Title
Impact of race, socioeconomic status, and the health care system on the treatment of advanced-stage ovarian cancer in California

Permalink
https://escholarship.org/uc/item/4hj0b86v

Journal
American Journal of Obstetrics and Gynecology, 212(4)

ISSN
0002-9378

Authors
Long, Beverly
Chang, Jenny
Ziogas, Argyrios
et al.

Publication Date
2015-04-01

DOI
10.1016/j.ajog.2014.10.1104

Copyright Information
This work is made available under the terms of a Creative Commons Attribution License, available at https://creativecommons.org/licenses/by/4.0/

Peer reviewed
Impact of race, socioeconomic status, and the health care system on the treatment of advanced-stage ovarian cancer in California

Beverly Long, MD; Jenny Chang, MPH; Argyrios Ziogas, PhD; Krishnansu S. Tewari, MD; Hoda Anton-Culver, PhD; Robert E. Bristow, MD, MBA

OBJECTIVE: We sought to investigate the impact of race, socioeconomic status (SES), and health care system characteristics on receipt of specific components of National Comprehensive Cancer Network guideline care for stage IIIC/IV ovarian cancer.

STUDY DESIGN: Patients diagnosed with stage IIIIC/IV epithelial ovarian cancer between Jan. 1, 1996, through Dec. 31, 2006, were identified from the California Cancer Registry. Multivariate logistic regression analyses evaluated differences in surgery, chemotherapy, and treatment sequence according to race, increasing SES (SES-1 to SES-5), and provider annual case volume.

RESULTS: A total of 11,865 patients were identified. Median age at diagnosis was 65.0 years. The overall median cancer-specific survival was 28.2 months. African American race (odds ratio [OR], 2.04; 95% confidence interval [CI], 1.45–2.87) and care by a low-volume physician (OR, 19.72; 95% CI, 11.87–32.77) predicted an increased risk of not undergoing surgery. Patients with SES-1 (OR, 0.71; 95% CI, 0.60–0.85) and those treated at low-volume hospitals (OR, 0.88; 95% CI, 0.77–0.99) or by low-volume physicians (OR, 0.80; 95% CI, 0.70–0.92) were less likely to undergo debulking surgery. African American race (OR, 1.55; 95% CI, 1.24–1.93) and SES-1 (OR, 1.80; 95% CI, 1.35–2.39) were both significant predictors of not receiving chemotherapy. African American patients were also more likely than whites to receive no treatment (OR, 2.08; 95% CI, 1.45–2.99) or only chemotherapy (OR, 1.55; 95% CI, 1.10–2.18). Patients with low SES were more likely to receive no treatment (OR, 1.95; 95% CI, 1.44–2.64) or surgery without chemotherapy (OR, 1.67; 95% CI, 1.38–2.03).

CONCLUSION: Among patients with advanced-stage ovarian cancer, African American race, low SES, and treatment by low-volume providers are significant and independent predictors of receiving no surgery, no debulking surgery, no chemotherapy, and nonstandard treatment sequences.

Key words: disparities, ovarian cancer, race, socioeconomic status

Ovarian cancer is the second most common gynecologic cancer in the United States, with >22,000 cases diagnosed each year.1 Because most patients present with advanced disease, >14,000 deaths are attributed to ovarian cancer annually. Significant survival gains have followed the widespread adoption of cytoreductive surgery and combined chemotherapy regimens, but improvements have not been distributed equally among races or socioeconomic categories. While 5-year survival in white women with ovarian cancer increased from 37-43% from 1975 through 2006, 5-year survival among African American patients decreased from 43-37% over the same time period.2 Although biologic, socioeconomic, and cultural differences have been cited as reasons for this disparity, the widening survival gap suggests that African American patients have not benefited from recent improvements in ovarian cancer care, and it highlights treatment factors as important contributors to the survival disparity. Previous studies have found that African American patients with ovarian cancer are less likely to receive primary cytoreductive surgery, appropriate chemotherapy, and National Comprehensive Cancer Network (NCCN) guideline—adherent care.3,4 However, the specific deviations from recommended treatment programs have not been well defined. The objective of this study was to examine disparities in the quality of ovarian cancer care across a large, statewide population, as well as to identify specific treatment components that contribute to the receipt of...
nonstandard therapy in patients with advanced-stage ovarian cancer.

