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Article

ARTICLE

Quality of Care and Outcomes of Patients With Gynecologic Malignancies Treated at Safety-Net Hospitals

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Abstract

Background: Although safety-net hospitals (SNH) provide a valuable role serving vulnerable patients, the quality of gynecologic oncology care at these hospitals remains inadequately documented. We examined the quality of care at SNH for women with gynecologic cancers.
Methods: We used the National Cancer Database to identify hospitals that treated patients with uterine, ovarian, or cervical cancer from 2004 to 2015. Hospitals with the greatest proportion of uninsured patients or Medicaid beneficiaries were defined as SNH. Quality metrics were derived from evidence-based recommendations. Thirty-day mortality, readmission rates, and 5-year survival were calculated. Multivariable models were developed to determine the association between treatment at SNH and outcomes.
Results: Overall, 594 750 patients diagnosed with gynecologic cancer were treated at 1340 hospitals. Compared with non-SNH, patients at SNH were younger, more frequently racial minorities, low income, and had more aggressive histologies and advanced-stage tumors. SNH had lower rates of minimally invasive surgery for uterine cancer (62.3% vs 75.9%, $P < .0001$), debulking for ovarian cancer (83.6% vs 86.9%, $P < .05$), and lymph node assessment for all three cancer types ($P < .05$). Rates of chemotherapy for uterine and ovarian cancer was greater whereas concurrent chemoradiation for cervical cancer was lower ($P < .05$ for all). Thirty-day mortality and readmission rates were equivalent. Mortality was moderately worse for patients with stage IV ovarian cancer and stage II–III cervical cancer ($P < .05$) but were otherwise equivalent.
Conclusions: After adjusting for patient and tumor characteristics, women with gynecologic cancers treated at SNH receive lower-quality surgical care and equivalent medical care and a subset of these patients has modest decreases in survival.

Safety-net hospitals (SNH) play a critical role in the US health-care system by serving the most vulnerable patients and improving access to care. The National Academy of Medicine and Centers for Medicare and Medicaid Services (CMS) define these hospitals by the relative volume of uninsured or Medicaid patients (1). However, for incompletely understood reasons, likely a combination of patient risk factors, low resources, and management challenges, these hospitals often have inferior clinical outcomes (2–4). These outcomes have more recently come under scrutiny as reimbursement strategies designed to incentivize performance have gained traction and have been criticized for unfairly penalizing safety-net providers who are already under financial duress (5,6).

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A number of studies have suggested that, even when controlling for a more complex patient population, the quality of surgical care at SNH remains inferior to the care rendered at non-SNH (7). Patients at SNH less frequently undergo minimally invasive surgery, have longer lengths of stay, and higher readmission and postoperative mortality rates (8–12). Within oncology, the data are mixed. Pancreatic cancer patients at SNH have equivalent surgical resection margins, chemotherapy rates, and 5-year stage-specific survival (13). However, patients with glioblastoma are less likely to receive standard-of-care treatment and have reduced overall survival (14).

For women with gynecologic malignancies, individual characteristics such as race and insurance status have been studied as predictors of outcomes. Yet beyond hospital and surgeon volume, the role of hospital characteristics in defining patient outcomes has been poorly described for this patient population. Specifically, the relationship between safety-net status and gynecologic cancer care remains unexplored. The objective of our study was to examine the quality of care, readmission rates, and survival of women with uterine, ovarian, or cervical cancer treated at SNH compared with those treated at non-SNH.

Methods

Data Source

We used the National Cancer Database (NCDB) for this analysis. NCDB is a nationwide oncology hospital registry developed and maintained by the American Cancer Society and the American College of Surgeons (15). It captures approximately 70% of all patients with new cancer diagnoses at more than 1500 American hospitals affiliated with the Commission on Cancer (CoC). This study was deemed exempt by the Columbia University Institutional Review Board.

Study Cohort

We identified women diagnosed with an index diagnosis of invasive uterine, ovarian, or cervical cancer from 2004 to 2015. Figure 1 illustrates cohort selection. We used the unique facility identifiers to select hospitals at which these patients received care. The payer mix of each hospital was analyzed. The calculation of SNH status was based on the proportion of uninsured patients and Medicaid recipients within a specific hospital. The hospitals were stratified into quartiles based on these proportions. Patients with unknown insurance status (2%) were not included in this calculation or the analysis. Each hospital was classified into the following quartiles based on the proportion of patients who were uninsured or Medicaid recipients: lowest Medicaid payer mix, low Medicaid payer mix, high Medicaid payer mix, and highest Medicaid payer mix. Consistent with prior policy reports (3), the hospitals comprising the highest Medicaid payer mix quartile were categorized as SNH (Figure 2). After the calculation of SNH, the study cohort was further restricted to include patients with pathologically confirmed invasive gynecologic cancers. Patients with multiple cancer diagnoses were identified by their first case of cancer.

Patient and Hospital Characteristics

Patient characteristics included cancer type (uterine, ovarian, cervical), patient's age (<40, 40–49, 50–59, 60–69, 70–79, and ≥80 years), race or ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and others), insurance status (private, Medicare, Medicaid, uninsured, and other government), zip code-level median household income (<$30 000, $30 000–$35 999, $36 000–$45 999, and ≥$46 000), zip-code level education (≥29%, 20%–28.9%, 14%–19.9%, and <14% of adults without a high school diploma), and patients' residential location (metropolitan, urban, rural, and unknown). Comorbidities were reported based on the Charlson/Deyo comorbidity score and categorized as 0, 1, or at least 2 conditions (16).

Hospital characteristics included region of the country (East, South, Midwest, West), facility type (community, comprehensive community, academic/research, integrated network), and hospital annualized volume for each cancer site calculated as the total number of patients divided by the number of years in which a given hospital treated at least one patient.

Tumor Characteristics

Tumor characteristics included the grade of tumor differentiation (well, moderate, poor, unknown), stage according to American Joint Committee on Cancer criteria and International Federation of Gynecology & Obstetrics system (I, II, III, IV, unknown), and histology based on cancer type. Uterine cancer histologies included endometrioid, serous, clear cell, carcinosarcoma, sarcoma, and other or unknown. Ovarian cancer histologies included serous, mucinous, endometrioid, clear cell, transitional cell, epithelial nonspecific, and other or unknown. Cervical cancer histologies included squamous cell, adenocarcinoma, adenosquamous, and other or unknown.

Quality Metrics and Outcomes

Quality metrics for treatment were derived from evidence-based recommendations (Table 1). For endometrial cancer, we evaluated the proportion of patients with stage I tumors who underwent minimally invasive hysterectomy (17–19), lymph node assessment for women with stage IB grade 2 or 3, or stage II endometrioid adenocarcinomas (20,21), and the use of chemotherapy for stage III–IVB disease (22,23). For ovarian cancer patients, we assessed performance of debulking (cytoreduction and/or omentectomy) for patients with stage IIA–IV tumors (24–28), proportion of lymph node dissection in cancer-directed surgery for patients with stage I–IIIB tumors (29–31), use of chemotherapy for patients with high-risk early-stage tumors (stage IA/B grade 3, stage IC any grade, or stage IA/B/C clear cell) (32–34), and use of chemotherapy for patients with stage III–IV tumors who underwent primary cytoreduction (35). For patients with cervical cancer, we assessed performance of a radical hysterectomy (vs simple hysterectomy) for stage IA2, IB1, IIA1, and IIA2 patients who had hysterectomy (36); performance of pelvic lymph node dissection in patients with stage IA2, IB1, IIA1, and IIA2 tumors who underwent surgery (37); and use of concurrent chemotherapy in patients with stages IB2, IIA2, IIB, IIIA, IIIB, and IVA undergoing radiation treatment (38–40).

