relevant for each patient's tumor characteristics. The main outcomes assessed were receipt of surgery among patients for whom surgery was recommended and receipt of systemic therapy if recommended.

Study Population

Non-Hispanic (NH)–Black, Hispanic, and NH-White women aged ≥65 years diagnosed with primary OC (SEER primary site code C569) in 2008 through 2015 were selected from the SEER-Medicare linked dataset (Figure 1). Patients were required to have at least 12 months of continuous enrollment in Medicare fee-for-service Parts A and B before diagnosis; at least one Medicare inpatient, outpatient, or carrier claim with a diagnosis code for OC (ICD-9-CM 183.0 and ICD-10-CM C569) within 2 months of SEER diagnosis; and continuous fee-for-service Medicare enrollment in the 12 months after diagnosis date or until death. Patients with fallopian tube cancer, borderline tumors, or peritoneal cancers were excluded. Those who died of OC in the first year after diagnosis were excluded to allow for evaluation of receipt of treatment; patients who died of a cause other than cancer were included. Patients were excluded if they were missing any variables used to calculate HCA dimension scores or determine guideline-concordant treatment. For analyses of receipt of guideline-concordant systemic therapy, the cohort was limited to patients with a diagnosis for which the NCCN Guidelines recommended the treatment. Decision trees for exclusions based on treatment guidelines are outlined in Figures 2 and 3.

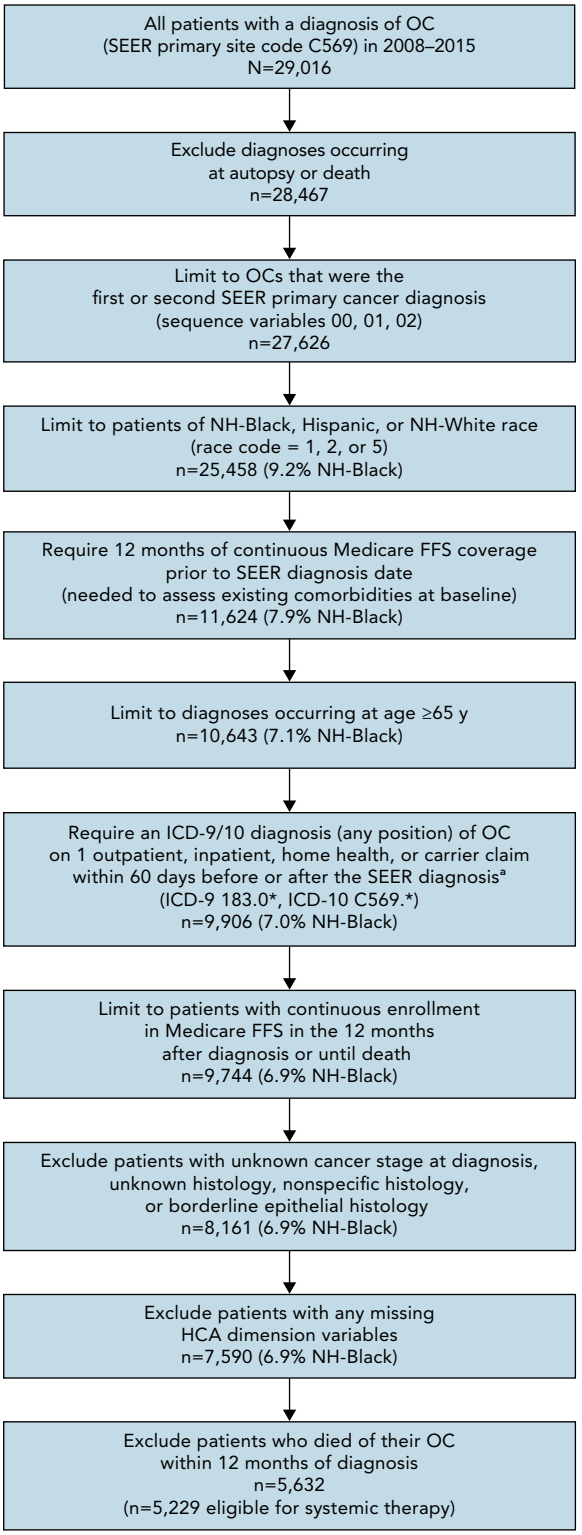

Figure 1. Participant flow chart for NH-Black, Hispanic, and NH-White patients with OC per SEER-Medicare 2008 to 2015. The proportion of NH-Black patients is presented for sensitivity purposes.
Abbreviations: FFS, fee-for-service; HCA, healthcare access; NH, non-Hispanic; OC, ovarian cancer.
[a]Used to set the actual diagnosis date because SEER only has month/year of diagnosis.

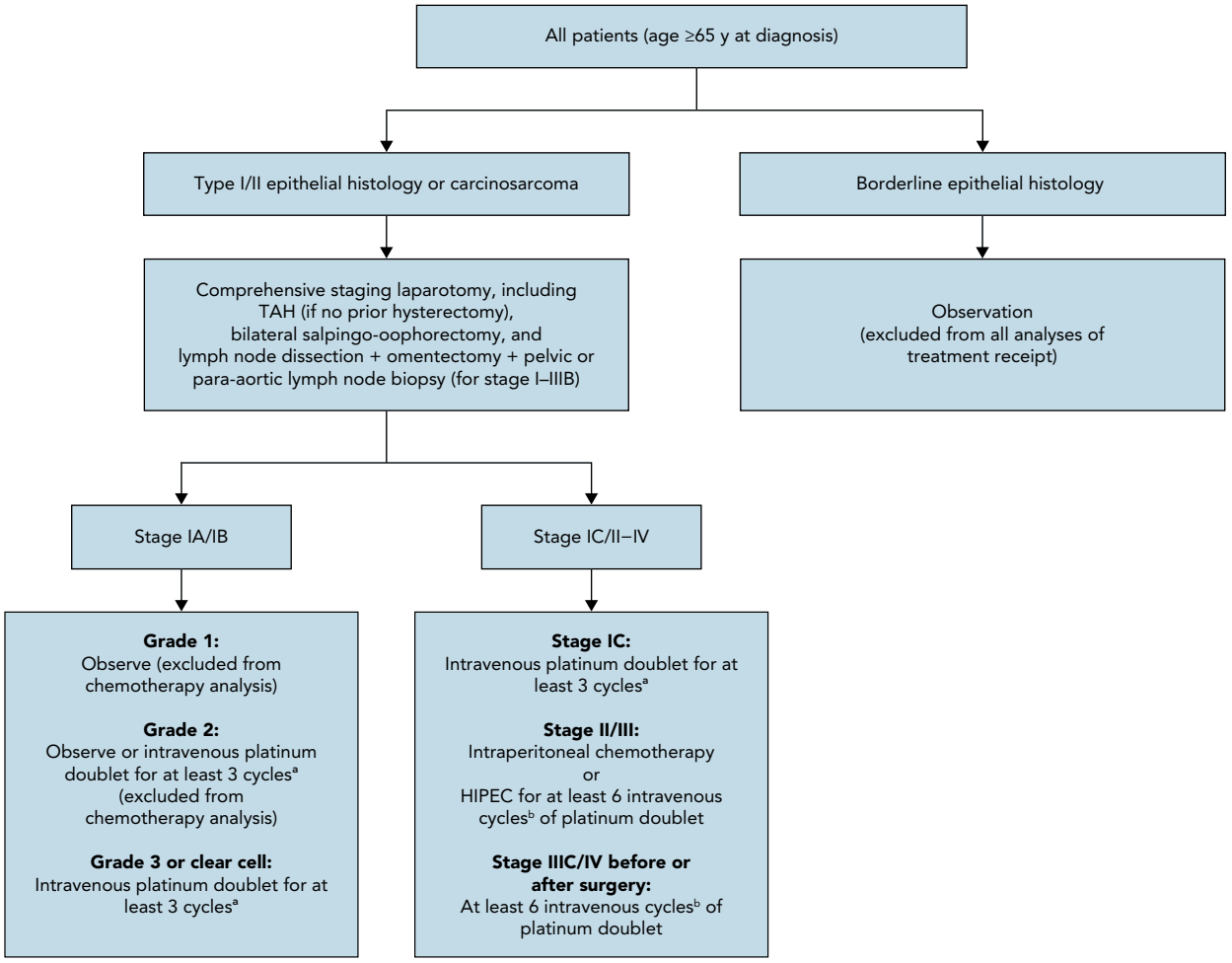

Figure 2. Decision tree for guideline-concordant primary treatment of epithelial ovarian cancer.
Simplified and adapted from the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Ovarian Cancer, Version 2.2013. This diagram does not reflect the full NCCN recommendations and is limited to clinical information and treatments that can be assessed in the SEER-Medicare database.
Abbreviations: HIPEC, hyperthermic intraperitoneal chemotherapy; TAH, total abdominal hysterectomy.
[a]NCCN Guidelines specifically recommend 3–6 cycles of intravenous platinum doublet.
[b]NCCN Guidelines specifically recommend 6–8 cycles of intravenous platinum doublet.
Adapted from Morgan RJ, Alvarez RD, Armstrong DK, et al. NCCN Clinical Practice Guidelines in Oncology: Ovarian Cancer, Version 2.2013; with permission. For the most recent version of these guidelines, visit NCCN.org.

SEER Patient Demographics and Clinical Characteristics

Patient and clinical characteristics from SEER data included race, ethnicity, age at diagnosis, stage at diagnosis, histology at diagnosis, marital status, geographic region of residence, and residence in a metropolitan area. We used validated coding algorithms to assess patient comorbidities and calculate the Charlson-Deyo comorbidity index score in the 12 months before OC diagnosis (supplemental eAppendix 1, available with this article at JNCCN.org).[19,20]

HCA Dimension Scores

A total of 35 patient, census tract, and regional-level variables (supplemental eAppendix 2) measuring dimensions of healthcare affordability (ie, census tract poverty rates, educational attainment), availability (ie, number of hospitals/specialists available per capita), and accessibility (ie, residence in metropolitan/rural area, distance traveled to care) were assessed, and confirmatory factor analysis (CFA) was used to identify the most influential variables for each aspect of HCA and create composite scores of affordability, availability, and accessibility. These findings have recently been corroborated by our group (unpublished data, 2022). Factor loadings from CFA were used to generate HCA domain scores ranging from −3 to 4. Lower values represented lower access for the dimension (ie, lower availability scores corresponded with fewer physicians and hospitals in the patient's region of residence). CFA for HCA domains is described in supplemental eAppendix 3.