**Materials and Methods**

This was a retrospective population-based case study of primary invasive epithelial ovarian cancers reported to the California Cancer Registry from Jan. 1, 1996, through Dec. 31, 2006. The study received exempt status from the Institutional Review Board of the University of California, Irvine (Human Subjects #2011-8317). The California Cancer Registry is a standardized, quality-controlled population-based cancer surveillance registry that has collected information about tumor characteristics, patient characteristics, diagnosis, and treatment for all cancers diagnosed in California since 1988. Case reporting in the state is estimated to be 99%, and follow-up completion rates are >95%. International Classification of Diseases for Oncology, Second Edition was used to identify tumor location and histology. Cases were identified using the ovarian Surveillance, Epidemiology, and End Results Program (SEER) primary site code (C569).

The study population consisted of women at least 18 years of age who were diagnosed with primary advanced-stage epithelial ovarian cancer from Jan. 1, 1996, through Dec. 31, 2006. There were 21,044 incident ovarian cancer cases identified during the time period with follow-up continuing through January 2008. After sequentially excluding borderline tumors; germ-cell tumors; sex cord tumors; cases with missing International Classification of Diseases for Oncology, Second Edition morphology codes; cases prepared solely from autopsy or death certificates; and cases with unknown or incomplete surgery, chemotherapy, or hospital information, 18,327 cases of all stages remained. As this study included only patients with stage IIIC or IV ovarian cancer, a total of 11,865 cases were finally analyzed.

Explanatory variables included patient, tumor, and health care provider characteristics. Race/ethnicity was categorized into 4 groups: white, African American, Hispanic, and Asian/Pacific Island. Patient insurance type was grouped into 4 categories: private insurance (managed care, health maintenance organization, preferred provider organization, or other private insurance), Medicaid, Medicare, or other insurance type. Socioeconomic status (SES) was classified into 5 categories: lowest, lower-middle, middle, higher-middle, and highest SES based on quintiles of Yost’s index of socioeconomic status (YOSTSCL) score. Age at diagnosis was used as either a continuous variable or categorical variable with groups including those age <45, 45-54, 55-69, and ≥70 years.

Hospital volume was derived based on the average number of ovarian cancer cases treated at each hospital annually. Hospitals with ≥20 cases per year were classified as high-volume hospitals; hospitals with <20 cases per year were low volume. Physician volume was derived from the average number of cases treated annually by each physician (surgeon, medical oncologist, or attending physician). Physicians involved in ≥10 cases per year were considered high volume.

Outcome variables included the concordance of surgery type, chemotherapy type, and treatment sequence with NCCN treatment guidelines. Surgery type was classified as follows: no surgery, oophorectomy with or without hysterectomy, oophorectomy with omentectomy, and/or debulking surgery. Chemotherapy type was categorized into 4 groups including multiple-agent chemotherapy, single-agent chemotherapy, no chemotherapy despite recommendation, and no chemotherapy for other reason. Treatment sequence had 6 categories: surgery and adjuvant chemotherapy, neo-adjuvant chemotherapy and surgery, surgery and chemotherapy in unknown sequence, surgery only, chemotherapy only, and no surgery or chemotherapy.

Differences among treatment groups (surgery, chemotherapy, and treatment sequence) were analyzed with $\chi^2$ or Fisher exact test. A multinomial logistic regression model was used to perform multivariate analysis for outcomes with >2 categories. The guideline-adherent treatment category was used as the referent for each outcome variable, and binary logistic regression was performed for this outcome. Race and SES were interpreted as independent variables, as interaction terms for these variables were not significant.

**Results**

**Population characteristics**

Patient, tumor, and provider characteristics are shown in Table 1. Overall, 11,865 patients were included. A total of 7272 patients (61.3%) had stage IIIC disease, while 4593 (38.7%) had stage IV disease. White patients accounted for 71.7% of cases, followed in frequency by Hispanics (15.3%), Asian/Pacific Islanders (8.3%), and African American (4.7%). Despite a small percentage of minority patients, sample sizes were sufficient for analysis. Median age at diagnosis was 65.0 years (18-104 years). Private insurance was the most common payer category (47.7%), while 32.5% of patients had Medicare. Patient distribution across socioeconomic quintiles was relatively even. SES-1 was slightly underrepresented, accounting for only 13.0% of the study population. Most patients were treated at low-volume hospitals (82.1%) and by low-volume providers (61.9%). The median cancer-specific survival for all patients was 28.2 months.