For patients who underwent surgery, we assessed all-cause mortality and readmission within 30 days of the procedure. Five-year survival was measured from the date of diagnosis until last follow-up or death from any cause.

Statistical Analysis

Following hospital stratification, all analyses were conducted at the patient level. Differences in the distribution of categorical

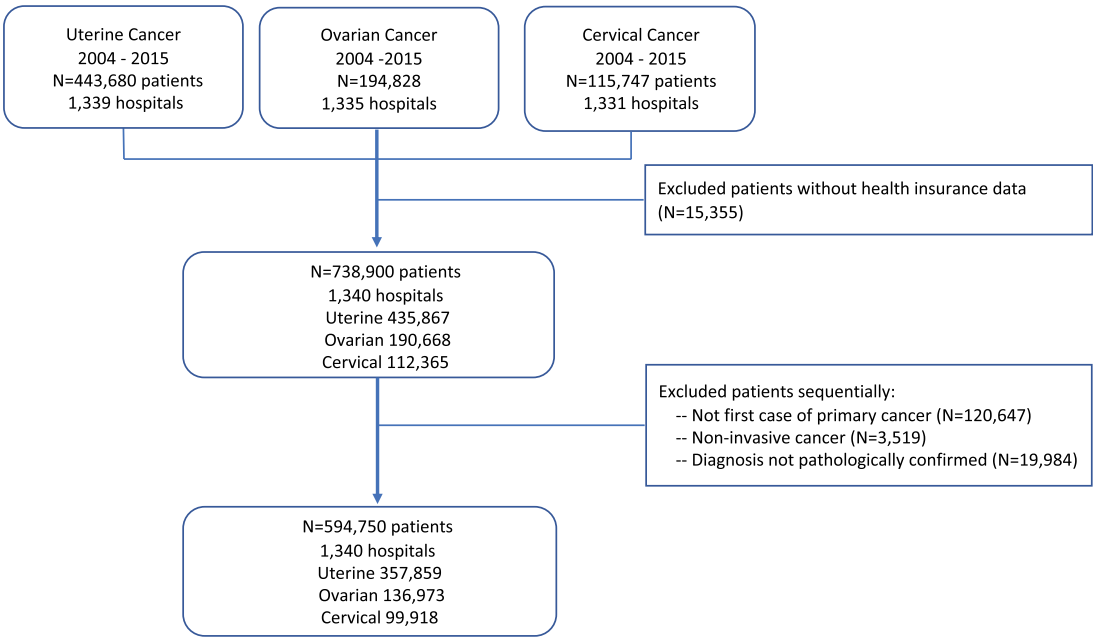

Figure 1. Cohort selection flowchart.

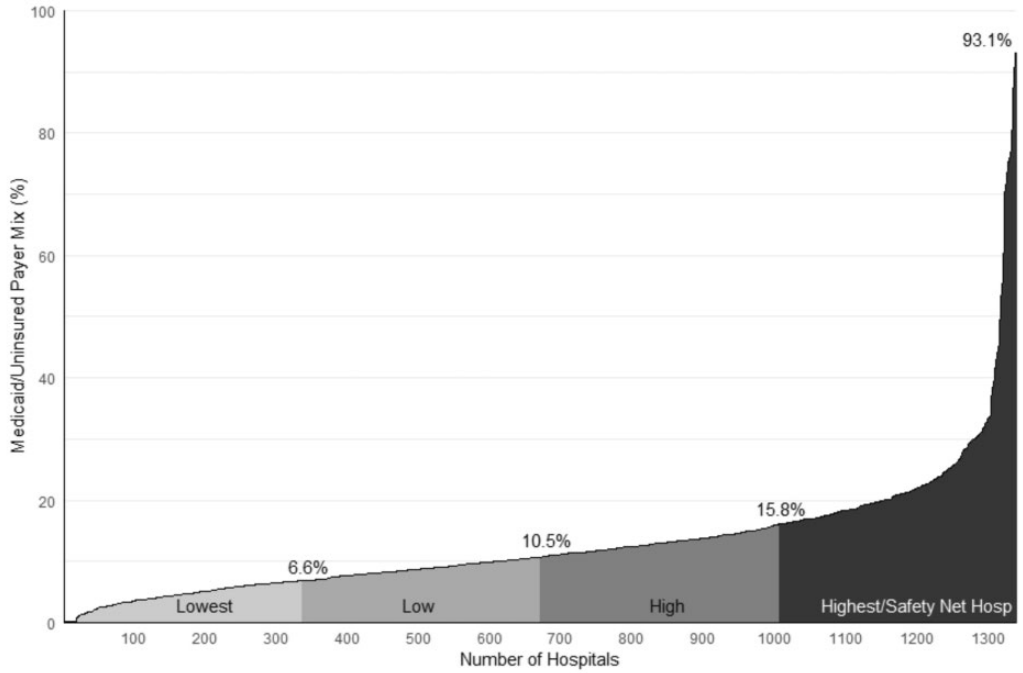

Figure 2. Hospital quartiles by Medicaid and uninsured payer mix.

variables were assessed using chi-squared tests. The unadjusted rates of adherence to each quality metric were compared across the hospital quartiles by cancer site. Multivariable Poisson regression models based on the generalized estimating equations, to account for patients clustered within hospitals, were developed to estimate the association between treatment at SNH and adherence to each quality metric compared with the lowest quartile hospitals for each cancer site. This model was adjusted for patient demographics, tumor characteristics, and hospital factors. The results are reported as adjusted risk ratio with 95% confidence intervals (CI).

