

Supplemental online content for:

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

Mary Katherine Montes de Oca, MD; Lauren E. Wilson, PhD; Rebecca A. Previs, MD; Anjali Gupta; Ashwini Joshi, MPH; Bin Huang, PhD; Maria Pisu, PhD; Margaret Liang, MD; Kevin C. Ward, PhD; Maria J. Schymura, PhD; Andrew Berchuck, MD; and Tomi F. Akinyemiju, PhD

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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.

^aReference category is no surgery received that met minimum recommendation (high confidence).

Table 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	<p>The Charlson-Deyo comorbidity will be created during the baseline period based on the following score:</p> <ul style="list-style-type: none"> • 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	<p>ICD-9-CM codes: 410.*, 412.* ICD-10-CM codes: I21.*, I22.*, I25.2*</p>
Congestive heart failure	<p>ICD-9-CM codes: 398.01, 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.*</p>
Peripheral vascular disease	<p>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</p>
Hypertension	<p>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*</p>
Dementia	<p>ICD-9-CM codes: 290.*, 294.1*, 331.2* ICD-10-CM codes: F01.*, F02.*, F03.9*, G31.1*</p>
Cerebrovascular disease	<p>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.*</p>
Chronic pulmonary disease	<p>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*</p>
Rheumatologic disease	<p>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*</p>
Peptic ulcer disease	<p>ICD-9-CM codes: 531.*, 532.*, 533.*, 534.* ICD-10-CM codes: K25.*, K26.*, K27.*, K28.*</p>
Mild liver disease	<p>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*</p>
Diabetes (mild to moderate)	<p>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*</p>
Hemiplegia or paraplegia	<p>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*</p>
ESRD	585.6, N18.6 or ESRD eligibility flag
Diabetes with complication	<p>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</p>
Moderate or severe liver disease	<p>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*</p>
AIDS	<p>ICD-9-CM codes: 042.*, 043.*, 044.* ICD-10-CM codes: B20.*</p>

Abbreviation: ESRD, end-stage renal disease.

Appendix 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

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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 0UBF0ZZ, 0UBF3ZZ, 0UBF4ZZ, 0UBF7ZZ, 0UBF8ZZ, 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	<p>CPT: 964xx, 965xx, Q0083–Q0085, G0355–G0362, J8530–J8999 and J9xxx</p> <p>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</p>
Intraperitoneal chemotherapy	<p>CPT: 96445</p>
Platinum doublets	
Carboplatin or cisplatin	<p>CPT: J9045, J9062, J9060, C9418</p> <p>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</p>
Second agents for platinum doublets	<p>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</p> <p>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, 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</p>
Etoposide	<p>CPT: J9181, J9182, C9425, J8560, C9414</p> <p>NDC: 007035657, 633230104, 680010265, 000153404, 003783266, 007035653, 007035656, 167290114, 167290262, 553900291, 553900292, 553900293, 553900491, 553900492, 553900493</p>
Bleomycin	<p>CPT: C9417, J9040</p> <p>NDC: 674570424, 674570425, 708600206, 000690081, 000690084, 007035747, 007035748, 167290288, 445670509, 445670510, 445670511, 477810609, 477810610, 611260003, 611260004, 633230103, 680010283, 680830162, 680830163, 445670530, 000153070, 000153072</p>