**Surgery**

Table 2 presents patient, tumor, and provider characteristics stratified by surgery type. Overall, 25% of patients received no surgery for advanced-stage ovarian cancer, although African American race was associated with an increased likelihood of not undergoing surgery. Among African American patients, 37.3% did not undergo surgery compared to 23.8% for whites, 25.4% for Hispanics, and 26.0% for Asian/Pacific Islanders. Multinomial logistic regression analysis revealed that African American patients experienced a 2-fold increase in the risk of no surgery (odds ratio [OR], 2.04; 95% confidence interval [CI], 1.45–2.87) and were 50% more likely than whites to undergo only resection of the primary tumor with or without hysterectomy (OR, 1.49; 95%
CI, 1.02—2.18). Patients in the lowest SES category (SES-1) received no surgery in 30.4% of cases compared to 19.4% for patients in the highest SES category (SES-5), although these values were not statistically significant. SES-1 patients were significantly less likely than SES-5 patients to receive debulking surgery (OR, 0.71; 95% CI, 0.60—0.85).

The frequency of debulking surgery was also correlated with race and SES. African American patients underwent debulking surgery in just 38.7% of cases compared to 51.1% of cases for whites, 43.7% for Hispanics, and 44.7% for Asian/Pacific Islanders. Among patients in the highest SES category (SES-5), 55.6% underwent cytoreductive surgery. In the lowest SES category (SES-1), just 39.7% underwent debulking (OR, 0.71; 95% CI, 0.60—0.85). Hispanics (OR, 0.86; 95% CI, 0.74—0.99) and Asian/Pacific Islanders (OR, 0.79; 95% CI, 0.66—0.94) were also significantly less likely to undergo debulking surgery.

Both low-volume hospitals (OR, 0.88; 95% CI, 0.77—0.99) and low-volume physicians (OR, 0.80; 95% CI, 0.70—0.92) were significantly associated with lower rates of debulking surgery. The likelihood of receiving no surgery was also increased almost 20-fold for low-volume physicians (OR, 19.72; 95% CI, 11.87—32.77). Patient insurance status was not associated with the likelihood of receiving surgery.

**Chemotherapy**

When compared to whites, African American patients were significantly more likely to receive no chemotherapy (OR, 1.55; 95% CI, 1.24—1.93) or single-agent chemotherapy (OR, 1.42; 95% CI, 1.04—1.93). Of African American patients, 28% were found to have received no chemotherapy with “other” reason supplied, while only 4.6% of African American patients (compared to 6.7% of whites and 7.2% of Asian/Pacific Islanders) did not receive chemotherapy despite practitioner recommendation (Table 3).

There was a statistically significant inverse linear relationship between SES quintile and nonreceipt of chemotherapy. SES-1 had the highest risk of

| TABLE 1 Population characteristics |
|-------------------------------|-------------|-------|
| Characteristic               | n   | %   |
| Total                        | 11,865 | 100  |
| Race                         |       |      |
| White                        | 8509  | 71.7 |
| African American             | 561   | 4.7  |
| Hispanic                     | 1813  | 15.3 |
| Asian/Pacific Islander       | 982   | 8.3  |
| Insurance                    |       |      |
| Private                      | 5660  | 47.7 |
| Medicaid                     | 986   | 8.3  |
| Medicare                     | 3853  | 32.5 |
| Other                        | 1366  | 11.5 |
| SES                          |       |      |
| Lowest                       | 1545  | 13   |
| Lower-middle                 | 2156  | 18.2 |
| Middle                       | 2508  | 21.1 |
| Higher-middle                | 2769  | 23.3 |
| Highest                      | 2887  | 24.3 |
| Age, y                       |       |      |
| <45                          | 1043  | 8.8  |
| 45—54                        | 2083  | 17.6 |
| 55—69                        | 4214  | 35.5 |
| ≥70                          | 4525  | 38.1 |
| Stage                        |       |      |
| IIIC                         | 7272  | 61.3 |
| IV                           | 4593  | 38.7 |
| Grade                        |       |      |
| I                            | 348   | 2.9  |
| II                           | 1573  | 13.3 |
| III                          | 5028  | 42.4 |
| IV                           | 1249  | 10.5 |
| Not stated                   | 3667  | 30.9 |
| Histology                    |       |      |
| Serous                       | 5789  | 48.8 |
| Mucinous                     | 419   | 3.5  |
| Endometrioid                 | 644   | 5.4  |
| Clear cell                   | 322   | 2.7  |
| Adenocarcinoma, NOS          | 1988  | 16.8 |
| Other                        | 2703  | 22.8 |

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015. (continued)
not receiving chemotherapy despite provider recommendations (OR, 1.80; 95% CI, 1.35–2.39) and not receiving chemotherapy for “other” reasons (OR, 1.67; 95% CI, 1.40–1.99). Low-volume hospitals were also associated with increased likelihood of receiving no chemotherapy for “other” reason (OR, 1.77; 95% CI, 1.53–2.05), no chemotherapy despite recommendations (OR, 1.55; 95% CI, 1.23–1.96), or single-agent chemotherapy (OR, 1.49; 95% CI, 1.24–1.8). Patients treated by low-volume physicians were also more likely to receive no chemotherapy for “other” reason (OR, 1.29; 95% CI, 1.10–1.50), although there was no association with single-agent chemotherapy or nonreceipt of chemotherapy when it was recommended.