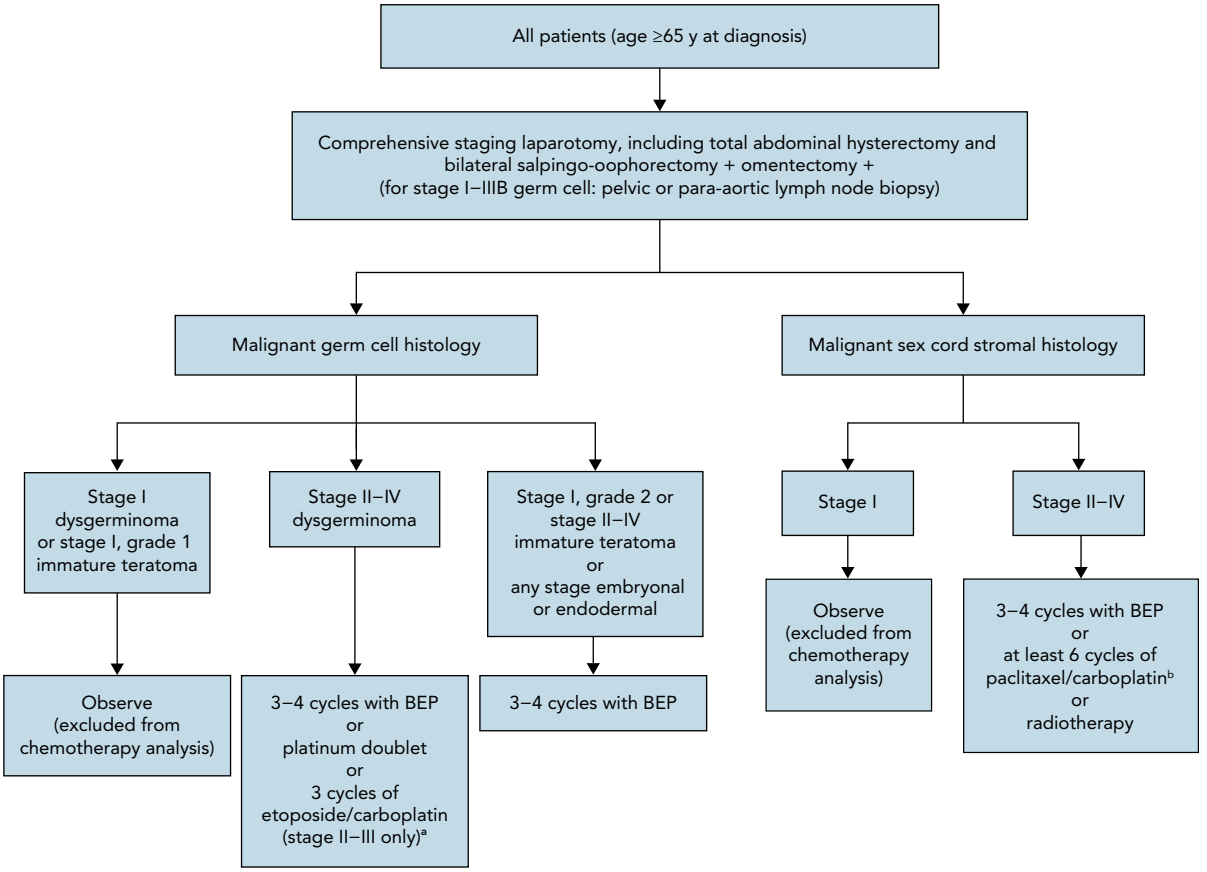

Figure 3. Decision tree for guideline-concordant primary treatment of less common histologic types.
Simplified and adapted from the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Ovarian Cancer, Version 2.2013. This diagram does not reflect the full NCCN treatment recommendations and is limited to initial treatment recommendations and clinical information and treatments that can be assessed in the SEER-Medicare database.
Abbreviation: BEP, bleomycin/etoposide/platinum.
[a]NCCN Guidelines specify initial observation for stage I dysgerminoma, but also specify that 3 cycles of etoposide/carboplatin are appropriate for select patients with stage IB–III dysgerminoma. In this study, we did not require patients with stage IB/IC dysgerminoma to receive guideline-concordant chemotherapy because we could not identify the patient population for which it was appropriate in the SEER-Medicare database.
[b]NCCN Guidelines specifically recommend 6–8 cycles of intravenous platinum doublet.
Adapted from Morgan RJ, Alvarez RD, Armstrong DK, et al. NCCN Clinical Practice Guidelines in Oncology: Ovarian Cancer, Version 2.2013; with permission. For the most recent version of these guidelines, visit NCCN.org.

Receipt of Guideline-Concordant Surgery

Patients were considered to have received any OC-directed surgery if they had a Medicare claim that indicated an ovarian surgical procedure (supplemental eAppendix 4) 2 months before or 6 months postdiagnosis or had OC primary site surgery documented in the SEER registry data. Receipt of guideline-concordant surgery was adapted from the NCCN Guidelines (Figures 2 and 3). We considered guideline-concordant surgery to involve the receipt of comprehensive staging laparotomy, including total abdominal hysterectomy (if no prior hysterectomy), bilateral salpingo-oophorectomy, lymph node dissection (if applicable), omentectomy, and pelvic or para-aortic lymph node biopsy (for stages I–IIIB). Receipt of procedures in administrative claims data were difficult to accurately assess; therefore, we selected a subset of surgical codes that we had high confidence represented receipt of guideline-concordant OC surgery and categorized these procedures as such (supplemental eAppendix 5). Because this definition likely excluded some surgeries meeting recommendations that were coded less specifically, we conducted a sensitivity analysis including a second subset of codes that might or might not represent receipt of guideline-concordant surgery (supplemental eAppendix 5).

Initiation and Completion of Guideline-Concordant Systemic Therapy

We adapted the 2013 NCCN Guidelines (Figures 2 and 3) to determine the recommended systemic therapy by tumor characteristics.[21] We examined 3 outcomes: initiation of any systemic therapy, initiation of recommended regimen, and completion of recommended cycles. Patients were considered to have initiated guideline-concordant systemic therapy if they had ≥1 Medicare claim for

administration of recommended systemic therapies for the patient's stage, grade, and histology (Figures 2 and 3, supplemental eAppendix 6) within 12 months postdiagnosis.[21] Patients were considered to have completed the recommended therapy cycles if they had the recommended number of therapy administration claims at least 20 days apart within 12 months postdiagnosis. Extended duration between cycles was not penalized in this analysis.

Statistical Analysis

The distribution of patient demographics, clinical characteristics, HCA scores, and treatment receipt was calculated for the full cohort and stratified by patient race; group-level differences were tested using Kruskal-Wallis and Cochran-Mantel-Haenszel tests. Univariable- and multivariable-adjusted Cox proportional hazards regression models were used to estimate cause-specific hazard ratios (HRs) for patient race and HCA scores with (1) receipt of any surgery and (2) initiation of any systemic therapy, accounting for the competing risk of death from another cause. Multivariable-adjusted modified Poisson regression with robust error estimation was used to assess relative risk (RR) associations between patient race, HCA scores, and the following treatment outcomes: (1) receiving ≥1 cycle of guideline-recommended systemic therapy, (2) completing the recommended cycles of therapy within 12 months of diagnosis, and (3) receiving guideline-concordant surgery.[22] Poisson regression was used to estimate RR instead of logistic regression because of the high prevalence of the measured outcomes (>10%).[22] For the sensitivity analysis, multivariable-adjusted multinomial regression was used to assess associations between HCA dimension scores and the categorical outcome of receiving guideline-concordant surgery, receiving surgery that may or may not have met guidelines, or not receiving surgery meeting guidelines. All multivariable models were adjusted for age at diagnosis, stage at diagnosis, tumor histology, US Census region of residence, number of comorbidities, year of diagnosis, and whether the patient died of causes other than OC in the 12 months postdiagnosis.

Results

Study Population and Clinical Characteristics

The cohort included 5,632 patients with OC diagnosed from 2008 to 2015; 333 (5.9%) were NH-Black, 318 (5.6%) were Hispanic, and 4,981 (88.4%) were NH-White (Table 1). We found that 84% of NH-White patients had type II epithelial histology, compared with 81% each of NH-Black and Hispanic patients. NH-Black and Hispanic patients had a higher comorbidity burden than NH-White patients ($P<.001$).

Racial Differences in Affordability, Availability, and Accessibility

NH-Black patients had lower affordability and availability scores than NH-White patients ($P<.001$) and thus were more likely to be dual-enrolled in Medicaid and Medicare, live in financially deprived areas, and live in areas with fewer/poorer-quality healthcare resources (Table 1). However, Hispanic and NH-Black patients had higher accessibility scores than NH-White patients and were thus more likely to live in urban, denser areas.

Rates of Treatment Receipt by Patient Race and/or Ethnicity

Among patients eligible for surgery (Figure 4; n=5,632), 79% received any OC surgery within 2 months before through 6 months after diagnosis, with NH-Black patients less likely to receive any surgery (72%) compared with NH-White (79%) or Hispanic patients (82%). Approximately 45% of patients received guideline-concordant surgery, with NH-Black patients receiving this at lower rates (37%; $P=.005$). Among patients eligible for systemic therapy based on stage, grade, and histology at diagnosis (n=5,299), 80% initiated guideline-concordant therapy within 12 months of diagnosis. NH-Black patients were less likely to initiate guideline-concordant systemic therapy (74%) compared with NH-White (81%) and Hispanic (84%) patients ($P=.005$). Of those eligible for chemotherapy, 44% of NH-White and Hispanic patients and 36% of NH-Black patients received all recommended cycles. Only 24% of NH-White and Hispanic patients and 14% of NH-Black patients received both guideline-concordant surgery and completed chemotherapy.

Receipt of Guideline-Concordant Surgery

After adjusting for patient demographic and clinical characteristics and HCA dimension scores (Table 2), neither patient race and/or ethnicity nor HCA scores were independently associated with any surgery receipt. In fully adjusted regression models assessing the receipt of guideline-concordant surgery, patients with higher affordability (RR, 1.05; 95% CI, 1.01–1.08) and availability (RR, 1.06; 95% CI, 1.02–1.10) were more likely to receive guideline-concordant surgery (Table 3). In sensitivity analyses comparing patients who received no surgery or guideline-nonconcordant surgery versus those who received guideline-concordant surgery or surgery that may or may not have met guidelines, patients with higher affordability (RR, 1.16; 95% CI, 1.06–1.26) and availability scores (RR, 1.13; 95% CI, 1.02–1.25) were more likely to receive guideline-concordant surgery (supplemental eTable 1).