Survival analysis was restricted to patients diagnosed from 2004 to 2014 who had complete vital status data. Kaplan-Meier curves were used to calculate observed 5-year survival. Marginal multivariable Cox proportional-hazard models were developed to determine all-cause mortality differences between patients receiving services at SNH vs those at the lowest quartile hospitals after accounting for hospital clustering and

Table 1. Quality indicators for the study cohort

Quality indicators	Detailed descriptions	Total patients for calculation*
Uterine cancer		
Minimally invasive surgery (17–19)	Minimally invasive hysterectomy; stage I disease	126 037
Lymph node assessment (20,21)	Lymph node assessment in cancer surgery; endometroid adenocarcinoma stage IB grade 2 or 3, stage II	28 738
Chemotherapy for advanced stage (22,23)	Chemotherapy; stage III–IVB	40 865
30-day readmission	Readmission within 30 days of cancer-directed surgery	317 066
30-day mortality	Perioperative mortality within 30 days of cancer-directed surgery	286 688
Ovarian cancer		
Debulking (24–28)	Cytoreduction and/or omentectomy; stage IIA–IV	60 114
Lymph node assessment (29–31)	Lymph node assessment in cancer surgery; stage I–IIIB	43 984
Chemotherapy for high-risk early-stage disease (32,33)	Chemotherapy; stage IA/B grade 3, stage IC any grade, stage IA/B/C with clear cell histology	14 331
Chemotherapy for advanced stage (35)	Chemotherapy; stage IIB, IIC, III, IV patients who underwent primary cytoreduction	79 450
30-day readmission	Readmission within 30 days of cancer-directed surgery	116 358
30-day mortality	Perioperative mortality within 30 days of cancer-directed surgery	108 571
Cervical cancer		
Radical hysterectomy (37)	Radical hysterectomy; stage IA2, IB1, IIA1, IIA2	12 774
Lymph node assessment (37)	Pelvic lymph node dissection with radical hysterectomy; stage IA2, IB1, IIA1, IIA2	7108
Concurrent chemoradiation (38–40)	Concurrent chemotherapy (6–8 weeks); stage IB2, IIA2, IIB, IIIA, IIIB, IVA patients who received radiation	30 777
30-day readmission	Readmission within 30 days of cancer-directed surgery	53 015
30-day mortality	Perioperative mortality within 30 days of cancer-directed surgery	48 384

*To reduce heterogeneity within the quality analysis, patients with uterine cancer who did not undergo hysterectomy were excluded. All patients with cervical or ovarian cancer were included regardless of nonsurgical treatment. Quality indicators were assessed for the following years: 2010–2015 for minimally invasive surgery among uterine cancer patients, 2006–2015 for chemotherapy in advanced-stage uterine cancer patients, 2004–2015 for the remainder of the quality markers.

observed confounders. To determine if treatment differences between hospitals may influence survival, we developed two models. In the first model, we adjusted for patient, tumor, and hospital characteristics. In the second model, we adjusted for cancer site-specific treatment (guideline-appropriate surgery, chemotherapy, and radiation therapy) in addition to those variables in the first model. Results are reported as adjusted hazard ratios (aHR) with 95% confidence interval. The assumption of proportionality was assessed by using Martingale residuals for each variable in the model.

Sensitivity Analysis

We undertook a series of sensitivity analyses to examine the robustness of the findings. In the first sensitivity analysis, we limited the cohort to only women who received all their care at the same hospital (ie, no hospital transfers). In the second, we defined SNH using the CMS cutoff of 30% for the volume of inpatient uninsured or Medicaid recipients.

All analyses were performed with SAS 9.4 (SAS Institute Inc, Cary, NC), and R 3.5.1 (Foundation for Statistical Computing, Vienna, Austria) with "ggplot2" package. All statistical tests were two-sided. A *P* value of less than .05 was considered statistically significant.

Results

Hospital, Patient, and Tumor Characteristics

We identified a total of 594 750 patients treated at 1340 hospitals (Table 2). Facilities classified as SNH had an average of 20.7% (range=15.8%–93.1%) uninsured or Medicaid patients (Figure 2). In contrast, hospitals in the lowest quartile had an average of 4.4% (range 0%–6.6%) of uninsured or Medicaid patients.

SNH had a higher relative percentage of patients with cervical cancer and a lower number of uterine cancer patients than other centers ($P < .0001$). Patients at SNH were younger (11.4% vs 6.7% were age <40 years), more frequently black (16.1% vs 6.8%) or Hispanic (13.6% vs 3.6%), and lived in metropolitan zip codes with lower income and lower educational attainment ($P < .0001$ for all). SNH were more commonly academic medical centers and more frequently located in the South ($P < .0001$ for both).

Among all three cancer types, women at SNH more commonly presented with advanced-stage disease ($P < .0001$ for all) (Table 3). Patients with uterine cancer at SNH more commonly had nonendometrioid histologic variants and more commonly had high-grade tumors ($P < .001$ for both). Patients with cervical cancer managed at SNH were more likely to have squamous cell tumors and moderate or poorly differentiated neoplasms ($P < .0001$ for both).

Quality of Care

Patients with uterine cancer treated at SNH were less likely to undergo minimally invasive surgery (62.3% vs 75.9%, $P < .0001$) and nodal assessment (77.8% vs 83.1%, $P < .05$) but more likely to receive chemotherapy (74.5% vs 73.3%, $P < .05$) for advanced-stage disease (Table 4). Patients with ovarian cancer who received care at SNH were less likely to undergo debulking surgery (83.6% vs 86.9%) or nodal assessment (65.3% vs 74.1%), but early and advanced-stage patients were more likely to receive chemotherapy at SNH than at the lowest quartile hospitals (72.0% vs 68.6% and 84.0% vs 81.8%, respectively) ($P < .05$ for all). Cervical cancer patients who received care at SNH were less likely to undergo radical hysterectomy (56.6% vs 56.1%) and

Table 2. Patient and hospital factors stratified by percentage of Medicaid/uninsured patients at a given hospital