Treatment sequence

Order of treatments also differed by race and SES (Table 4). African American patients were more than twice as likely to receive no treatment (OR, 2.08; 95% CI, 1.45–2.99) compared to white patients. A treatment program consisting of only chemotherapy was significantly more likely for African American (OR, 1.55; 95% CI, 1.10–2.18) or Hispanic (OR, 1.34; 95% CI, 1.07–1.68) patients. Hispanic patients were also significantly more likely to be treated with neoadjuvant chemotherapy (OR, 1.22; 95% CI, 1.01–1.48).

There were statistically significant relationships between SES classification and treatment regimens, as well. Patients in the lowest SES quintile were almost twice as likely to undergo no treatment (OR, 1.95; 95% CI, 1.44–2.64) and 67% more likely to undergo surgery without chemotherapy (OR, 1.67; 95% CI, 1.38–2.03) compared to patients in the highest SES quintile.

Low-volume hospital status was significantly associated with all non-standard treatment sequences: no treatment (OR, 1.59; 95% CI, 1.21–2.08), only surgery (OR, 1.94; 95% CI, 1.67–2.26), only chemotherapy (OR, 1.41; 95% CI, 1.13–1.76), and neoadjuvant chemotherapy (OR, 1.42; 95% CI, 1.19–1.69). Similarly, care by a low-volume physician was associated with a 15-fold increase in the likelihood of no treatment (OR, 15.66; 95% CI, 8.34–29.41).

Comment

Due to aggressive surgical debulking and combined chemotherapy regimens, ovarian cancer survival in the general population has shown steady improvement over the last several decades. Conversely, multiple population-based analyses have shown a decline in survival rates for African American patients during the same time period. Later stage at diagnosis and other biologic factors have been studied as sources of this survival disparity; however, recent studies have shown that differences in quality of care may substantially contribute to the survival gap.
| Characteristics         | No surgery |          |          | Removal of ovary +/- hysterectomy |          |          | Oophorectomy with omentectomy |          |          | Debulking |          |          |
|-------------------------|------------|----------|----------|----------------------------------|----------|----------|-------------------------------|----------|----------|-----------|----------|----------|
|                         | n          | %        | OR       | 95% CI                           | n        | %        | OR                           | 95% CI   |          | n         | %        | OR       | 95% CI   |          |          | n         | %        | OR       | 95% CI   |
| Total                   | 2905       | 25       |          |                                  | 805      | 7        |          |                                  | 2314     | 19       | 5796      | 49       |          |          |          |          |          |
| Race                    |            |          |          |                                  |          |          |          |                                  |          |          |          |          |          |          |          |          |          |
| White                   | 2025       | 23.8     | 1.00     |                                  | 539      | 6.3      | 1.00   |                                  | 1598     | 18.8     | 4347      | 51.1     | 1.00     |          |          |          |          |
| African American        | 209        | 37.3     | 2.04     | 1.45                              | 45       | 8.0      | 1.49   | 1.02                              | 90       | 16       | 217       | 38.7     | 0.99     | 0.76     | 1.28     |          |          |
| Hispanic                | 461        | 25.4     | 1.08     | 0.87                              | 154      | 8.5      | 1.10   | 0.88                              | 405      | 22.3     | 793       | 43.7     | 0.86     | 0.74     | 0.99     |          |          |
| Asian/Pacific Islander  | 255        | 26       | 1.14     | 0.87                              | 67       | 6.8      | 0.87   | 0.65                              | 67       | 6.8      | 221       | 22.5     | 439      | 44.7     | 0.79     | 0.66     | 0.94     |