Receipt of Guideline-Concordant Systemic Therapies

NH-Black patients were less likely to initiate systemic therapy than NH-White patients (HR, 0.86; 95% CI,

Table 1. Baseline Patient Characteristics (N=5,632)

Variable	Non-Hispanic White n (%)	Non-Hispanic Black n (%)	Hispanic n (%)	*P* Value
Total, n	4,981	333	318	
Age at OC diagnosis, mean [SD], y	75.8 [6.7]	75.2 [6.1]	74.7 [6.2]	**.007**
Affordability score,[a] mean [SD]	0.2 [0.9]	−0.7 [0.8]	−0.4 [1.0]	**<.001**
Availability score,[b] mean [SD]	0.0 [0.9]	−0.1 [0.8]	−0.1 [0.9]	**.003**
Accessibility score,[c] mean [SD]	−0.0 [0.5]	0.1 [0.4]	0.1 [0.4]	**<.001**
Tumor stage at diagnosis				.65
I	820 (16.5)	53 (15.9)	50 (15.7)	
II	452 (9.1)	27 (8.1)	30 (9.4)	
III	2,262 (45.4)	145 (43.5)	133 (41.8)	
IV	1,447 (29.1)	108 (32.4)	105 (33.0)	
Histology				**<.001**
Type I epithelial	732 (14.7)	<50	<65	
Type II epithelial	4,206 (84.4)	271 (81.4)	258 (81.1)	
Other	43 (0.9)	<20	<11	
Geographic region				**<.001**
Midwest	606 (12.2)	45 (13.5)	13 (4.1)	
Other	426 (8.6)	<40	<11	
Northeast	1,105 (22.2)	80 (24.0)	49 (15.4)	
South	720 (14.5)	110 (33.0)	<11	
West	2,124 (42.6)	<70	242 (76.1)	
Median comorbidity score (Q1, Q3)	2.0 (1.0, 3.0)	3.0 (1.0, 4.0)	2.0 (1.0, 4.0)	**<.001**
Myocardial infarction	107 (2.1)	<20	<11	.35
Hypertension	3,116 (62.6)	286 (85.9)	204 (64.2)	**<.001**
Peripheral vascular disease	370 (7.4)	37 (11.1)	26 (8.2)	**.048**
Congestive heart failure	353 (7.1)	49 (14.7)	31 (9.7)	**<.001**
Dementia	47 (0.9)	<11	<11	.04
Chronic obstructive pulmonary disease	687 (13.8)	54 (16.2)	40 (12.6)	.37
Cerebrovascular disease	357 (7.2)	27 (8.1)	20 (6.3)	.67
Rheumatologic disease	194 (3.9)	16 (4.8)	15 (4.7)	.57
Peptic ulcer disease	55 (1.1)	<11	<11	.62
Mild liver disease	169 (3.4)	17 (5.1)	19 (6.0)	**.018**
End-stage renal disease	285 (5.7)	38 (11.4)	19 (6.0)	**<.001**
Diabetes	869 (17.4)	125 (37.5)	100 (31.4)	**<.001**
Diabetes with complications	168 (3.4)	37 (11.1)	31 (9.7)	**<.001**
Hemiplegia or paraplegia	15 (0.3)	<11	<11	.60
Died of cause other than OC within 12 mo	173 (3.5)	18 (5.4)	13 (4.1)	.17
Year of diagnosis				.40
2008	731 (14.7)	50 (15.0)	45 (14.2)	
2009	665 (13.4)	45 (13.5)	31 (9.7)	
2010	628 (12.6)	33 (9.9)	42 (13.2)	
2011	565 (11.3)	47 (14.1)	40 (12.6)	
2012	594 (11.9)	46 (13.8)	36 (11.3)	
2013	588 (11.8)	45 (13.5)	33 (10.4)	
2014	584 (11.7)	42 (12.6)	48 (15.1)	
2015	626 (12.6)	25 (7.5)	43 (13.5)	

Bold indicates statistically significant *P* value.
Abbreviations: OC, ovarian cancer; Q1, quartile 1; Q3, quartile 3.
[a]Healthcare affordability defined based on measures of ability to pay for care (eg, area level poverty rates and health insurance coverage).
[b]Healthcare availability defined based on measures of availability of quality healthcare resources (eg, area level number of hospitals and physicians/specialists per capita and area level measures of hospital quality).
[c]Healthcare accessibility defined based on measures of distance/geographic location in relation to care (eg, residence in a rural area).

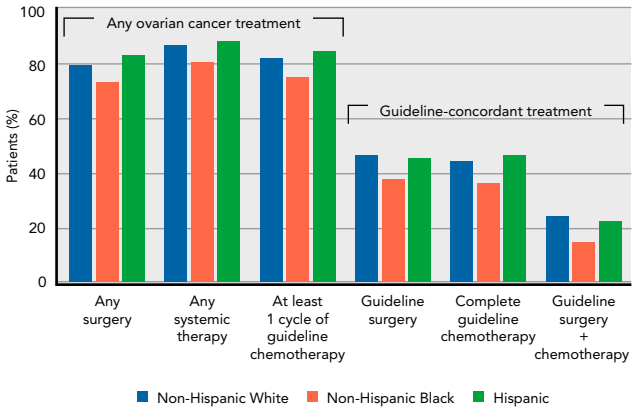

Figure 4. Receipt of treatment by patient race among patients who did not die of ovarian cancer in the first 12 months following their diagnosis (n=5,362 for surgical outcomes; n=5,229 for systemic therapy outcomes).

0.75–0.99) within 12 months of diagnosis after adjustment for patient demographic and clinical characteristics and HCA dimension scores (Table 2), and nearly all patients initiating systemic therapy received at least one round of guideline-concordant chemotherapy (Figure 4). Higher affordability scores were associated with initiation of any systemic therapy (HR, 1.10; 95% CI, 1.07–1.14) when accounting for competing risks of death from another cause (Table 2). Point estimates from Poisson RR models suggest that NH-Black patients were less likely to receive at least one cycle of guideline-concordant chemotherapy or to complete all cycles of chemotherapy, but confidence intervals crossed the null after adjustment for patient clinical characteristics (Table 4). HCA scores were not associated with the relative risk of initiating or completing guideline-concordant chemotherapy (Table 4).

Receipt of Both Guideline-Concordant Surgery and Systemic Therapies

In models adjusted for patient demographic and clinical characteristics and HCA scores, NH-Black patients were less likely than NH-White patients to receive both guideline-concordant surgery and chemotherapy (odds ratio, 0.59; 95% CI, 0.42–0.84; supplemental eTable 2). Higher availability was associated with greater likelihood of receiving guideline-concordant care (odds ratio, 1.15; 95% CI, 1.05–1.27).

Discussion

In this retrospective cohort study of patients aged ≥65 years with OC in the SEER-Medicare database, only 24% of NH-White and 14% of NH-Black patients received both guideline-concordant surgery and the recommended number of chemotherapy cycles. NH-Black patients had scores indicating lower HCA affordability and availability compared with NH-White patients. Patients with higher affordability and availability scores were more likely to receive guideline-concordant surgery and initiate systemic therapy. After accounting for demographic and clinical characteristics and all 3 HCA scores, we found that NH-Black patients were less likely to initiate systemic therapy than NH-White patients.

Our results are striking, given that prior studies found that 57% to 68% of White women and 39% to 54% of Black women with OC completed guideline-concordant care.[23,24] These differences are likely driven by our use of a more stringent coding definition of guideline-concordant treatment than prior administrative claims–based studies, and our inclusion of patients with stage I and II disease who had recommendations for treatment based on the NCCN Guidelines. For example, we considered surgery codes as guideline-concordant if they included bilateral salpingo-oophorectomy plus omentectomy or a malignancy-specific code including oophorectomy and lymph node biopsies, whereas previous studies included a much broader range of surgical codes, including codes for wedge or partial resection of the ovary. Although our stringent coding may explain striking differences in receipt of guideline-concordant treatment compared with other studies, we suspect that low rates of receipt of guideline-concordant treatment in our study and prior studies could be driven by the influence of poor healthcare access, in addition to patient comorbidities, and the older age and frailty of patients diagnosed with advanced-stage disease in the Medicare population.[25] We observed similar rates of any receipt of cancer-directed surgery and any receipt of chemotherapy as in prior studies.

Efforts to equalize access to guideline-concordant treatment are key to eliminating disparities in OC survival; there is an increased mortality risk among those who do not receive guideline-concordant treatment and among Black individuals independent of receipt of guideline-concordant treatment.[6,8,15,24,26,27] Studies have demonstrated that Black populations have worse survival due to barriers to receipt of quality care,[28,29] including late diagnosis, higher comorbidity burden,[30] and less access to high-volume surgeons.[31,32] HCA is well recognized as a fundamental contributor to receipt of appropriate OC treatment, but most prior studies only evaluated one dimension or component of HCA,[31,33–35] whereas this study attempts to comprehensively capture multiple dimensions of HCA. We found that patients with higher affordability were more likely to receive guideline-concordant surgery and initiate and complete chemotherapy, which is consistent with past findings that low SES is associated with lower likelihood to undergo surgery or receive chemotherapy.[28] We found that patients of minority race had lower

Table 2. Hazard Ratio for Receiving Any OC Surgery and Systemic Therapy

		Adjusted HR (95% CI)				
	Unadjusted HR (95% CI)	Patient Characteristics[a]	Patient Characteristics + Affordability Score[a]	Patient Characteristics + Availability Score[a]	Patient Characteristics + Accessibility Score[a]	Patient Characteristics + 3 HCA Scores[a]
Receipt of any OC surgery (N=5,632)						
Affordability score			1.01 (0.98–1.05)			1.02 (0.98–1.06)
Availability score				1.00 (0.96–1.05)		1.00 (0.96–1.04)
Accessibility score					0.98 (0.92–1.04)	0.97 (0.91–1.04)
Race (ref: NH-White)						
NH-Black	**0.78 (0.68–0.89)**	0.93 (0.82–1.06)	0.94 (0.83–1.07)	0.93 (0.82–1.06)	0.94 (0.83–1.06)	0.95 (0.84–1.08)
Hispanic	1.03 (0.91–1.17)	1.01 (0.89–1.15)	1.02 (0.90–1.17)	1.01 (0.89–1.15)	1.01 (0.89–1.16)	1.03 (0.90–1.17)
Age at diagnosis (ref: 65–70 y)						
71–75 y		0.98 (0.91–1.07)	0.98 (0.91–1.07)	0.98 (0.91–1.07)	0.98 (0.91–1.07)	0.99 (0.91–1.07)
76–80 y		0.92 (0.85–1.01)	0.92 (0.85–1.00)	0.92 (0.85–1.01)	0.92 (0.85–1.01)	0.92 (0.85–1.01)
≥81 y		**0.82 (0.75–0.89)**	**0.82 (0.75–0.89)**	**0.82 (0.75–0.89)**	**0.82 (0.75–0.89)**	**0.83 (0.76–0.90)**
Stage (ref: stage I)						
II		1.03 (0.90–1.18)	1.03 (0.89–1.18)	1.03 (0.90–1.18)	1.03 (0.89–1.18)	1.03 (0.89–1.18)
III		**0.85 (0.77–0.95)**	**0.85 (0.77–0.95)**	**0.85 (0.77–0.95)**	**0.85 (0.77–0.95)**	**0.86 (0.77–0.95)**
IV		**0.67 (0.60–0.74)**	**0.67 (0.60–0.74)**	**0.67 (0.60–0.74)**	**0.67 (0.60–0.74)**	**0.68 (0.61–0.76)**
Year of diagnosis		**0.98 (0.97–0.99)**	**0.98 (0.97–0.99)**	**0.98 (0.97–0.99)**	**0.98 (0.97–0.99)**	**0.98 (0.97–0.99)**
Initiation of any systemic therapy (N=5,229)[b]						
Affordability score			**1.10 (1.07–1.14)**			**1.09 (1.05–1.13)**
Availability score				**1.05 (1.01–1.09)**		1.03 (0.99–1.08)
Accessibility score					**1.08 (1.02–1.15)**	1.03 (0.97–1.10)
Race (ref: NH-White)						
NH-Black	**0.79 (0.70–0.90)**	**0.82 (0.72–0.94)**	0.88 (0.76–1.00)	**0.82 (0.72–0.94)**	**0.81 (0.71–0.93)**	**0.86 (0.75–0.99)**
Hispanic	0.98 (0.87–1.11)	0.96 (0.85–1.10)	1.02 (0.90–1.17)	0.97 (0.86–1.11)	0.96 (0.84–1.09)	1.02 (0.90–1.16)
Age at diagnosis (ref: 65–70 y)						
71–75 y		0.92 (0.86–1.00)	0.92 (0.85–1.00)	**0.92 (0.85–0.99)**	**0.92 (0.86–1.00)**	**0.92 (0.85–0.99)**
76–80 y		**0.84 (0.77–0.91)**	**0.84 (0.77–0.91)**	**0.83 (0.77–0.91)**	**0.84 (0.77–0.91)**	**0.83 (0.77–0.91)**
≥81 y		**0.63 (0.57–0.68)**	**0.62 (0.57–0.68)**	**0.62 (0.57–0.68)**	**0.62 (0.57–0.68)**	**0.62 (0.57–0.68)**
Stage (ref: stage I)						
II		**1.18 (1.02–1.35)**	**1.18 (1.03–1.36)**	**1.18 (1.02–1.35)**	**1.18 (1.03–1.36)**	**1.18 (1.03–1.36)**
III		**1.63 (1.46–1.83)**	**1.63 (1.46–1.83)**	**1.63 (1.46–1.82)**	**1.63 (1.46–1.83)**	**1.63 (1.46–1.82)**
IV		**1.87 (1.66–2.10)**	**1.88 (1.67–2.11)**	**1.87 (1.66–2.11)**	**1.87 (1.66–2.10)**	**1.88 (1.67–2.12)**
Year of diagnosis		**1.03 (1.02–1.04)**	**1.03 (1.01–1.04)**	**1.03 (1.01–1.04)**	**1.03 (1.01–1.04)**	**1.03 (1.01–1.04)**