Factor	Lowest Medicaid payer mix No. (%)	Low Medicaid payer mix No. (%)	High Medicaid payer mix No. (%)	Highest Medicaid payer mix No. (%)	*P*
Median proportion of Medicaid and uninsured patients	4.4%	8.6%	12.8%	20.7%	
Patients	144 136 (24.2)	156 736 (26.4)	153 141 (25.8)	140 737 (23.7)	
Hospitals	335 (25.0)	334 (24.9)	336 (25.1)	335 (25)	
Cancer type					<.0001
Uterine	91 840 (63.7)	97 179 (62.0)	93 039 (60.8)	75 801 (53.9)	
Ovarian	34 741 (24.1)	36 689 (23.4)	34 933 (22.8)	30 610 (21.7)	
Cervical	17 555 (12.2)	22 868 (14.6)	25 169 (16.4)	34 326 (24.4)	
Age, y					<.0001
<40	9622 (6.7)	12 073 (7.7)	12 675 (8.3)	15 715 (11.2)	
40–49	17 577 (12.2)	20 077 (12.8)	20 185 (13.2)	22 552 (16.0)	
50–59	38 691 (26.8)	41 261 (26.3)	40 455 (26.4)	37 675 (26.8)	
60–69	42 146 (29.2)	44 879 (28.6)	43 357 (28.3)	36 829 (26.2)	
70–79	24 233 (16.8)	26 160 (16.7)	24 727 (16.1)	19 542 (13.9)	
≥80	11 867 (8.2)	12 286 (7.8)	11 742 (7.7)	8424 (6.0)	
Race					<.0001
Non-Hispanic: white	111 974 (77.7)	118 982 (75.9)	114 623 (74.8)	85 776 (60.9)	
Non-Hispanic: black	9750 (6.8)	15 229 (9.7)	13 364 (8.7)	22 694 (16.1)	
Hispanic	5237 (3.6)	9100 (5.8)	8737 (5.7)	19 162 (13.6)	
Other	5991 (4.2)	5041 (3.2)	5615 (3.7)	6889 (4.9)	
Unknown	11 184 (7.8)	8384 (5.3)	10 802 (7.1)	6216 (4.4)	
Insurance status					<.0001
Private	85 224 (59.1)	84 019 (53.6)	75 790 (49.5)	54 555 (38.8)	
Medicare	51 379 (35.6)	57 268 (36.5)	54 946 (35.9)	44 393 (31.5)	
Medicaid	4417 (3.1)	9287 (5.9)	13 612 (8.9)	23 617 (16.8)	
Uninsured	2273 (1.6)	4743 (3.0)	7013 (4.6)	16 080 (11.4)	
Other government	843 (0.6)	1419 (0.9)	1780 (1.2)	2092 (1.5)	
Median household income*					<.0001
<$30 000	9058 (6.3)	16 640 (10.6)	18 576 (12.1)	33 914 (24.1)	
$30 000–$35 999	14 678 (10.2)	26 151 (16.7)	30 387 (19.8)	31 409 (22.3)	
$36 000–$45 999	31 870 (22.1)	43 398 (27.7)	47 949 (31.3)	36 722 (26.1)	
$46 000+	83 270 (57.8)	65 325 (41.7)	51 477 (33.6)	33 437 (23.8)	
Not available	5260 (3.6)	5222 (3.3)	4752 (3.1)	5255 (3.7)	
Less than high school education†					<.0001
≥ 29%	14 015 (9.7)	20 653 (13.2)	22 353 (14.6)	44 500 (31.6)	
20–28.9%	23 928 (16.6)	33 619 (21.4)	38 200 (24.9)	38 517 (27.4)	
14–19.9%	31 250 (21.7)	39 839 (25.4)	39 622 (25.9)	24 933 (17.7)	
<14%	69 674 (48.3)	57 389 (36.6)	48 181 (31.5)	27 515 (19.6)	
Not available	5269 (3.7)	5236 (3.3)	4785 (3.1)	5272 (3.7)	
Urban/rural					<.0001
Metropolitan	124 874 (86.6)	126 930 (81.0)	114 296 (74.6)	107 915 (76.7)	
Urban	12 517 (8.7)	22 772 (14.5)	29 583 (19.3)	25 783 (18.3)	
Rural	1907 (1.3)	2696 (1.7)	3529 (2.3)	3153 (2.2)	
Unknown	4838 (3.4)	4338 (2.8)	5733 (3.7)	3886 (2.8)	
Comorbidity score					<.0001
0	113 778 (78.9)	121 201 (77.3)	118 211 (77.2)	110 211 (78.3)	
1	24 441 (17.0)	28 406 (18.1)	27 902 (18.2)	23 944 (17.0)	
>2	5917 (4.1)	7129 (4.5)	7028 (4.6)	6582 (4.7)	
Year of diagnosis					<.0001
2004	9128 (6.3)	10 202 (6.5)	10 277 (6.7)	9548 (6.8)	
2005	9729 (6.7)	10 930 (7.0)	10 577 (6.9)	10 285 (7.3)	
2006	10 272 (7.1)	11 626 (7.4)	11 135 (7.3)	10 483 (7.4)	
2007	10 939 (7.6)	12 040 (7.7)	11 739 (7.7)	10 960 (7.8)	
2008	11 389 (7.9)	12 507 (8.0)	12 290 (8.0)	11 552 (8.2)	
2009	11 714 (8.1)	13 408 (8.6)	12 617 (8.2)	11 702 (8.3)	
2010	12 103 (8.4)	13 449 (8.6)	12 738 (8.3)	11 624 (8.3)	
2011	12 659 (8.8)	13 915 (8.9)	13 203 (8.6)	12 131 (8.6)	
2012	13 086 (9.1)	14 023 (8.9)	14 009 (9.1)	12 442 (8.8)	
2013	13 855 (9.6)	14 265 (9.1)	14 379 (9.4)	13 096 (9.3)	
2014	14 489 (10.1)	14 945 (9.5)	15 060 (9.8)	13 380 (9.5)	
2015	14 773 (10.2)	15 426 (9.8)	15 117 (9.9)	13 534 (9.6)	

(continued)

Table 2. (continued)

Factor	Lowest Medicaid payer mix No. (%)	Low Medicaid payer mix No. (%)	High Medicaid payer mix No. (%)	Highest Medicaid payer mix No. (%)	P
Facility location					<.0001
Eastern	42 068 (29.2)	32 262 (20.6)	29 849 (19.5)	16 888 (12.0)	
South	21 198 (14.7)	41 533 (26.5)	39 335 (25.7)	48 087 (34.2)	
Midwest	50 569 (35.1)	55 503 (35.4)	43 649 (28.5)	34 114 (24.2)	
West	20 679 (14.3)	15 365 (9.8)	27 633 (18.0)	25 933 (18.4)	
Unknown	9622 (6.7)	12 073 (7.7)	12 675 (8.3)	15 715 (11.2)	
Facility type					<.0001
Community cancer program	5412 (3.8)	7903 (5.0)	8223 (5.4)	10 633 (7.6)	
Comprehensive community cancer program	74 093 (51.4)	72 032 (46.0)	50 482 (33.0)	24 539 (17.4)	
Academic/research program	44 930 (31.2)	39 702 (25.3)	66 324 (43.3)	77 529 (55.1)	
Integrated network cancer program	10 079 (7.0)	25 026 (16.0)	15 437 (10.1)	12 321 (8.8)	
Unknown	9622 (6.7)	12 073 (7.7)	12 675 (8.3)	15 715 (11.2)	

*Zip code median household income.
†Zip code average.

pelvic lymph node dissection (96.5% vs 97.7%) and were less likely to receive concurrent chemoradiotherapy (59.6% vs 65.3%) ($P < .05$ for all). For all three cancer sites, there were no differences in 30-day readmission or perioperative mortality rates following surgery.

Survival Analysis

Crude 5-year survival is presented in Table 5. For women with uterine cancer, there was no difference in overall mortality. For women with ovarian cancer, although there was no difference in overall mortality for those with stage I–III disease, there was a survival disparity between SNH and non-SNH for women with stage IV ovarian cancer (5-year survival, 22.0% vs 24.5%; aHR for overall mortality = 1.10, 95% CI = 1.03 to 1.17). For women with cervical cancer, there were no survival differences for stage I and stage IV disease, yet there were modest decreases in overall mortality both for stage II (63.2% vs 65.9%, aHR = 1.13, 95% CI = 1.02 to 1.26) and stage III (45.2% vs 47.8%, aHR = 1.10, 95% CI = 1.01 to 1.19).

Sensitivity Analysis

We ran two sensitivity analyses to validate our results. These data are demonstrated in Supplementary Table 1 (available online). For the first sensitivity analysis, we limited the cohort to women who received their full course of care at a single hospital. None of the quality metrics or survival outcomes were changed from our original analysis. For our second sensitivity analysis, we limited the cohort of patients to those who received care at hospitals serving at least 30% uninsured or Medicaid patients (4.3% of hospitals). Notably, these hospitals had similar surgical volumes as those in the original SNH cohort. We found that differences in surgical quality indicators were more robust but that chemotherapy rates became equivalent. The survival disparities also resolved; the only survival disparity that persisted was in patients with stage III cervical cancer (aHR for overall mortality = 1.13, 95% CI = 1.02 to 1.25).