| Socioeconomic status    |            |          |          |                                  |          |          |          |                                  |          |          |          |          |          |          |          |          |          |
| Lowest SES              | 469        | 30.4     | 1.06     | 0.82                              | 117      | 7.6      | 1.00   | 0.75                              | 345      | 22.3     | 614       | 39.7     | 0.71     | 0.60     | 0.85     |          |          |
| Low-mid SES             | 613        | 28.4     | 1.19     | 0.94                              | 149      | 6.9      | 1.13   | 0.87                              | 400      | 18.6     | 994       | 46.1     | 0.95     | 0.81     | 1.11     |          |          |
| Middle SES              | 644        | 25.7     | 1.07     | 0.86                              | 183      | 7.3      | 1.18   | 0.92                              | 479      | 19.1     | 1202      | 47.9     | 0.90     | 0.78     | 1.05     |          |          |
| High-mid SES            | 663        | 23.9     | 0.98     | 0.79                              | 190      | 6.9      | 1.11   | 0.87                              | 543      | 19.6     | 1373      | 49.6     | 0.89     | 0.77     | 1.02     |          |          |
| Highest SES             | 561        | 19.4     | 1.00     |          | 166      | 5.7      | 1.00   |          | 5447     | 18.9     | 1613      | 55.9     | 1.00     |          |          |          |          |
| Stage                   |            |          |          |                                  |          |          |          |                                  |          |          |          |          |          |          |          |          |          |
| IIIC                    | 1036       | 14.2     | 1.00     |          | 539      | 7.4      | 1.00   |          | 1731     | 23.8     | 3966      | 54.5     | 1.00     |          |          |          |          |
| IV                      | 1914       | 41.7     | 4.02     | 3.46                              | 266      | 5.8      | 1.39   | 1.16                              | 583      | 12.7     | 1830      | 39.8     | 1.38     | 1.24     | 1.54     |          |          |
| Hospital volume         |            |          |          |                                  |          |          |          |                                  |          |          |          |          |          |          |          |          |          |
| High                    | 309        | 14.6     | 1.00     |          | 137      | 6.5      | 1.00   |          | 428      | 20.2     | 1245      | 58.8     | 1.00     |          |          |          |          |
| Low                     | 2641       | 27.1     | 1.16     | 0.94                              | 668      | 6.9      | 1.05   | 0.85                              | 1886     | 19.4     | 4551      | 46.7     | 0.88     | 0.77     | 0.99     |          |          |
| Physician volume        |            |          |          |                                  |          |          |          |                                  |          |          |          |          |          |          |          |          |          |
| High                    | 18         | 1.0      | 1.00     |          | 111      | 6.2      | 1.00   |          | 414      | 23.1     | 1248      | 69.7     | 1.00     |          |          |          |          |
| Low                     | 2214       | 30.2     | 19.7     | 11.9                             | 517      | 7.0      | 1.30   | 1.02                              | 1398     | 19.0     | 3212      | 43.8     | 0.80     | 0.70     | 0.92     |          |          |
| Unknown                 | 718        | 26.3     | 20.8     | 12.3                             | 177      | 6.5      | 1.19   | 0.90                              | 502      | 18.4     | 1336      | 48.9     | 0.94     | 0.80     | 1.10     |          |          |

CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.
### TABLE 3
Patient characteristics and multinomial logistic model by chemotherapy type

| Characteristic                  | No chemotherapy – “other” reason | No chemotherapy despite recommendation | Multiple agent chemotherapy | Single agent chemotherapy |
|---------------------------------|----------------------------------|----------------------------------------|----------------------------|---------------------------|
|                                 | n  | %  | OR | 95% CI | n  | %  | OR | 95% CI | n  | %  | OR | 95% CI | n  | %  |
| **Total**                       | 2482 | 21 |  |  | 757 | 6 |  |  | 1010 | 9 |  |  |  | 7616 | 64 |
| **Race**                        |     |    |    |        |     |    |    |        |     |    |    |        |     |    |
| White                           | 1748 | 20.5 | 1.00 |  | 571 | 6.7 | 1.00 |  | 741 | 8.7 | 1.00 |  | 5449 | 64 |
| African American                | 157 | 28.0 | 1.55 | 1.24 | 1.93 | 26 | 9.8 | 0.76 | 1.50 | 1.17 | 55 | 9.8 | 1.42 | 1.04 | 1.93 | 323 | 57.6 |
| Hispanic                        | 386 | 21.3 | 1.02 | 0.88 | 1.18 | 89 | 7.7 | 0.68 | 0.53 | 0.88 | 139 | 7.7 | 0.95 | 0.77 | 1.17 | 1199 | 66.1 |
| Asian/Pacific Islander          | 191 | 19.5 | 1.11 | 0.93 | 1.34 | 71 | 7.6 | 1.23 | 0.94 | 1.61 | 75 | 7.6 | 0.99 | 0.77 | 1.28 | 645 | 65.7 |
| **Socioeconomic status**        |     |    |    |        |     |    |    |        |     |    |    |        |     |    |
| Lowest SES                      | 397 | 25.7 | 1.67 | 1.40 | 1.99 | 104 | 6.7 | 1.80 | 1.35 | 2.39 | 130 | 8.4 | 1.11 | 0.87 | 1.42 | 914 | 59.2 |
| Low-mid SES                     | 498 | 23.1 | 1.33 | 1.14 | 1.56 | 171 | 7.9 | 1.73 | 1.36 | 2.21 | 155 | 7.2 | 0.83 | 0.67 | 1.03 | 1332 | 61.8 |
| Middle SES                      | 559 | 22.3 | 1.29 | 1.11 | 1.50 | 158 | 6.3 | 1.35 | 1.06 | 1.72 | 204 | 8.1 | 0.91 | 0.75 | 1.11 | 1587 | 63.3 |
| High-mid SES                    | 541 | 19.5 | 1.11 | 0.96 | 1.29 | 187 | 6.8 | 1.41 | 1.11 | 1.78 | 252 | 9.1 | 0.99 | 0.83 | 1.20 | 1789 | 64.6 |
| Highest SES                     | 487 | 16.9 | 1.00 |  |  | 137 | 4.7 | 1.00 |  |  | 269 | 9.3 | 1.00 |  |  | 1994 | 69.1 |
| **Stage**                       |     |    |    |        |     |    |    |        |     |    |    |        |     |    |
| IIIC                            | 1317 | 18.1 | 1.00 |  |  | 462 | 6.4 | 1.00 |  |  | 600 | 8.3 | 1.00 |  |  | 4893 | 67.3 |
| IV                              | 1165 | 25.1 | 1.21 | 1.09 | 1.34 | 295 | 6.4 | 0.89 | 0.76 | 1.05 | 410 | 8.9 | 1.09 | 0.94 | 1.25 | 2723 | 59.3 |
| **Hospital volume**             |     |    |    |        |     |    |    |        |     |    |    |        |     |    |
| High                            | 269 | 12.7 | 1.00 |  |  | 93 | 4.4 | 1.00 |  |  | 151 | 7.1 | 1.00 |  |  | 1606 | 75.8 |
| Low                             | 2213 | 22.7 | 1.77 | 1.53 | 2.05 | 664 | 6.8 | 1.55 | 1.23 | 1.96 | 859 | 8.8 | 1.49 | 1.24 | 1.80 | 6010 | 61.7 |
| **Physician volume**            |     |    |    |        |     |    |    |        |     |    |    |        |     |    |
| High                            | 259 | 14.5 | 1.00 |  |  | 83 | 4.6 | 1.00 |  |  | 155 | 8.7 | 1.00 |  |  | 1294 | 72.3 |
| Low                             | 1829 | 24.9 | 1.29 | 1.10 | 1.50 | 529 | 7.2 | 1.25 | 0.97 | 1.61 | 558 | 7.6 | 0.86 | 0.70 | 1.04 | 4425 | 60.3 |
| Unknown                         | 394 | 14.4 | 0.54 | 0.54 | 0.78 | 145 | 5.3 | 0.77 | 0.57 | 1.03 | 297 | 10.9 | 1.03 | 0.83 | 1.29 | 1897 | 69.4 |

CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

Long, NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.
### Table 4
Patient characteristics and multinomial logistic model by treatment sequence