Bold indicates statistically significant *P* value.
Abbreviations: HCA, healthcare access; HR, hazard ratio; NH, non-Hispanic; OC, ovarian cancer.
[a]Models additionally adjusted for tumor histology, patient comorbid conditions, and geographic region of residence at diagnosis and account for competing risk of death from another cause.
[b]Outcome evaluated among patients diagnosed with cancer of a stage, grade, and histology for which it is recommended and who survived at least 12 months.

availability scores and that higher availability of healthcare resources was associated with increased likelihood of undergoing guideline-concordant surgery; past studies have also reported that patients of minority race and low SES are more likely to receive care at low-volume hospitals with low-volume physicians, which are components of HCA availability.[34] These results highlight the importance of increasing the number of affordable, high-quality healthcare facilities in minority neighborhoods. Patients who live in rural settings, a measure of lower accessibility, have poorer survival compared with their urban counterparts.[36] In our study, Hispanic and NH-Black patients had higher accessibility scores compared with NH-White patients. Although distance and availability of specialists may be a larger issue for White patients who are more likely to live in rural areas, NH-Black and Hispanic patients who live in urban areas may have other challenges, including transportation to appointments.

Importantly, we observed that racial disparities in the initiation of systemic therapy persisted even after

Table 3. Relative Risk for Receipt of Guideline-Concordant Surgery Among Patients Surviving Their Ovarian Cancer at Least 12 Months (N=5,632)

	RR (95% CI)				
	Patient Characteristics[a]	Patient Characteristics + Affordability Score[a]	Patient Characteristics + Availability Score[a]	Patient Characteristics + Accessibility Score[a]	Patient Characteristics + 3 HCA Scores[a]
Affordability score		**1.06 (1.03–1.09)**			**1.05 (1.01–1.08)**
Availability score			**1.06 (1.02–1.10)**		**1.06 (1.02–1.10)**
Accessibility score				1.06 (1.00–1.13)	1.04 (0.98–1.11)
Race (ref: NH-White)					
NH-Black	**0.85 (0.74–0.97)**	0.88 (0.77–1.02)	0.85 (0.74–0.97)	0.84 (0.73–0.97)	0.87 (0.75–1.00)
Hispanic	0.97 (0.86–1.10)	1.01 (0.90–1.14)	0.99 (0.87–1.11)	0.97 (0.86–1.09)	1.01 (0.89–1.14)
Age at diagnosis (ref: 65–70 y)					
71–75 y	0.99 (0.93–1.06)	0.99 (0.93–1.06)	0.99 (0.93–1.06)	0.99 (0.93–1.06)	0.99 (0.93–1.05)
76–80 y	**0.80 (0.74–0.87)**	**0.80 (0.74–0.87)**	**0.80 (0.74–0.87)**	**0.81 (0.74–0.87)**	**0.80 (0.74–0.87)**
≥81 y	**0.54 (0.49–0.60)**	**0.54 (0.49–0.60)**	**0.54 (0.49–0.60)**	**0.54 (0.49–0.60)**	**0.54 (0.49–0.59)**
Stage (ref: stage I)					
II	1.09 (0.93–1.28)	1.09 (0.93–1.28)	1.09 (0.93–1.28)	1.10 (0.94–1.28)	1.10 (0.94–1.28)
III	**1.85 (1.65–2.06)**	**1.84 (1.65–2.06)**	**1.84 (1.65–2.06)**	**1.85 (1.66–2.07)**	**1.84 (1.65–2.06)**
IV	**1.42 (1.26–1.60)**	**1.42 (1.25–1.60)**	**1.42 (1.26–1.60)**	**1.42 (1.26–1.60)**	**1.42 (1.26–1.60)**
Region (ref: West)					
Midwest	0.94 (0.86–1.04)	0.97 (0.88–1.06)	0.96 (0.87–1.06)	0.97 (0.88–1.06)	0.99 (0.90–1.09)
Other/Missing	0.87 (0.78–0.97)	0.91 (0.81–1.01)	0.91 (0.81–1.02)	0.88 (0.79–0.98)	0.95 (0.84–1.06)
Northeast	1.07 (1.00–1.15)	1.05 (0.98–1.13)	1.01 (0.94–1.09)	1.06 (0.99–1.14)	1.00 (0.93–1.08)
South	**0.90 (0.83–0.99)**	0.93 (0.85–1.02)	0.94 (0.86–1.03)	0.92 (0.84–1.00)	0.97 (0.88–1.06)
Died of other cause	**0.62 (0.49–0.80)**	**0.62 (0.49–0.80)**	**0.62 (0.49–0.80)**	**0.62 (0.48–0.80)**	**0.62 (0.49–0.80)**
Year of diagnosis	0.99 (0.97–1.00)	0.98 (0.97–1.00)	0.98 (0.97–1.00)	0.99 (0.97–1.00)	0.98 (0.97–1.00)

Bold indicates statistically significant *P* value.
Abbreviations: HCA, healthcare access; NH, non-Hispanic; RR, relative risk.
[a]Models additionally adjusted for tumor histology and patient comorbidities.

adjusting for HCA dimensions. Therefore, simply addressing differences in these dimensions may be insufficient to ameliorate racial disparities in treatment. Two HCA dimensions remain unaccounted for in our study: accommodation (coordination and convenience of care) and acceptability (quality of patient–provider interactions).[14] Although they cannot be estimated in the SEER-Medicare dataset, these dimensions encompass measures of patient-centered care—communication, cultural competence, implicit bias, and discrimination—that may be an important moderator of the association between other HCA dimensions and treatment outcomes. For example, perceived discrimination is associated with decreased healthcare utilization, lower adherence to medical recommendations,[37,38] and prolonged symptom duration before OC diagnosis among NH-Black women.[39] Future studies that examine acceptability and accommodation are necessary to fully characterize HCA in relation to treatment.

This study highlights the role of race and HCA in receipt of appropriate OC treatment. However, administrative claims data cannot provide the full clinical picture that physicians use to make treatment recommendations and/or account for patient preferences. The SEER database is limited in the specificity available for measures of HCA; most measures are calculated at the area level and may not accurately reflect individual circumstances. The HCA scoring system and treatment guideline–concordance were not clinically validated, limiting interpretations of the data. Although we did not examine the timeliness of receipt of therapy or dose intensity, delays in chemotherapy completion can negatively impact survival.[40,41] The strengths of our analysis include a racially diverse population, large sample size, and comprehensive evaluation of HCA accessibility, availability, and affordability.

Conclusions

HCA affordability and availability were associated with guideline-concordant treatment. However, NH-Black patients were less likely to initiate systemic therapy compared with NH-White patients even after accounting for HCA dimensions. Further research on other HCA dimensions and

Table 4. Relative Risk for Receipt of Recommended Chemotherapy Among Patients Who Survived Their Ovarian Cancer at Least 12 Months (N=5,229)

	RR (95% CI)				
	Patient Characteristics[a]	Patient Characteristics + Affordability Score[a]	Patient Characteristics + Availability Score[a]	Patient Characteristics + Accessibility Score[a]	Patient Characteristics + 3 HCA Scores[a]
Received at least 1 cycle of recommended chemotherapy					
Affordability score		1.07 (0.97–1.17)			1.04 (0.94–1.14)
Availability score			1.01 (0.91–1.12)		1.00 (0.90–1.12)
Accessibility score				**1.19 (1.02–1.37)**	1.17 (1.00–1.36)
Race (ref: NH-White)					
NH-Black	0.74 (0.54–1.02)	0.78 (0.56–1.07)	0.74 (0.54–1.02)	**0.72 (0.52–0.99)**	0.74 (0.53–1.03)
Hispanic	1.17 (0.82–1.67)	1.22 (0.85–1.75)	1.17 (0.82–1.68)	1.16 (0.81–1.65)	1.19 (0.83–1.70)
Age at diagnosis (ref: 65–70 y)					
71–75 y	0.79 (0.62–1.00)	0.79 (0.62–1.00)	0.79 (0.62–1.00)	0.79 (0.62–1.00)	0.79 (0.62–1.00)
76–80 y	**0.50 (0.40–0.64)**	**0.50 (0.40–0.64)**	**0.50 (0.40–0.64)**	**0.51 (0.40–0.64)**	**0.51 (0.40–0.64)**
≥81 y	**0.20 (0.16–0.25)**	**0.20 (0.16–0.25)**	**0.20 (0.16–0.25)**	**0.20 (0.16–0.25)**	**0.20 (0.16–0.25)**
Stage (ref: stage I)					
II	**1.41 (1.03–1.93)**	**1.41 (1.03–1.93)**	**1.41 (1.03–1.93)**	**1.42 (1.04–1.94)**	**1.42 (1.04–1.94)**
III	**2.44 (1.89–3.15)**	**2.44 (1.89–3.15)**	**2.44 (1.89–3.15)**	**2.45 (1.90–3.17)**	**2.45 (1.90–3.16)**
IV	**1.83 (1.40–2.39)**	**1.83 (1.41–2.39)**	**1.83 (1.40–2.39)**	**1.83 (1.41–2.39)**	**1.83 (1.41–2.39)**
Region (ref: West)					
Midwest	0.87 (0.68–1.12)	0.89 (0.70–1.15)	0.88 (0.68–1.12)	0.93 (0.73–1.20)	0.94 (0.73–1.22)
Other/Missing	1.21 (0.88–1.64)	1.26 (0.92–1.74)	1.22 (0.88–1.68)	1.26 (0.92–1.72)	1.29 (0.93–1.80)
Northeast	1.07 (0.87–1.31)	1.05 (0.86–1.29)	1.06 (0.85–1.33)	1.05 (0.86–1.29)	1.04 (0.83–1.30)
South	0.92 (0.73–1.15)	0.95 (0.75–1.20)	0.92 (0.73–1.17)	0.96 (0.76–1.21)	0.97 (0.76–1.24)
Died of other cause	**0.13 (0.09–0.18)**	**0.13 (0.09–0.18)**	**0.13 (0.09–0.18)**	**0.13 (0.09–0.18)**	**0.13 (0.09–0.18)**
Completed recommended number of chemotherapy cycles					
Affordability score		0.99 (0.93–1.06)			0.98 (0.91–1.05)
Availability score			1.00 (0.92–1.08)		1.00 (0.93–1.09)
Accessibility score				1.08 (0.96–1.21)	1.09 (0.97–1.23)
Race (ref: NH-White)					
NH-Black	0.79 (0.61–1.03)	0.79 (0.60–1.02)	0.79 (0.61–1.03)	0.78 (0.60–1.02)	0.77 (0.59–1.00)
Hispanic	1.00 (0.77–1.28)	0.99 (0.77–1.28)	1.00 (0.77–1.28)	0.99 (0.77–1.27)	0.98 (0.75–1.26)
Age at diagnosis (ref: 65–70 y)					
71–75 y	**0.83 (0.71–0.96)**	**0.83 (0.71–0.96)**	**0.83 (0.71–0.96)**	**0.83 (0.71–0.96)**	**0.83 (0.71–0.96)**
76–80 y	**0.65 (0.56–0.77)**	**0.65 (0.56–0.77)**	**0.65 (0.56–0.77)**	**0.65 (0.56–0.77)**	**0.66 (0.56–0.77)**
≥81 y	**0.32 (0.27–0.38)**	**0.32 (0.27–0.38)**	**0.32 (0.27–0.38)**	**0.32 (0.27–0.37)**	**0.32 (0.27–0.37)**
Stage (ref: stage I)					
II	**0.31 (0.24–0.41)**	**0.31 (0.24–0.41)**	**0.31 (0.24–0.41)**	**0.31 (0.24–0.41)**	**0.31 (0.24–0.41)**
III	**0.40 (0.32–0.50)**	**0.40 (0.32–0.50)**	**0.40 (0.32–0.50)**	**0.40 (0.32–0.50)**	**0.40 (0.32–0.50)**
IV	**0.39 (0.31–0.49)**	**0.39 (0.31–0.49)**	**0.39 (0.31–0.49)**	**0.39 (0.31–0.49)**	**0.39 (0.31–0.49)**
Region (ref: West)					
Midwest	**1.30 (1.08–1.58)**	**1.30 (1.07–1.58)**	**1.30 (1.07–1.58)**	**1.34 (1.10–1.63)**	**1.34 (1.10–1.63)**
Other/Missing	0.88 (0.71–1.10)	0.88 (0.70–1.10)	0.88 (0.70–1.11)	0.89 (0.72–1.12)	0.88 (0.70–1.12)
Northeast	0.96 (0.82–1.12)	0.96 (0.82–1.12)	0.96 (0.81–1.14)	0.95 (0.82–1.11)	0.95 (0.80–1.13)
South	**0.74 (0.62–0.88)**	**0.74 (0.61–0.88)**	**0.74 (0.61–0.89)**	**0.75 (0.63–0.90)**	**0.75 (0.62–0.90)**
Died of other cause	**0.13 (0.08–0.24)**	**0.13 (0.08–0.24)**	**0.13 (0.08–0.24)**	**0.13 (0.08–0.23)**	**0.13 (0.08–0.23)**