Discussion

These data demonstrate that women with gynecologic cancers treated at SNH receive a mix of guideline-adherent care and nonguideline-adherent care. Although they more commonly receive lower-quality surgical care than women treated at non-SNH, the rates of adjuvant chemotherapy are equivalent and sometimes higher at SNH. Readmission and 30-day mortality rates are equivalent, yet there is a modest decrease in overall mortality for patients with stage IV ovarian cancer and stage II–III cervical cancer seen at SNH. Importantly, although these differences are statistically significant given our large sample size, they may be less clinically significant and may in fact represent roughly comparable risk-adjusted outcomes between SNH and non-SNH.

The disparities in surgical care between SNH and non-SNH that we identified are consistent with studies from other tumor sites that have noted similar trends. Patients with early-stage non–small cell lung cancer are less likely to undergo curative intent surgery at SNH and patients with glioblastoma managed at SNH are less likely to receive trimodal therapy, undergo gross total resection, receive radiation, and chemotherapy (14). However, in contrast, hospital safety-net status does not affect the rates of complete resection, radiation therapy, and chemotherapy for patients with pancreatic cancer or rectal cancer (13,41). Factors that influence quality of care at SNH may vary by procedure type and require further investigation. Interestingly, for gynecological cancers, we found that although the quality of surgical care at SNH was lower than at non-SNH, receipt of evidence-based chemotherapy was higher at SNH for uterine and ovarian cancer patients. Plausibly, based on our lymph node assessment data, these patients are more often incompletely staged, in which setting these patients generally would receive adjuvant chemotherapy.

The association between treatment at an SNH and survival were modest. The most pronounced survival difference we found was for women with stage II–III cervical cancer: those who require complex multimodal therapy with chemotherapy, external beam radiation, and brachytherapy. Adjusting for treatment in our model did not statistically significantly affect overall mortality rates. This is consistent with other work that demonstrates persistent survival differences between SNH and non-SNH despite adjusting for treatment (42). What may affect survival more than the exact treatment regimen are the uncaptured challenges in coordination of care, such as treatment delays, loss to follow-up, lower access to primary care, and preventive health services that are experienced at a

Table 3. Oncologic characteristics of the study cohort stratified by tumor type and hospital-level percentage of uninsured or Medicaid patients

Characteristic	Lowest Medicaid payer mix No. (%)	Low Medicaid payer mix No. (%)	High Medicaid payer mix No. (%)	Highest Medicaid payer mix No. (%)	*P*
Uterine cancer (n = 357 859)					
Stage					<.0001
I	58 360 (63.5)	60 100 (61.8)	57 883 (62.2)	43 701 (57.7)	
II	4732 (5.2)	5559 (5.7)	5448 (5.9)	5120 (6.8)	
III	8193 (8.9)	9064 (9.3)	9205 (9.9)	8094 (10.7)	
IV	4426 (4.8)	4651 (4.8)	4789 (5.1)	4748 (6.3)	
Unknown	16 129 (17.6)	17 805 (18.3)	15 714 (16.9)	14 138 (18.7)	
Histology					<.0001
Endometrioid	63 151 (68.8)	64 819 (66.7)	63 033 (67.7)	47 474 (62.6)	
Serous	5356 (5.8)	5712 (5.9)	5617 (6.0)	5179 (6.8)	
Clear cell	1143 (1.2)	1325 (1.4)	1207 (1.3)	1099 (1.4)	
Carcinosarcoma	4104 (4.5)	4615 (4.7)	4429 (4.8)	4377 (5.8)	
Sarcoma	3629 (4.0)	3982 (4.1)	3617 (3.9)	3682 (4.9)	
Other/unknown	14 457 (15.7)	16 726 (17.2)	15 136 (16.3)	13 990 (18.5)	
Grade					<.0001
Well	35 168 (38.3)	35 464 (36.5)	34 090 (36.6)	24 873 (32.8)	
Moderate	21 635 (23.6)	23 249 (23.9)	21 846 (23.5)	18 112 (23.9)	
Poorly	19 884 (21.7)	21 667 (22.3)	21 234 (22.8)	18 561 (24.5)	
Unknown	15 153 (16.5)	16 799 (17.3)	15 869 (17.1)	14 255 (18.8)	
Ovarian cancer (n = 136 973)					
Stage					<.0001
I	7596 (21.9)	7651 (20.9)	7222 (20.7)	6281 (20.5)	
II	2856 (8.2)	2860 (7.8)	2685 (7.7)	2321 (7.6)	
III	12 678 (36.5)	13 187 (35.9)	13 221 (37.8)	11 356 (37.1)	
IV	5310 (15.3)	5579 (15.2)	5446 (15.6)	4859 (15.9)	
Unknown	6301 (18.1)	7412 (20.2)	6359 (18.2)	5793 (18.9)	
Histology					<.0001
Serous	17 784 (51.2)	18 331 (50.0)	17 823 (51.0)	15 240 (49.8)	
Mucinous	1903 (5.5)	2013 (5.5)	2098 (6.0)	2003 (6.5)	
Endometrioid	3329 (9.6)	3250 (8.9)	2838 (8.1)	2437 (8.0)	
Clear cell	2282 (6.6)	2198 (6.0)	2021 (5.8)	1611 (5.3)	
Transitional cell	114 (0.3)	113 (0.3)	113 (0.3)	114 (0.4)	
Epithelial tumor nonspecific	5042 (14.5)	5836 (15.9)	5344 (15.3)	4813 (15.7)	
Other/unknown	4287 (12.3)	4948 (13.5)	4696 (13.4)	4392 (14.3)	
Grade					<.0001
Well	2685 (7.7)	2974 (8.1)	2618 (7.5)	2317 (7.6)	
Moderate	4118 (11.9)	4611 (12.6)	4459 (12.8)	4011 (13.1)	
Poorly	18 897 (54.4)	19 290 (52.6)	18 598 (53.2)	15 042 (49.1)	
Unknown	9041 (26.0)	9814 (26.7)	9258 (26.5)	9240 (30.2)	
Cervical cancer (n = 99 918)					
Stage					<.0001
I	8970 (51.1)	11 199 (49.0)	11 757 (46.7)	14 598 (42.5)	
II	2180 (12.4)	3145 (13.8)	3606 (14.3)	5765 (16.8)	
III	2772 (15.8)	3867 (16.9)	4893 (19.4)	7320 (21.3)	
IV	2002 (11.4)	2566 (11.2)	3070 (12.2)	4447 (13.0)	
Unknown	1631 (9.3)	2091 (9.1)	1843 (7.3)	2196 (6.4)	
Histology					<.0001
Squamous cell	10 823 (61.7)	14 738 (64.4)	16 669 (66.2)	24 547 (71.5)	
Adenocarcinoma	4097 (23.3)	4758 (20.8)	4981 (19.8)	5233 (15.2)	
Adenosquamous	584 (3.3)	845 (3.7)	843 (3.3)	1128 (3.3)	
Other/unknown	2051 (11.7)	2527 (11.1)	2676 (10.6)	3418 (10.0)	
Grade					<.0001
Well	2067 (11.8)	2573 (11.3)	2651 (10.5)	2945 (8.6)	
Moderate	5350 (30.5)	7096 (31.0)	7883 (31.3)	11 304 (32.9)	
Poorly	5561 (31.7)	6828 (29.9)	7872 (31.3)	10 554 (30.7)	
Unknown	4577 (26.1)	6371 (27.9)	6763 (26.9)	9523 (27.7)	