| Characteristic                  | No treatment | Only surgery | Only chemotherapy | Surgery and chemotherapy, unknown sequence | Neoadjuvant chemotherapy and surgery | Surgery and adjuvant chemotherapy |
|--------------------------------|--------------|--------------|-------------------|--------------------------------------------|-------------------------------------|-----------------------------------|
|                                | n % OR 95% CI| n % OR 95% CI| n % OR 95% CI     | n % OR 95% CI                              | n % OR 95% CI                       | n % OR 95% CI                     |
| **Total**                      | 1281 11     | 1937 16      | 1418 12           | 193 2                                      | 1123 10                             | 5913 50                           |
| **Race**                       |             |              |                   |                                            |                                     |                                   |
| White                          | 889 10.4    | 1416 16.6    | 959 11.3          | 148 1.7                                    | 798 9.4                             | 4299 50.5                         |
| African American               | 95 16.9     | 87 15.5      | 93 16.6           | 4 0.7                                      | 45 8.0                              | 237 42.2                          |
| Hispanic                       | 190 10.5    | 240 13.2     | 23 1.3            | 193 10.6                                   | 883 48.7                            |                                   |
| Asian/Pacific Islander         | 107 10.9    | 126 12.8     | 18 1.8            | 87 8.9                                     | 494 50.3                            |                                   |
| Socioeconomic status           |             |              |                   |                                            |                                     |                                   |
| Lowest SES                     | 222 14.4    | 207 13.4     | 22 1.4            | 147 9.5                                    | 668 43.2                            |                                   |
| Low-mid SES                    | 273 12.7    | 288 13.4     | 35 1.6            | 185 8.6                                    | 984 45.6                            |                                   |
| Middle SES                     | 263 11.3    | 310 12.4     | 45 1.8            | 231 9.2                                    | 1211 48.3                           |                                   |
| High-mid SES                   | 287 10.4    | 432 15.6     | 44 1.6            | 248 9.0                                    | 1439 52.0                           |                                   |
| Highest SES                    | 216 7.5     | 407 14.1     | 47 1.6            | 312 10.8                                   | 1611 55.8                           |                                   |
| **Stage**                      |             |              |                   |                                            |                                     |                                   |
| IIIC                           | 447 6.1     | 485 6.7      | 140 1.9           | 586 8.1                                    | 4299 59.1                           |                                   |
| IV                             | 834 18.2    | 933 20.3     | 53 1.2            | 537 11.7                                   | 1614 35.1                           |                                   |
| Hospital volume                |             |              |                   |                                            |                                     |                                   |
| High                           | 114 5.4     | 173 8.2      | 16 0.8            | 187 8.8                                    | 1382 65.2                           |                                   |
| Low                            | 1167 12.0   | 1245 12.8    | 177 1.8           | 936 9.6                                    | 4531 46.5                           |                                   |
| Physician volume               |             |              |                   |                                            |                                     |                                   |
| High                           | 11 0.6      | 0 0          | 37 2.1            | 222 12.4                                   | 1197 66.8                           |                                   |
| Low                            | 1224 16.7   | 1124 15.3    | 116 1.6           | 626 8.5                                    | 3446 46.9                           |                                   |
| Unknown                        | 46 1.7      | 489 17.9     | 275 10.1          |                                            |                                     |                                   |

CI, confidence interval; n/a, not applicable; OR, odds ratio; SES, socioeconomic status.

Long, NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.
It is clear that quality of care is an important factor in ovarian cancer outcomes. Several retrospective studies associate optimal cytoreduction and platinum/taxane chemotherapy regimens with improved survival,\(^1\),\(^6\)-\(^8\) and a prior analysis of California Cancer Registry data by Bristow et al\(^9\) found decreased disease-specific survival (hazard ratio, 1.18; 95% CI, 1.07—1.32) in patients who received care not adherent to NCCN guidelines. Despite the importance of appropriate care, minority and low-SES patients are also less likely to receive care that conforms to NCCN guidelines. In a recent study by Bristow et al.\(^3\), African American race, Medicaid or uninsured status, and median household income of <$35,000/y were independently associated with lower rates of NCCN guideline—adherent care, and non-NCCN guideline—adherent care was an independent predictor of shorter overall survival. Still, specific aspects of treatment deviations within the context of NCCN ovarian cancer treatment guidelines have not been well defined. The objective of this study was to investigate differences in ovarian cancer—related surgical procedures, chemotherapy regimens, and treatment sequence according to racial and socioeconomic classification in women with stage IIIC/IV disease and identify which of these factors contribute to the observed deviations from guideline care.

Strengths of the current study include the large study population, the reliability of the California Cancer Registry, and the inclusion of a recent time period during which there were no major changes to treatment guidelines. Treatment during this time period is presumed to be homogenous, as it occurred prior to the addition of intraperitoneal chemotherapy was widely adopted in response to GOG-172. There are also several limitations. First, this was a retrospective study using a population-based data set. This type of data carries an inherent risk of election and reporting bias. We were also unable to control for unreported variables that could influence the likelihood of receiving recommended care. Such variables include the presence of medical comorbidities, the extent of initial disease, and cumulative chemotherapy dose and intensity. We were also unable to analyze the complexity of the surgical procedures, amounts of residual disease, or physician specialty, as this information is not recorded by the California Cancer Registry.

Despite these limitations, the current data offer several new observations that could account for the disparities in ovarian cancer survival. Race and SES are significantly and independently associated with specific treatment elements contributing to NCCN guideline care, and a linear association is noted between decreasing SES and an increasing risk of not receiving appropriate surgery or chemotherapy. Because debulking surgery is the cornerstone of modern ovarian cancer treatment, disparities in surgical care likely account for much of the survival gap in this disease. Our results show that African American patients are significantly less likely to undergo any surgery and more likely to undergo inappropriate surgery (ie, removal of an ovarian mass without staging or debulking). Lower SES was not associated with a statistically significant increase in the risk of not undergoing surgery for ovarian cancer, although patients classified as SES-1 were less likely to receive debulking surgery. While higher rates of comorbid conditions in African American and low-income patients could contribute to the decreased rate of surgical intervention in these groups, such conditions are unlikely to completely account for the disparities seen in this study. Both low SES and African American race were associated with nonreceipt of chemotherapy, although the strongest association was seen with decreasing SES. Decreased rates of chemotherapy seen in low-SES patients may be explained by lack of insurance funding for chemotherapy, as “other” payer status was the only payer group statistically associated with no chemotherapy despite provider recommendations.