Bold indicates statistically significant *P* value.
Abbreviations: HCA, healthcare access; NH, non-Hispanic; RR, relative risk.
[a]Models additionally adjusted for tumor histology and patient comorbidities.

a thorough examination of facilitators and barriers to treatment are needed to enhance delivery of optimal treatment and close the racial gap in survival for patients with OC.

Acknowledgments

The authors acknowledge the helpful assistance provided by the SEER-Medicare reviewers, information management system coordinator Elaine Yanisko, and all the patients whose valuable data contributed to this study.

Submitted March 5, 2022; final revision received July 14, 2022; accepted for publication July 14, 2022.

Author contributions: *Conceptualization:* Akinyemiju. *Statistical analysis:* Wilson. *Data compilation:* Wilson. *Writing—original draft:* All authors. *Writing—review and editing:* Previs, Gupta, Joshi, Huang, Pisu, Liang, Ward, Schymura, Berchuck, Akinyemiju.

Data availability statement: Data may be requested by applying to the SEER-Medicare program.

Disclosures: Dr. Wilson has disclosed receiving grant/research support from AstraZeneca. Dr. Previs has disclosed serving on an advisory board for Myriad Genetics and Natera. The remaining authors have disclosed that they have not received any financial consideration from any person or organization to support the preparation analysis, results, or discussion of this article.

Funding: Research reported in this publication was supported by the NCI of the NIH under award number R37CA233777 (T.F. Akinyemiju) and by the NIH under award number K12 HD103083 (R.A. Previs).

Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

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Healthcare Access Dimensions and Guideline-Concordant Ovarian Cancer Treatment: SEER-Medicare Analysis of the ORCHiD Study

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J Natl Compr Canc Netw 2022;20(11):1255–1266.e11

eTable 1. Multinomial Regression for Quality of Surgery Among Patients Surviving at Least 12 Months (N=5,632)

	Surgery May or May Not Be Guideline-Concordant[a] RR (95% CI)	Surgery Was Guideline-Concordant[a] RR (95% CI)
Affordability score	1.09 (0.99–1.21)	**1.16 (1.06–1.26)**
Availability score	1.02 (0.91–1.14)	**1.13 (1.02–1.25)**
Accessibility score	0.87 (0.74–1.03)	1.01 (0.87–1.17)
Race (ref: NH-White)		
NH-Black	0.79 (0.56–1.12)	**0.68 (0.50–0.93)**
Hispanic	1.21 (0.84–1.74)	1.11 (0.81–1.53)
Age at diagnosis (ref: 65–70 y)		
71–75 y	0.84 (0.67–1.06)	0.87 (0.71–1.06)
76–80 y	**0.52 (0.41–0.66)**	**0.43 (0.35–0.53)**
≥81 y	**0.27 (0.21–0.33)**	**0.17 (0.14–0.21)**
Tumor stage (ref: stage I)		
II	**1.75 (1.25–2.45)**	**1.76 (1.23–2.52)**
III	**0.64 (0.50–0.82)**	**2.27 (1.75–2.93)**
IV	**0.09 (0.07–0.12)**	**0.61 (0.47–0.79)**
Died of another cause	**0.44 (0.28–0.68)**	**0.37 (0.25–0.55)**

Bold indicates statistically significant *P* value.
RR adjusted for tumor histology, patient comorbid conditions, geographic region of residence at diagnosis, and year of diagnosis.
Abbreviations: NH, non-Hispanic; RR, relative risk.
[a]Reference category is no surgery received that met minimum recommendation (high confidence).

eTable 2. Adjusted Logistic Regression of Receipt of Guideline-Concordant Treatment Among Patients Surviving at Least 12 Months

	OR (95% CI)				
	Patient Characteristics	**Patient Characteristics + Affordability Score**	**Patient Characteristics + Availability Score**	**Patient Characteristics + Accessibility Score**	**Patient Characteristics + 3 HCA Scores**
Affordability score		**1.10 (1.02–1.19)**			1.07 (0.98–1.16)
Availability score			**1.17 (1.06–1.28)**		**1.15 (1.05–1.27)**
Accessibility score				1.09 (0.95–1.24)	1.06 (0.92–1.22)
Race (ref: NH-White)					
NH-Black	**0.58 (0.41–0.81)**	**0.61 (0.43–0.87)**	**0.57 (0.40–0.81)**	**0.57 (0.40–0.80)**	**0.59 (0.42–0.84)**
Hispanic	0.84 (0.62–1.12)	0.89 (0.66–1.19)	0.86 (0.64–1.15)	0.83 (0.62–1.11)	0.89 (0.66–1.20)
Age at diagnosis (ref: 65–70 y)					
71–75 y	0.91 (0.77–1.07)	0.91 (0.77–1.07)	0.90 (0.76–1.06)	0.91 (0.77–1.07)	0.90 (0.76–1.06)
76–80 y	**0.61 (0.50–0.73)**	**0.61 (0.50–0.73)**	**0.60 (0.50–0.73)**	**0.61 (0.51–0.74)**	**0.60 (0.50–0.73)**
≥81 y	**0.29 (0.23–0.36)**	**0.28 (0.23–0.35)**	**0.28 (0.22–0.35)**	**0.28 (0.23–0.35)**	**0.28 (0.22–0.35)**
Stage (ref: stage I)					
II	**0.50 (0.36–0.71)**	**0.50 (0.36–0.71)**	**0.50 (0.36–0.71)**	**0.51 (0.36–0.71)**	**0.50 (0.36–0.71)**
III	1.13 (0.88–1.44)	1.13 (0.88–1.44)	1.12 (0.87–1.43)	1.13 (0.89–1.45)	1.12 (0.87–1.43)
IV	1.04 (0.80–1.35)	1.04 (0.80–1.35)	1.04 (0.80–1.35)	1.04 (0.81–1.35)	1.04 (0.80–1.35)
Region (ref: West)					
Midwest	1.07 (0.86–1.32)	1.11 (0.89–1.38)	1.12 (0.90–1.4)	1.10 (0.88–1.37)	1.17 (0.94–1.47)
Other/Missing	0.77 (0.59–1.00)	0.83 (0.63–1.08)	0.87 (0.66–1.15)	0.78 (0.60–1.01)	0.92 (0.69–1.22)
Northeast	0.98 (0.82–1.16)	0.94 (0.79–1.13)	0.85 (0.70–1.03)	0.97 (0.81–1.15)	0.83 (0.69–1.01)
South	0.64 (0.52–0.80)	0.67 (0.54–0.84)	0.71 (0.57–0.89)	0.65 (0.52–0.81)	0.74 (0.59–0.93)
Died of other causes	**0.15 (0.07–0.35)**	**0.16 (0.07–0.35)**	**0.15 (0.07–0.35)**	**0.15 (0.07–0.35)**	**0.16 (0.07–0.35)**
Year of diagnosis	0.97 (0.94–1.00)	0.97 (0.94–1.00)	0.97 (0.94–1.00)	0.97 (0.94–1.00)	0.97 (0.94–1.00)

Bold indicates statistically significant *P* value.
Abbreviations: HCA, healthcare access; NH, non-Hispanic; OC, ovarian cancer; OR, odds ratio.