Table 4. Quality metric adherence stratified by tumor type and hospital quartiles of Medicaid/uninsured patients*

	Crude quality metrics rate, No. (%)				
	Lowest Medicaid payer mix	Low Medicaid payer mix	High Medicaid payer mix	Highest Medicaid payer mix	aRR (95% CI) SNH vs lowest
Uterine cancer					
Minimally invasive surgery	26 051 (75.9)	26 023 (75.5)	24 693 (74.4)	14 979 (62.3)	0.85 (0.79 to 0.91)‡
Lymph node assessment	6098 (83.1)	6241 (81.4)	6196 (81.5)	4768 (77.8)	0.96 (0.92 to 0.99)†
Chemotherapy, advanced stage	7173 (73.3)	7688 (72.2)	8035 (74.4)	7166 (74.5)	1.06 (1.02 to 1.10)†
30-day readmission	3499 (4.2)	3706 (4.3)	3667 (4.4)	3485 (5.4)	1.15 (0.89 to 1.49)
30-day mortality	454 (0.6)	562 (0.7)	530 (0.7)	470 (0.8)	1.01 (0.85 to 1.19)
Ovarian cancer					
Debulking	13 140 (86.9)	13 518 (86.3)	13 318 (84.6)	11 370 (83.6)	0.98 (0.95 to 1.00)†
Lymph node assessment	8537 (74.1)	8454 (72.6)	7890 (71.3)	6368 (65.3)	0.90 (0.86 to 0.96)†
Chemotherapy, high-risk early stage	2596 (68.6)	2689 (69.8)	2654 (72.2)	2168 (72.0)	1.08 (1.02 to 1.15)†
Chemotherapy, advanced stage	11 291 (81.8)	11 932 (81.7)	12 357 (83.9)	10 663 (84.0)	1.06 (1.03 to 1.10)†
30-day readmission	2382 (8.0)	2498 (8.0)	2560 (8.6)	2077 (8.1)	1.01 (0.81 to 1.26)
30-day mortality	497 (1.8)	603 (2.1)	563 (2.0)	486 (2.0)	1.10 (0.93 to 1.31)
Cervical cancer					
Radical hysterectomy	1421 (56.1)	1834 (55.9)	1787 (54.2)	2074 (56.6)	0.97 (0.90 to 1.05)
Lymph node assessment	1743 (97.7)	1798 (98)	1743 (97.7)	1998 (96.5)	0.98 (0.97 to 0.99)†
Concurrent chemoradiation	2896 (65.3)	4149 (64.5)	5129 (64.6)	7135 (59.6)	0.95 (0.90 to 0.99)†
30-day readmission	474 (4.5)	656 (4.9)	698 (5.2)	882 (5.6)	1.11 (0.84 to 1.47)
30-day mortality	27 (0.3)	38 (0.3)	39 (0.3)	46 (0.3)	1.19 (0.68 to 2.10)

*Multivariable Poisson regression model adjusted for age, race, insurance status, zip code median household income and education level, urban/rural, comorbidity score, year of diagnosis, cancer histology/grade/stage, hospital factors (hospital annualized volume, hospital region, hospital type), and hospital clustering. aRR = adjusted risk ratio; CI = confidence interval; SNH = safety-net hospital.
†$P < .05$.
‡$P < .0001$.

Table 5. Survival stratified by tumor type and hospital quartiles of Medicaid and uninsured patients*

	Crude 5-year survival rate (95% CI)				aHR (95% CI) for overall mortality Highest vs lowest Medicaid payer mix	
Tumor type	Lowest Medicaid payer mix	Low Medicaid payer mix	High Medicaid payer mix	Highest Medicaid payer mix	Model 1	Model 2
Uterine cancer						
Stage I	90.6 (90.3 to 90.9)	89.8 (89.5 to 90.1)	89.6 (89.3 to 89.9)	88.9 (88.6 to 89.3)	1.07 (1.00 to 1.15)	1.07 (0.99 to 1.14)
Stage II	76.8 (75.3 to 78.3)	76.0 (74.6 to 77.3)	75.2 (73.8 to 76.5)	74.0 (72.6 to 75.5)	1.10 (1.00 to 1.22)	1.10 (0.99 to 1.22)
Stage III	57.7 (56.3 to 59.2)	56.6 (55.3 to 57.8)	56.1 (54.9 to 57.4)	54.5 (53.2 to 55.9)	1.03 (0.95 to 1.10)	1.04 (0.97 to 1.12)
Stage IV	23.4 (21.6 to 25.3)	23.1 (21.5 to 24.8)	22.8 (21.2 to 24.4)	24.1 (22.5 to 25.8)	1.00 (0.93 to 1.08)	1.01 (0.94 to 1.10)
Ovarian cancer						
Stage I	87.7 (86.8 to 88.6)	87.4 (86.4 to 88.2)	87.2 (86.3 to 88.1)	87.0 (85.9 to 88.0)	0.97 (0.86 to 1.09)	0.96 (0.85 to 1.07)
Stage II	71.0 (69.0 to 73.0)	71.4 (69.4 to 73.3)	70.7 (68.6 to 72.7)	69.2 (67.0 to 71.4)	1.05 (0.92 to 1.21)	1.04 (0.92 to 1.19)
Stage III	40.6 (39.6 to 41.6)	39.6 (38.6 to 40.6)	39.2 (38.2 to 40.2)	40.2 (39.2 to 41.3)	1.01 (0.95 to 1.07)	1.01 (0.95 to 1.07)
Stage IV	24.5 (23.1 to 25.9)	23.4 (22.1 to 24.8)	23.2 (21.9 to 24.6)	22.0 (20.6 to 23.4)	1.10 (1.03 to 1.17)†	1.11 (1.03 to 1.19)†
Cervical cancer						
Stage I	88.6 (87.8 to 89.4)	88.2 (87.5 to 88.9)	87.0 (86.2 to 87.7)	85.3 (84.7 to 86.0)	1.09 (0.98 to 1.21)	1.03 (0.92 to 1.15)
Stage II	65.9 (63.5 to 68.2)	64.4 (62.5 to 66.4)	62.3 (60.5 to 64.1)	63.2 (61.8 to 64.7)	1.16 (1.04 to 1.28)†	1.13 (1.02 to 1.26)†
Stage III	47.8 (45.6 to 50.0)	47.3 (45.4 to 49.1)	45.9 (44.2 to 47.5)	45.2 (43.9 to 46.6)	1.10 (1.02 to 1.20)†	1.10 (1.01 to 1.19)†
Stage IV	15.5 (13.6 to 17.4)	14.9 (13.3 to 16.6)	14.2 (12.7 to 15.8)	17.2 (15.9 to 18.6)	1.02 (0.93 to 1.11)	1.01 (0.92 to 1.11)

*Multivariable Cox proportional-hazard model 1 adjusted for patient factors (age, race, insurance status, zip code median household income and education level, urban/rural, comorbidity score, year of diagnosis, cancer stage/grade/histology), hospital factors (hospital annualized volume, hospital region, hospital type, hospital clustering). Model 2 adjusted for covariates in model 1 plus treatment variables (guideline-appropriate surgery, chemotherapy, radiotherapy). aHR = adjusted hazard ratio; CI = confidence interval.
†$P < .05$.

disproportionately higher rate for patients who receive care at SNH compared with non-SNH (43,44).