While additional research is needed to further characterize the survival gap in ovarian cancer, the current study highlights several areas where survival gains could be made. Interventions should focus on improving access to high-volume providers and hospitals that provide NCCN guideline—adherent regimens. Further research should aim to define other reasons for deviation from guidelines, control for variation due to differences in medical comorbidities, and develop appropriate risk-adjusted measurement models.

REFERENCES

1. Siegel R, Naishadham D, Jemal A. Cancer statistics, 2013. CA Cancer J Clin 2013;63: 11-30.
2. Siegel R, Ward E, Brawley O, Jemal A. Cancer statistics, 2011: the impact of eliminating socioeconomic and racial disparities on premature cancer deaths. CA Cancer J Clin 2011;61: 212-36.
3. Bristow RE, Powell MA, Al-Hammadi N, et al. Disparities in ovarian cancer care quality and survival according to race and socioeconomic status. J Natl Cancer Inst 2013;105:823-32.
4. Chan JK, Zhang M, Hu JM, Shin JY, Osann K, Kapp DS. Racial disparities in surgical treatment and survival of epithelial ovarian cancer in United States. J Surg Oncol 2008;97:103-7.
5. State of California Department of Public Health. Cancer Reporting in California: Standards for Automated Reporting, in California Cancer Reporting System Standards, Vol I. Sacramento, CA: California Department of Health Services, Cancer Surveillance Section; 1997.
6. Cancer Reporting in California: Standards for Automated Reporting, in California Cancer Reporting System Standards, Vol. II. California Department of Health Services, Cancer Surveillance Section; 1997.
7. Cancer Reporting in California: Standards for Automated Reporting, in California Cancer Reporting System Standards, Vol. III. California Department of Health Services, Cancer Surveillance Section; 1997.
8. Parkin-Patul A, Allen M, Wright WE. Validation of self-reported cancers in the California teachers study. Am J Epidemiol 2003;157: 539-45.
9. Yost K, Perkins C, Cohen R, Morris C, Wright W. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. Cancer Causes Control 2001;12: 703-11.
10. Morgan RJ, Copeland L, Gershenson D, et al. Update of the NCCN ovarian cancer practice guidelines. Oncology 1997;11: 95-105.
11. Morgan R, Alvarez RD, Armstrong DK, et al. NCCN practice guidelines for ovarian cancer. Version 2000. National Comprehensive Cancer Network; 2000.
12. Morgan R, Alvarez RD, Armstrong DK, et al. Ovarian cancer guideline. Version 1.2002. Fort Washington, PA: National Comprehensive Cancer Network; 2002.

13. Morgan R, Alvarez RD, Armstrong DK, et al. Ovarian cancer. Version 1.2003. Fort Washington, PA: National Comprehensive Cancer Network; 2003.

14. Morgan R, Alvarez RD, Armstrong DK, et al. Ovarian cancer. Version 1.2005. Fort Washington, PA: National Comprehensive Cancer Network; 2005.

15. Parham G, Phillips JL, Hicks ML, et al. The National Cancer Data Base report on malignant epithelial ovarian carcinoma in African-American women. Cancer 1997;80:16-26.

16. Elatter A, Bryant A, Winter-Roach BA, Hatem M, Naik R. Optimal primary surgical treatment for advanced epithelial ovarian cancer. Cochrane Database Syst Rev 2011;8:CD00756.

17. McGuire WP, Hoskins WJ, Brady MF, et al. A phase III randomized study of cyclophosphamide and cisplatin versus paclitaxel and cisplatin in patients with suboptimal stage III and IV epithelial ovarian cancer. N Engl J Med 1996;334:106-15.

18. Ozols RF, Bundy BN, Greer BE, et al. Phase III trial of carboplatin and paclitaxel compared with cisplatin and paclitaxel in patients with optimally resected stage III ovarian cancer: a Gynecologic Oncology Group study. J Clin Oncol 2003;21:3194-200.

19. Bristow RE, Chang J, Ziegas A, Anton-Culver H. Adherence to treatment guidelines for ovarian cancer as a measure of quality care. Obstet Gynecol 2013;121:122.