eAppendix 1. Diagnosis Codes for Patient Comorbid Conditions

Baseline Charlson-Deyo comorbidity index	The Charlson-Deyo comorbidity will be created during the baseline period based on the following score: • 1 each: Myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic pulmonary disease, rheumatologic disease, peptic ulcer disease, mild liver disease, diabetes (mild to moderate) • 2 each: Hemiplegia or paraplegia, renal disease, diabetes with complication, any malignancy (leukemia, lymphoma) • 3 each: Moderate or severe liver disease • 6 each: Malignant tumor, AIDS
Myocardial infarction	**ICD–9-CM codes:** 410.*, 412.* **ICD–10-CM codes:** I21.*, I22.*, I25.2*
Congestive heart failure	**ICD–9-CM codes:** 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4*, 425.5*, 425.7*, 425.8*, 425.9*, 428.* **ICD–10-CM codes:** I09.81, I11.0*, I13.0*, I13.2*, I42.0*, I42.5*, I42.6*, I42.7*, I42.8*, I42.9*, I43.*, I50.*
Peripheral vascular disease	**ICD–9-CM codes:** 093.0*, 437.3*, 440.*, 441.*, 443.1*, 443.2*, 443.8*, 443.9*, 447.1*, 557.1*, 557.9*, V43.4* **ICD–10-CM codes:** A52.01, E08.51, E08.52, E09.51, E09.52, E10.51, E10.52, E11.51, E11.52, E13.51, E13.52, I67.0*, I67.1*, I70.*, I71.*, I73.1*, I73.8*, I73.9*, I77.7*, I79.*, K55.1*, K55.8*, K55.9*, Z95.82
Hypertension	**ICD–9-CM codes:** 401.*, 402.*, 403.*, 404.*, 405.*, 437.2* **ICD–10-CM codes:** I10.*, I11.*, I12.*, I13.*, I15.0*, I15.2*, I15.8*, I15.9*, I16.*, I67.4*
Dementia	**ICD–9-CM codes:** 290.*, 294.1*, 331.2* **ICD–10-CM codes:** F01.*, F02.*, F03.9*, G31.1*
Cerebrovascular disease	**ICD–9-CM codes:** 362.34, 430.*, 431.*, 432.*, 433.*, 434.*, 435.*, 436.*, 437.*, 438.* **ICD–10-CM codes:** G45.0*, G45.1*, G45.2*, G45.4*, G45.8*, G45.9*, G46.*, H34.0*, I60.*, I61.*, I62.*, I63.*, I65.*, I66.*, I67.1*, I67.2*, I67.4*, I67.5*, I67.6*, I67.7*, I67.81, I67.82, I67.84, I67.89, I67.9*, I68.*, I69.*
Chronic pulmonary disease	**ICD–9-CM codes:** 416.8*, 416.9*, 490.*, 491.*, 492.*, 493.*, 494.*, 495.*, 496.*, 500.*, 501.*, 502.*, 503.*, 504.*, 505.*, 506.4*, 508.1*, 508.8* **ICD–10-CM codes:** I27.2*, I27.81, I27.89, I27.9*, J40.*, J41.*, J42.*, J43.*, J44.*, J45.2*, J45.3*, J45.4*, J45.5*, J45.90, J45.99, J47.*, J60.*, J61.*, J62.*, J63.*, J64.*, J65.*, J66.*, J67.*, J68.4*, J70.1*, J70.2*, J70.3*, J70.4*, J70.8*
Rheumatologic disease	**ICD–9-CM codes:** 446.5*, 710.0*, 710.1*, 710.2*, 710.3*, 710.4*, 714.0*, 714.1*, 714.2*, 714.8*, 725.* **ICD–10-CM codes:** M05.*, M06.*, M31.5*, M31.6*, M32.*, M33.*, M34.*, M35.0*, M35.3*, M36.0*
Peptic ulcer disease	**ICD–9-CM codes:** 531.*, 532.*, 533.*, 534.* **ICD–10-CM codes:** K25.*, K26.*, K27.*, K28.*
Mild liver disease	**ICD–9-CM codes:** 070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6*, 070.9*, 570.*, 571.*, 573.3*, 573.4*, 573.8*, 573.9*, V42.7* **ICD–10-CM codes:** B17.9*, B18.0*, B18.1*, B18.2*, B19.0*,B19.9*,K70.0*, K70.1*, K70.2*, K70.3*, K70.40, K70.9*, K71.0*, K71.10, K71.2*, K71.3*, K71.4*, K71.5*, K71.6*, K71.7*, K71.8*, K71.9*, K72.00, K73.*, K74.0*, K74.1*, K74.2*, K74.3*, K74.4*, K74.5*, K74.6*, K75.2*, K75.3*, K75.4*, K75.8*, K75.9*, K76.0*, K76.1*, K76.2*, K76.3*, K76.4*, K76.5*, K76.89, K76.9*, K77.*, Z48.23, Z94.4*
Diabetes (mild to moderate)	**ICD–9-CM codes:** 250.0*, 250.1*, 250.2*, 250.3*, 250.8*, 250.9* **ICD–10-CM codes:** E10.1*, E10.618, E10.62, E10.63, E10.64, E10.65, E10.69, E10.8*, E10.9*, E11.0*, E11.1*, E11.618, E11.62, E11.63, E11.64, E11.65, E11.69, E11.8*, E11.9, E13.00, E13.01, E13.10, E13.11, E13.618, E13.62, E13.63, E13.64, E13.65, E13.69, E13.8*, E13.9*
Hemiplegia or paraplegia	**ICD–9-CM codes:** 334.1*, 342.*, 343.*, 344.0*, 344.1*, 344.2*, 344.3*, 344.4*, 344.5*, 344.6*, 344.9* **ICD–10-CM codes:** G04.1*, G11.4*, G80.*, G81.*, G82.*, G83.0*, G83.1*, G83.2*, G83.3*, G83.4*, G83.9*
ESRD	585.6, N18.6 or ESRD eligibility flag
Diabetes with complication	**ICD–9-CM codes:** 250.4*, 250.5*, 250.6*, 250.7* **ICD–10-CM codes:** E10.2*, E10.3*, E10.4*, E10.5*, E10.610, E11.2*, E11.3*, E11.4*, E11.5*, E11.610, E13.2*, E13.3*, E13.4*, E13.5*, E13.610
Moderate or severe liver disease	**ICD–9-CM codes:** 456.0*, 456.1*, 456.2*, 572.2*, 572.3*, 572.4*, 572.8* **ICD–10-CM codes:** I85.*, K70.41, K71.11, K72.01, K72.1*, K72.9*, K76.6*, K76.7*
AIDS	**ICD–9-CM codes:** 042.*, 043.*, 044.* **ICD–10-CM codes:** B20.*

Abbreviation: ESRD, end-stage renal disease.

eAppendix 2. Measures of Healthcare Affordability, Accessibility, and Availability at Time of Ovarian Cancer Diagnosis Used to Create Composite Scores

Categorical Variables
Affordability Measures
Patient is dual enrolled in Medicaid and Medicare
Patient's primary hospital eligibility for disproportionate share payments
Accessibility Measures
Patient lives in metropolitan area
Patient lives in a metropolitan or metropolitan-adjacent area
Patient lives in rural area
Patient's main hospital is rural primary hospital
Availability Measures
Patient's main hospital teaching status
Patient's main hospital NCI Cancer Center designation
Clinical
Comprehensive
Patient's main hospital is member of NCI gynecologic oncology group
Primary physician specialty
General surgery
Gynecologic oncology
Hematology/Oncology/Medical oncology
Internal medicine
No primary
OB-GYN
Other
Pathology/Other oncology
Primary/General
Surgical oncology
Continuous Variables
Affordability Measures
Census tract at diagnosis: percent Black residents
Census tract at diagnosis: percent persons aged ≥25 years with at least 4 years of college
Census tract at diagnosis: median household income
Census tract at diagnosis: percent persons aged ≥25 years with less than a high school education
Census tract at diagnosis: per capita income for Census tract
Census tract at diagnosis: percent persons aged ≥25 years with some college education
Census tract at diagnosis: percent of households below poverty line
County level: percent of residents without health insurance
Accessibility Measures
Straight line geographic distance from patient residential zip code to patient's main hospital zip code
County level: no. of hospitals per 1,000 residents in patient's county in year of diagnosis

(*continued on next page*)

eAppendix 2. Measures of Healthcare Affordability, Accessibility, and Availability at Time of Ovarian Cancer Diagnosis Used to Create Composite Scores (cont.)

Continuous Variables (cont.)
Availability Measures
Patient's main hospital number of beds
HRR level: discharges for ambulatory sensitive conditions per 1,000 population
HRR level: hematologists/oncologists per 100,000 residents
HRR level: percentage of Medicare beneficiaries that died in year of diagnosis
HRR level: hospital-based physicians per 100,000 residents (2011)
HRR level: OB-GYNs per 100,000 women
HRR level: percentage of Medicare beneficiaries seeing a primary care provider that year
HRR level: primary care providers per 100,000 residents
HRR level: hospital discharge 30 day return to emergency department rates (%)
HRR-level: 30 days hospital readmission rates (%)
HRR level: physicians per 100,000 residents
HRR level: surgeons per 100,000 residents
County level: No. of gynecologic oncologists per 1,000 residents in year of diagnosis
County level: No. of OB-GYNs seeing patients per 1,000 residents
County level: No. of primary care providers per 1,000 residents

Abbreviations: HRR, healthcare referral region; OB-GYN, obstetrician-gynecologist.

eAppendix 3. HCA Measure Definitions and Creation of HCA Dimension Scores

Assignment of Primary Provider and Hospital Treatment Facility

A patient's primary cancer treatment provider was identified as the provider listed on the highest number of the patient's outpatient, carrier, home health, and hospice claims listing a cancer diagnosis. Physician specialties were determined from Medicare claims files using Health Care Financing Administration (HCFA) specialty codes. Ties between physicians were broken by prioritizing physician specialties of interest (gynecologic oncology, medical oncology, hematology/oncology, or surgical oncology) and claim date closest to the ovarian cancer (OC) diagnosis date. The patient's primary treating hospital in the year the patient was diagnosed was defined as the facility at which the patient had the majority of inpatient and outpatient claims in that calendar year. In the case of ties, priority was given to facilities with records in the SEER-Medicare Hospital File.

Measures of Healthcare Affordability

Measures of healthcare affordability included dual enrollment in Medicaid, census tract-level measures of socioeconomic status (SES), and county-level health insurance coverage. A patient's dual Medicaid enrollment status in the 12 months prior to OC diagnosis was sourced from the SEER-Medicare dataset, as were the following SES indicators of the patient's residential census tract at the time of diagnosis drawn from data from the US Census Bureau's American Community Survey: median per capita income, percentage of Black residents, percentage of adults aged ≥25 years with less than a high school education, percentage of households with incomes below the poverty level, and percentage of adults aged ≥25 years with a college degree. Census tract SES characteristics were categorized into quartiles, and included as a binary variable in models (highest quartile vs lower 3 quartiles). Federal Information Processing Standards (FIPS) codes for the patient's county and state of residence and the patient's year of diagnosis were used to link to the US Census Bureau's Small Area Health Insurance Estimates 2008–2018 American Community Survey-Based Estimates datasets (https://www.census.gov/data/datasets/time-series/demo/sahie/estimates-acs.html) to obtain the estimated percentage of county residents without health insurance in the year of the patient's diagnosis.

Measures of Healthcare Availability

Healthcare availability metrics for the patient's county and healthcare referral regions were linked to SEER-Medicare data using year of diagnosis, county and state FIPS codes, and patient zip codes from the Area Healthcare Resources

File and the Dartmouth Atlas Project. County-level metrics were drawn from the publicly available Area Healthcare Resource Files provided by the Health Resources and Services Administration (https://data.hrsa.gov/data/download). County-level linked measures were calculated as number per 1,000 population and included number of hospitals, number of primary care providers, and number of obstetricians-gynecologists (OB-GYNs). Hospital referral region (HRR)–level availability metrics derived from Medicare and Medicaid data from the Dartmouth Atlas Project (https://atlasdata.dartmouth.edu/downloads) were linked using patient zip code and year of diagnosis. HRR data captures the characteristics of the regional markets for tertiary healthcare systems. HRR-level availability metrics of interest for the patient's year of diagnosis were acute care beds available per 1,000 population, physicians per 100,000 population, primary care physicians per 100,000 population, hematologists/oncologists per 100,000 population, OB-GYNs per 100,000 women aged 15 to 44 years, percentage of Medicare beneficiaries that died, percentage of beneficiaries seeing a primary care physician that year, discharges for ambulatory sensitive conditions per 1,000 population, hospital discharge 30-day readmission rates, and hospital discharge 30-day return to emergency department rates. For metrics without data available for each calendar year, the information was imputed from the most proximate year available to the patient's diagnosis within 5 years. The NCI hospital file was used to determine facility-associated availability metrics including the hospital's ownership, affiliation with a medical school, NCI Cancer Center designation critical access status, and number of beds in the year of the patient's cancer diagnosis. If the hospital's information was missing in a calendar year, the information was imputed as the highest availability value for the hospital recorded in the study time period.