We found no association between site of care and immediate perioperative outcomes such as readmission and 30-day mortality. Given the complex social situation of many underinsured patients who are treated at SNH, these findings underscore the importance of comprehensive risk adjustment in calculating these publicly available and frequently cited quality metrics (45). Controlling both for patient and hospital factors generally seems to eliminate the differences in crude rates of 30-day readmission and mortality. For patients undergoing major cancer surgery, risk-adjusted readmission rates have been

demonstrated to be higher for patients at SNH, yet these differences are eliminated after adjusting for hospital factors, such as the number of beds, ownership, teaching status, and CoC-approved program designation (10).

We recognize several important limitations. First, defining safety-net status remains challenging (46). Our definition of SNH relied on previously described classification criteria (8,11–14,41,47). However, the hospitals classified as SNH are highly heterogeneous and include a mix of academic medical centers, low-volume community hospitals, and urban teaching facilities. Interestingly, when we limited our safety-net cohort to the top approximately 5% of hospitals that cared for the greatest proportion of uninsured or Medicaid gynecologic cancer patients (≥30%, based on CMS cutoff), the disparities in surgical quality indicators became more pronounced, whereas the disparities in 5-year survival nearly all resolved. Disentangling predictors of quality among SNH and their relationship with outcomes clearly warrants further investigation. Second, although 70% of cancer cases are estimated to be captured within the NCDB, it is limited to CoC-accredited centers, and the hospitals that are not represented in this database may be disproportionately low resourced. These non-CoC centers with 30% of cancer cases may be low volume or have other resource constraints that affect their ability to join the CoC registry and may also affect the quality of care provided to their patients. With this selection bias in mind, we anticipate that the minimal differences we observed in some quality indicators may be an underestimate of the true differences. Third, NCDB does not identify dual-enrolled Medicaid and Medicare patients, so the quartile calculation may be skewed to be more restrictive in its cutoff because the elderly poor would not be included. Lastly, we are unable to account for a number of unmeasured complex social and clinical factors that likely influenced the medical decision making involved in delivering surgical and medical care in our cohort. Drivers of inequity affect patients at multiple levels, from cancer predisposition to systematic barriers in accessing high-quality care, and retrospective study design is limited in assessing variables that cannot be quantified or are not collected.

The quality of surgical oncologic care at SNH faces a number of ongoing challenges. First, many national efforts to promote value-based care provide incentives and disincentives based on adherence to quality metrics and short-term outcomes. Implementation of many of these programs will be challenging for SNH and may financially penalize the most vulnerable hospitals. Second, ongoing trends to concentrate surgical oncological care to high-volume centers may have direct effects on reducing volume at SNH, many of which are not high-volume centers. The possible improvements in outcomes with concentration of care away from SNH must be balanced against the burden these efforts place on vulnerable patient populations that may find it difficult to travel to receive needed care. To avoid widening the racial and socioeconomic disparity gap in patient outcomes, efforts to centralize care must be coupled with evidence-based efforts to make care logistically and financially accessible to all patients.

Overall, this paper contributes to the data demonstrating that surgical care at SNH can be mixed in quality and outcomes. Although more granular data are needed to further investigate these disparities in quality and outcomes, more important work lies in actually eliminating these disparities in care. The American Society of Clinical Oncology established the Health Equity Committee in 2003, the Rural Cancer Care Task Force this year (48), and a series of resource-stratified guidelines (49) with the intention to improve quality of care for targeted populations (50). Kaiser Permanente has piloted the use of social diagnostic codes to identify and address social determinants of health, integrating Electronic Health Record order sets that can trigger referrals for counseling or various social services (51). Recently, the American Medical Association and the UnitedHealth Group have announced a collaboration to create similar billing codes for social determinants of health, which will likely broaden their impact (52).

In sum, these data demonstrate that for women with gynecological malignancies, the quality of surgical care at SNH is lower than at non-SNH facilities; however, other factors that influence cancer outcomes, such as systemic and local treatment, are similar. Despite lower-quality surgical care, survival differences for women treated at SNH and non-SNH are modest. Further research is needed to determine which specific characteristics of SNH affect the provision of quality surgical care for gynecological cancer patients. A concerted effort will be needed to enact the systemic changes necessary to improve quality of care without reducing access for our most vulnerable patients.

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References

1. Institute of Medicine. *America's Health Care Safety Net: Intact but Endangered*. Washington, DC: The National Academies Press; 2000.
2. Spivey M, Kellermann AL. Rescuing the safety net. *N Engl J Med*. 2009;360(25):2598–2601.
3. Sutton JP, Washington RE, Fingar KR, Elixhauser A. Characteristics of Safety-Net Hospitals, 2014: Statistical Brief #213. Rockville, MD: Healthcare Cost and Utilization Project (HCUP) Statistical Briefs; 2006.
4. Wakeam E, Hevelone ND, Maine R, et al. Failure to rescue in safety-net hospitals: availability of hospital resources and differences in performance. *JAMA Surg*. 2014;149(3):229–235.
5. Odisho AY, Etzioni R, Gore JL. Beyond classic risk adjustment: socioeconomic status and hospital performance in urologic oncology surgery. *Cancer*. 2018;124(16):3372–3380.
6. Buntin MB, Ayanian JZ. Social risk factors and equity in Medicare payment. *N Engl J Med*. 2017;376(6):507–510.