Factor Analysis and Creation of HCA Factor Scores

We used the Penchansky and Thomas framework of healthcare access to guide our selection of variables representing the hypothesized latent constructs of healthcare access (affordability, availability, and accessibility) to include in our analysis using a 2-stage confirmatory factor analysis approach. First, factor analysis was conducted for each a priori grouping of HCA dimension measures (affordability, availability, and accessibility), then variables with significant loadings in the three preliminary models were carried forward into one final combined model. Two variables measuring number of specialists available (gynecologic oncologists and OB-GYNs) had high correlation efficiency, thus the gynecologic oncologist variable was excluded. A total of 14 HCA dimension measures were carried over and loaded into the second stage factor analysis. There was a clear separation for each of the 3 hypothesized factors (representing affordability, availability, and accessibility) on the factor analysis scree plot, and each factor captured the majority of measures for a hypothesized HCA domain. We next conducted reliability tests and assessed model fit for these selected factors. Based on the reliability tests, we adjusted our final factor model by excluding the number of hospitals per 1,000 county population variable, which resulted in improved reliability metrics for the accessibility domain. The final factor model comprised a total of 13 variables loading onto the 3 factors, with close to 89% of the sample variance was explained. We also conducted exploratory factor analysis to agnostically determine factor structure for HCA domains. However, the 3-factor model did not demonstrate a simple and clear structure with respect to which variables loaded together on each factor, and factors 2 and 3 had low reliability scores when assessed using Cronbach's alpha coefficient. Therefore, to improve interpretability and reliability of the factor scores, we relied on the confirmatory factor analysis approach.

Estimated factor scores for each HCA domain were created using PROC FACTOR to generate a linear composite of optimally weighted variables under analysis. To test heterogeneity of the associations by patient race and ethnicity, values of factor scores were stratified by race and ethnicity. Factor weighted sum scores were compared for each factor across patient race and ethnicity. Scores were centered at zero, with values ranging from approximately −3 to 4, with negative values representing the lowest scores for the dimension (ie, low affordability), and positive scores representing higher scores for the dimension. Factor analyses were conducted using SAS 9.4 (SAS Institute Inc.).

eAppendix 4. Any Ovarian Cancer Surgery Coding Definitions

Billing Codes for Surgery	
ICD-9 and ICD-10 procedure codes	
ICD-9: 54.4 ICD-10-Mapping from CMS GEMS 0D5U0ZZ,0D5U3ZZ, 0D5U4ZZ, 0D5V0ZZ, 0D5V3ZZ, 0D5V4ZZ, 0D5W0ZZ, 0D5W3ZZ, 0D5W4ZZ, 0DBU0ZZ, 0DBU3ZZ, 0DBU4ZZ 0DBV0ZZ 0DBV3ZZ, 0DBV4ZZ, 0DBW0ZZ, 0DBW3ZZ, 0DBW4ZZ, 0DTU0ZZ, 0DTU4ZZ, 0WBH0ZZ, 0WBH3ZZ, 0WBH4ZZ	Omentectomy, excision, destruction peritoneal tissue
ICD-9: 65.2× ICD-10 GEMS 0U900ZZ, 0U903ZZ, 0U910ZZ, 0U913ZZ, 0U920ZZ, 0U923ZZ, 0UB00ZZ, 0UB03ZZ, 0UB07ZZ, 0UB08ZZ, 0UB10ZZ, 0UB13ZZ, 0UB17ZZ, 0UB18ZZ, 0UB20ZZ, 0UB23ZZ, 0UB27ZZ, 0UB28ZZ, 0U904ZZ, 0U914ZZ, 0U924ZZ, 0UB04ZZ, 0UB14ZZ, 0UB24ZZ, 0U504ZZ, 0U514ZZ, 0U524ZZ, 0UB04ZZ, 0UB14ZZ, 0UB24ZZ, 0U500ZZ, 0U503ZZ, 0U508ZZ, 0U510ZZ, 0U513ZZ, 0U518ZZ, 0U520ZZ, 0U523ZZ, 0U528ZZ, 0U800ZZ, 0U803ZZ, 0U810ZZ, 0U813ZZ, 0U820ZZ, 0U823ZZ, 0UB00ZZ, 0UB03ZZ, 0UB10ZZ, 0UB13ZZ, 0UB20ZZ, 0UB23ZZ	Wedge resection or partial excision of ovary
ICD-9: 65.3× ICD-10 GEMS 0UT04ZZ, 0UT14ZZ, 0UT00ZZ, 0UT07ZZ, 0UT08ZZ, 0UT0FZZ, 0UT10ZZ, 0UT17ZZ, 0UT18ZZ, 0UT1FZZ	Unilateral oophorectomy
ICD-9: 65.4× ICD-10 GEMS mapping 0UT04ZZ, 0UT14ZZ, 0UT54ZZ, 0UT64ZZ, 0UT00ZZ, 0UT10ZZ, 0UT50ZZ, 0UT60ZZ	Bilateral oophorectomy
ICD-9: 65.51–65.54 ICD-10 GEMS mapping 0UT20ZZ, 0UT27ZZ, 0UT28ZZ, 0UT2FZZ, 0UT00ZZ, 0UT07ZZ, 0UT08ZZ, 0UT0FZZ, 0UT10ZZ, 0UT17ZZ, 0UT18ZZ, 0UT1FZZ, 0UT24ZZ, 0UT04ZZ, 0UT14ZZ	Other removal of ovaries
ICD-9: 65.6× ICD-10 GEMS 0UT20ZZ, 0UT70ZZ, 0UT00ZZ, 0UT10ZZ, 0UT50ZZ, 0UT60ZZ, 0UT24ZZ, 0UT74ZZ, 0UT04ZZ, 0UT14ZZ, 0UT54ZZ, 0UT64ZZ	Bilateral salpingo-oophorectomy
ICD-9: 66.63, 66.69 ICD-10 GEMS 0UB70ZZ, 0UB73ZZ, 0UB74ZZ, 0UB77ZZ, 0UB78ZZ, 0UB50ZZ, 0UB53ZZ, 0UB54ZZ, 0UB57ZZ, 0UB58ZZ, 0UB60ZZ, 0UB63ZZ, 0UB64ZZ, 0UB67ZZ, 0UB68ZZ	Bilateral/Other partial salpingectomy
ICD-9: 68.8 ICD-10 GEMS 0UB70ZZ, 0UB73ZZ, 0UB74ZZ, 0UB77ZZ, 0UB78ZZ, 0UB50ZZ, 0UB53ZZ, 0UB54ZZ, 0UB57ZZ, 0UB58ZZ, 0UB60ZZ, 0UB63ZZ, 0UB64ZZ, 0UB67ZZ, 0UB68ZZ	Pelvic exenteration
ICD-9: 68.3–68.7, 68.9, 68.59 ICD-10 GEMS 0UT94ZL, 0UT90ZL, 0UT94ZZ, 0UTC4ZZ, 0UT90ZZ, 0UTC0ZZ, 0UT9FZL, 0UT9FZZ, 0UTC4ZZ, 0UT97ZL, 0UT97ZZ, 0UT98ZL, 0UT98ZZ, 0UTC7ZZ, 0UTC8ZZ, 0UT44ZZ, 0UT94ZZ, 0UTC4ZZ, 0UT40ZZ, 0UT90ZZ, 0UTC0ZZ, 0UT44ZZ, 0UT9FZZ, 0UTC4ZZ, 0UT47ZZ, 0UT48ZZ, 0UT97ZZ, 0UT98ZZ, 0UTC7ZZ, 0UTC8ZZ	Hysterectomy
ICD-9: 70.32 ICD-10 GEMS 0U5F0ZZ, 0U5F3ZZ, 0U5F4ZZ, 0U5F7ZZ, 0U5F8ZZ, 0UBF0ZZ, 0UBF3ZZ, 0UBF4ZZ, 0UBF7ZZ, 0UBF8ZZ	Excision/Destruction cul-de-sac lesion
CPT codes	
56303	Laparoscopy with excision of ovary or peritoneum
56307	Laparoscopic oophorectomy ± salpingectomy
56308	Laparoscopy and vaginal hysterectomy ± salpingo-oophorectomy
57531	Para-aortic lymph node sampling ± salpingo-oophorectomy
58150	TAH ± salpingo-oophorectomy
58152	TAH with colpo-urethrocystopexy ± salpingo-oophorectomy
58180	Subtotal hysterectomy ± salpingo-oophorectomy
58200	TAH with para-aortic and pelvic lymph node sampling ± salpingo-oophorectomy
58210	Radical hysterectomy

(*continued on next column*)

eAppendix 4. Any Ovarian Cancer Surgery Coding Definitions (cont.)	
Billing Codes for Surgery	
CPT codes (cont.)	
58240	Pelvic exenteration, including colostomy
58262	Vaginal hysterectomy ± salpingo-oophorectomy
58263	Vaginal hysterectomy with repair of enterocele ± salpingo-oophorectomy
58720	Salpingo-oophorectomy, complete or partial, unilateral or bilateral
58920	Wedge resection of ovary
58940	Oophorectomy, partial or total, unilateral or bilateral
58943	Oophorectomy, partial or total, unilateral or bilateral; for ovarian malignancy, with para-aortic and pelvic lymph node biopsies, peritoneal washings, peritoneal biopsies, diaphragmatic assessment, with or without salpingectomy(s), with or without omentectomy
58950	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy
58951	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with abdominal hysterectomy, pelvic and limited para-aortic lymphadenectomy
58952	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with radical dissection for debulking
58953	Bilateral salpingo-oophorectomy with omentectomy, TAH and radical dissection for debulking
58954	Bilateral salpingo-oophorectomy with omentectomy, TAH and radical dissection for debulking, with pelvic lymphadenectomy and limited para-aortic lymphadenectomy
58960	Laparotomy for staging or restaging of ovarian, tubal or primary peritoneal malignancy (second look) with or without omentectomy, peritoneal washing, biopsy of abdominal and pelvic peritoneum, diaphragmatic assessment with pelvic and limited per-aortic lymphadenectomy

Abbreviation: TAH, total abdominal hysterectomy.

eAppendix 5. Coding Definitions for Guideline-Concordant Surgery and "Possible" Guideline-Concordant Surgery

Guideline-concordant surgery: high confidence that surgery met guideline recommendations	
CPT Codes	
58943	Oophorectomy, partial or total, unilateral or bilateral; for ovarian malignancy, with para-aortic and pelvic lymph node biopsies, peritoneal washings, peritoneal biopsies, diaphragmatic assessment ± salpingectomy(s) ± omentectomy
58950	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy
58951	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with abdominal hysterectomy, pelvic and limited para-aortic lymphadenectomy
58952	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with radical dissection for debulking
58953	Bilateral salpingo-oophorectomy with omentectomy, TAH and radical dissection for debulking
58954	Bilateral salpingo-oophorectomy with omentectomy, TAH and radical dissection for debulking, with pelvic lymphadenectomy and limited para-aortic lymphadenectomy
58960	Laparotomy for staging or restaging of ovarian, tubal or primary peritoneal malignancy (second look) with or without omentectomy, peritoneal washing, biopsy of abdominal and pelvic peritoneum, diaphragmatic assessment with pelvic and limited per-aortic lymphadenectomy
SEER primary site surgical codes	
55–57, 70–74	
POSSIBLE guideline-concordant surgery: it is possible that surgical treatment adhered to guidelines, but codes are not specific enough to be sure	
SEER primary site codes	
25–54, 58–69, 75–80	
CPT codes	**Green code is sufficient alone** **If no green CPT code and stage IIIC–IV: require yellow code OR orange code** **If no green CPT code and stage <IIIC: require yellow code AND orange code**
56303	Laparoscopy with excision of ovary or peritoneum
56307	Laparoscopic oophorectomy ± salpingectomy
57531	Para-aortic lymph node sampling ± salpingo-oophorectomy
58200	TAH with para-aortic and pelvic lymph node sampling ± salpingo-oophorectomy
58240	Pelvic exenteration, including colostomy
58720	Salpingo-oophorectomy, complete or partial, unilateral or bilateral
58920	Wedge resection of ovary
58940	Oophorectomy, partial or total, unilateral or bilateral
58943	Oophorectomy, partial or total, unilateral or bilateral; for ovarian malignancy, with para-aortic and pelvic lymph node biopsies, peritoneal washings, peritoneal biopsies, diaphragmatic assessment ± salpingectomy(s) ± omentectomy
58950	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy
58951	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with TAH, pelvic and limited para-aortic lymphadenectomy
58952	Resection of ovarian malignancy with bilateral salpingo-oophorectomy and omentectomy, with radical dissection for debulking
58953	Bilateral salpingo-oophorectomy with omentectomy, TAH, and radical dissection for debulking
58954	Bilateral salpingo-oophorectomy with omentectomy, TAH, and radical dissection for debulking, with pelvic lymphadenectomy and limited para-aortic lymphadenectomy
58960	Laparotomy for staging or restaging of ovarian, tubal, or primary peritoneal malignancy (second look) ± omentectomy, peritoneal washing, biopsy of abdominal and pelvic peritoneum, diaphragmatic assessment with pelvic and limited per-aortic lymphadenectomy

(*continued on next page*)

eAppendix 5. Coding Definitions for Guideline-Concordant Surgery and "Possible" Guideline-Concordant Surgery (cont.)	
56308	Laparoscopy and vaginal hysterectomy ± salpingo-oophorectomy
58150	TAH ± salpingo-oophorectomy
58152	TAH with colpo-urethrocystopexy ± salpingo-oophorectomy
58180	Subtotal hysterectomy ± salpingo-oophorectomy
58210	Radical hysterectomy
ICD-9-PCS codes	**Require a yellow code plus a blue code; green code is sufficient alone**
54.4*	Omentectomy
65.2*	Wedge resection or partial excision of ovary
65.3*	Unilateral oophorectomy
65.4*	Bilateral oophorectomy
65.51–65.54	Other removal of ovaries
65.6*	Bilateral salpingo-oophorectomy
68.8*	Pelvic exenteration
ICD-10-PCS codes	**Require a yellow code and a blue code**
0D5U*, 0DBU*	Destruction/Excision of omentum
0D5V*, 0DBV*	Destruction/Excision of mesentery
0DTU*	Resection of omentum
0UT2*	Resection of bilateral ovaries
0UT0*	Resection–right ovary
0UT1*	Resection–left ovary

Abbreviation: TAH, total abdominal hysterectomy.

eAppendix 6. Codes for Any Systemic Therapy and Recommended Systemic Therapies

Any systemic therapy	**CPT:** 964xx, 965xx, Q0083–Q0085, G0355–G0362, J8530–J8999 and J9xxx **ICD-9 and ICD-10 procedure codes:** V58.1, V66.2, V62.7, E9331, E9307, 99.25 Z5111, Z5112, Z5189, 3E03305, 3E04305, XW03351, XW033B3, XW033C3, XW04351, XW043B3, XW043C3
Intraperitoneal chemotherapy	**CPT:** 96445
Platinum doublets	
Carboplatin or cisplatin	**CPT:** J9045, J9062, J9060, C9418 **NDC**: 477810605, 477810606, 477810604, 000153210, 000153211, 000153212, 000153213, 000153214, 000153215, 000153216, 551500386, 167290295, 477810603, 007034239, 007034244, 007034246, 007034248, 572770105, 572770106, 572770107, 633230172, 674570491, 674570492, 674570493, 674570494, 674570608, 694480005, 007033249, 250210202, 473350150, 473350151, 473350284, 507420445, 507420446, 507420447, 507420448, 617030339, 667580047, 680830190, 680830191, 680830192, 680830193, 712880100, 617030360, 674570424, 674570425, 708600206, 000690081, 000690084, 007035747, 007035748, 167290288, 445670509, 445670510, 445670511, 477810609, 477810610, 611260003, 611260004, 633230103, 680010283, 680830162, 680830163, 445670530, 000153070, 000153072
Second agents for platinum doublets	**CPT:** C9127, C9431, J9264, J9265, J9267, J9170, J9171, J9091, J9070, J9092, J9080, J9090, C9420, C9421, J9093, J9094, J9095, J9096, J9097, J8530, J9201, J9350, J8705, J9351, J9000, C9415, J9002, Q2048, Q2049, Q2050, J9001 **NDC:** 477810593, 477810594, 477810595, 459630613, 007034764, 007033216, 007033217, 007033213, 007033218, 167140137, 695390158, 695390159, 695390157, 708600215, 722050063, 722050062, 722050061, 000690076, 000690078, 000690079, 007034766, 007034767, 007034768, 250210213, 445670504, 445670505, 445670506, 519910937, 519910938, 553900114, 553900304, 553900314, 617030342, 633230763, 667580043, 674570434, 674570449, 674570471, 680830178, 680830179, 680830180, 688170134, 708600200, 701211221, 701211222, 701211223, 430660001, 430660006, 430660010, 435980389, 473350323, 473350895, 473350939, 724850216, 724850215, 724850214, 712880143, 712880144, 712880150, 712880151, 000699144, 004090369, 674570531, 674570532, 674570781, 690970369, 690970371, 001439204, 001439205, 000699141, 000699142, 000758001, 004090201, 004097870, 004090365, 004091732, 004094235, 004095068, 551500378, 551500379, 551500380, 680830401, 680830400, 680830399, 707000176, 707000175, 707000174, 000758003, 000758004, 000758005, 004090366, 004090367, 004090368, 007035720, 007035730, 009551020, 009551021, 009551022, 167140465, 167140500, 167290120, 167290228, 167290231, 167290267, 250210222, 398222120, 398222180, 398222200, 423670121, 435980258, 435980259, 435980610, 435980611, 459630734, 459630765, 459630781, 459630790, 578843021, 637390932, 637390971, 667580050, 667580950, 250210245, 473350285, 507420428, 507420431, 507420463, 701211240, 701211239, 701211238, 548790022, 548790021, 439750308, 439750307, 000150502, 167140857, 167140858, 167140859, 507420519, 507420520, 625590930, 625590931, 680010442, 680010443, 680010444, 726030104, 726030411, 726030326, 680010370, 680010371, 680010372, 690970516, 690970517, 100190982, 100190984, 708600218, 000540382, 000540383, 000544129, 000544130, 007813233, 007813244, 007813255, 100190935, 100190936, 100190937, 100190938, 100190939, 100190942, 100190943, 100190944, 100190945, 100190955, 100190956, 100190957, 100190988, 100190989, 100190990, 548685005, 548685218, 691890382, 691890383, 000150505, 000150503, 000150504, 000150506, 167290391, 167290419, 167290423, 605056113, 605056114, 605056115, 674570616, 674570617, 674570618, 680010359, 680010350, 680010348, 680010342, 167140909, 167140930, 250210239, 507420496, 507420497, 507420498, 633230102, 637593028, 637593029, 627560008, 627560073, 627560102, 627560219, 627560321, 627560438, 627560533, 627560614, 627560746, 627560974, 712880113, 712880114, 459630623, 459630624, 459630636, 167290426, 724850221, 724850222, 724850223, 000027501, 004090181, 004090182, 004090183, 004090185, 004090187, 250210209, 250210234, 250210235, 422360001, 422360002, 459630612, 459630619, 459630620, 551110686, 551110687, 633230125, 633230126, 708600204, 708600205, 712880117, 007035775, 007035778, 000027502, 000693857, 000693858, 000693859, 004090186, 005913562, 005913563, 007813282, 007813283, 167290092, 167290117, 167290118, 231550213, 231550214, 231550483, 231550484, 231550528, 231550529, 250210208, 473350153, 473350154, 553900391, 674570462, 674570463, 674570464, 680010282, 680830148, 680830149, 690970313, 690970314, 001439394, 001439395, 674570662, 167290243, 000780672, 000780673, 004090302, 507420404, 007034714, 250210236, 667580051, 000780674, 167290151, 250210206, 250210824, 459630615, 553900370, 627560023, 633230762, 664350410, 674570474, 000074205, 000074207, 000690075, 000074201, 001439275, 001439277, 435980682, 435980683, 477810256, 680010345, 553900237, 553900238, 167140001, 493150008, 493150009, 001439092, 001439093, 726030103, 726030200, 000690170, 000690171, 000693030, 000693034, 674570394, 701211218, 003380067, 003380063, 003380080, 003380086, 707101530, 707101531, 000131116, 000131136, 000131146, 000131156, 000131176, 000131266, 000131286, 000153352, 000153353, 680010492, 680010493, 000693031, 000693032, 000693033, 000694004, 000694015, 000694026, 000694030, 000694031, 000694032, 000694033, 000694034, 000694037, 001439546, 001439547, 001439548, 001439549, 004090124, 007035040, 007035043, 007035046, 167140742, 167140856, 250210207, 435980283, 435980541, 459630733, 473350049, 473350050, 473350082, 473350083, 531500314, 531500315, 531500317, 531500320, 596760960, 596760966, 627560826, 627560827, 633230101, 633230883, 674570393, 674570395, 674570396, 674570436, 674570478, 680830248, 680830249, 680830250, 701211219
Etoposide	**CPT:** J9181, J9182, C9425, J8560, C9414 **NDC:** 007035657, 633230104, 680010265, 000153404, 003783266, 007035653, 007035656, 167290114, 167290262, 553900291, 553900292, 553900293, 553900491, 553900492, 553900493
Bleomycin	**CPT:** C9417, J9040 **NDC:** 674570424, 674570425, 708600206, 000690081, 000690084, 007035747, 007035748, 167290288, 445670509, 445670510, 445670511, 477810609, 477810610, 611260003, 611260004, 633230103, 680010283, 680830162, 680830163, 445670530, 000153070, 000153072