7. Mouch CA, Regenbogen SE, Revels SL, Wong SL, Lemak CH, Morris AM. The quality of surgical care in safety net hospitals: a systematic review. *Surgery*. 2014;155(5):826–838.
8. Hoehn RS, Wima K, Vestal MA, et al. Effect of hospital safety-net burden on cost and outcomes after surgery. *JAMA Surg*. 2016;151(2):120–128.
9. Herrel LA, Ye Z, Miller DC. Utilization and outcomes of inpatient urological care at safety net hospitals. *J Urol*. 2015;194(5):1380–1385.
10. Hong Y, Zheng C, Hechenbleikner E, Johnson LB, Shara N, Al-Refaie WB. Vulnerable hospitals and cancer surgery readmissions: insights into the unintended consequences of the Patient Protection and Affordable Care Act. *J Am Coll Surg*. 2016;223(1):142–151.
11. Won RP, Friedlander S, Lee SL. Outcomes and costs of managing appendicitis at safety-net hospitals. *JAMA Surg*. 2017;152(11):1001–1006.
12. Herrel LA, Wong SL, Ye Z, Miller DC. Utilization and outcomes of inpatient surgery at safety-net hospitals. *J Health Care Poor Underserved*. 2016;27(4): 1872–1884.
13. Dhar VK, Hoehn RS, Kim Y, et al. Equivalent treatment and survival after resection of pancreatic cancer at safety-net hospitals. *J Gastrointest Surg*. 2018; 22(1):98–106.
14. Brandel MG, Rennert RC, Lopez Ramos C, et al. Management of glioblastoma at safety-net hospitals. *J Neurooncol*. 2018;139(2):389–397.
15. Boffa DJ, Rosen JE, Mallin K, et al. Using the National Cancer Database for outcomes research: a review. *JAMA Oncol*. 2017;3(12):1722–1728.
16. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–383.
17. Walker JL, Piedmonte MR, Spirtos NM, et al. Recurrence and survival after random assignment to laparoscopy versus laparotomy for comprehensive surgical staging of uterine cancer: Gynecologic Oncology Group LAP2 Study. *J Clin Oncol*. 2012;30(7):695–700.
18. Walker JL, Piedmonte MR, Spirtos NM, et al. Laparoscopy compared with laparotomy for comprehensive surgical staging of uterine cancer: Gynecologic Oncology Group Study LAP2. *J Clin Oncol*. 2009;27(32):5331–5336.
19. Janda M, Gebski V, Davies LC, et al. Effect of total laparoscopic hysterectomy vs total abdominal hysterectomy on disease-free survival among women with stage I endometrial cancer: a randomized clinical trial. *JAMA*. 2017; 317(12):1224–1233.
20. Creasman WT, Morrow CP, Bundy BN, Homesley HD, Graham JE, Heller PB. Surgical pathologic spread patterns of endometrial cancer. A Gynecologic Oncology Group study. *Cancer*. 1987;60(8 suppl):2035–2041.
21. Morrow CP, Bundy BN, Kurman RJ, et al. Relationship between surgical-pathological risk factors and outcome in clinical stage I and II carcinoma of the endometrium: a Gynecologic Oncology Group study. *Gynecol Oncol*. 1991; 40(1):55–65.
22. Randall ME, Filiaci VL, Muss H, et al. Randomized phase III trial of whole-abdominal irradiation versus doxorubicin and cisplatin chemotherapy in advanced endometrial carcinoma: a Gynecologic Oncology Group study. *J Clin Oncol*. 2006;24(1):36–44.
23. Homesley HD, Filiaci V, Gibbons SK, et al. A randomized phase III trial in advanced endometrial carcinoma of surgery and volume directed radiation followed by cisplatin and doxorubicin with or without paclitaxel: a Gynecologic Oncology Group study. *Gynecol Oncol*. 2009;112(3):543–552.
24. Hoskins WJ, McGuire WP, Brady MF, et al. The effect of diameter of largest residual disease on survival after primary cytoreductive surgery in patients with suboptimal residual epithelial ovarian carcinoma. *Am J Obstet Gynecol*. 1994;170(4):974–980.
25. Griffiths CT. Surgical resection of tumor bulk in the primary treatment of ovarian carcinoma. *Natl Cancer Inst Monogr*. 1975;42:101–104.
26. Chi DS, Eisenhauer EL, Zivanovic O, et al. Improved progression-free and overall survival in advanced ovarian cancer as a result of a change in surgical paradigm. *Gynecol Oncol*. 2009;114(1):26–31.
27. Schorge JO, Eisenhauer EE, Chi DS. Current surgical management of ovarian cancer. *Hematol Oncol Clin North Am*. 2012;26(1):93–109.
28. Bristow RE, Puri I, Chi DS. Cytoreductive surgery for recurrent ovarian cancer: a meta-analysis. *Gynecol Oncol*. 2009;112(1):265–274.
29. Colombo N, Guthrie D, Chiari S, et al. International Collaborative Ovarian Neoplasm trial 1: a randomized trial of adjuvant chemotherapy in women with early-stage ovarian cancer. *J Natl Cancer Inst*. 2003;95(2):125–132.
30. Collinson F, Qian W, Fossati R, et al. Optimal treatment of early-stage ovarian cancer. *Ann Oncol*. 2014;25(6):1165–1171.
31. Whitney CW, Spirtos NM. *Gynecologic Oncology Group Surgical Procedures Manual*. Philadelphia, PA: Gynecologic Oncology Group; 2010.
32. Trimbos JB, Vergote I, Bolis G, et al. Impact of adjuvant chemotherapy and surgical staging in early-stage ovarian carcinoma: European Organisation for Research and Treatment of Cancer-Adjuvant ChemoTherapy in Ovarian Neoplasm trial. *J Natl Cancer Inst*. 2003;95(2):113–125.
33. Trimbos JB, Parmar M, Vergote I, et al. International Collaborative Ovarian Neoplasm trial 1 and Adjuvant ChemoTherapy in Ovarian Neoplasm trial: two parallel randomized phase III trials of adjuvant chemotherapy in patients with early-stage ovarian carcinoma. *J Natl Cancer Inst*. 2003;95(2): 105–112.
34. Colombo N, Pecorelli S. What have we learned from ICON1 and ACTION? *Int J Gynecol Cancer*. 2003;13(suppl 2):140–143.
35. Aabo K, Adams M, Adnitt P, et al. Chemotherapy in advanced ovarian cancer: four systematic meta-analyses of individual patient data from 37 randomized trials. Advanced Ovarian Cancer Trialists' Group. *Br J Cancer*. 1998;78(11): 1479–1487.
36. Landoni F, Maneo A, Colombo A, et al. Randomised study of radical surgery versus radiotherapy for stage Ib-IIa cervical cancer. *Lancet*. 1997;350(9077): 535–540.
37. Colombo N, Carinelli S, Colombo A, et al. Cervical cancer: ESMO clinical practice guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2012; 23(suppl 7):vii27–vii32.
38. Morris M, Eifel PJ, Lu J, et al. Pelvic radiation with concurrent chemotherapy compared with pelvic and para-aortic radiation for high-risk cervical cancer. *N Engl J Med*. 1999;340(15):1137–1143.
39. Rose PG, Bundy BN, Watkins EB, et al. Concurrent cisplatin-based radiotherapy and chemotherapy for locally advanced cervical cancer. *N Engl J Med*. 1999;340(15):1144–1153.
40. Peters WA III, Liu PY, Barrett RJ II, et al. Concurrent chemotherapy and pelvic radiation therapy compared with pelvic radiation therapy alone as adjuvant therapy after radical surgery in high-risk early-stage cancer of the cervix. *J Clin Oncol*. 2000;18(8):1606–1613.
41. Hoehn RS, Go DE, Hanseman DJ, Shah SA, Paquette IM. Hospital safety-net burden does not predict differences in rectal cancer treatment and outcomes. *J Surg Res*. 2018;221:204–210.
42. Mokdad AA, Murphy CC, Pruitt SL, et al. Effect of hospital safety net designation on treatment use and survival in hepatocellular carcinoma. *Cancer*. 2018; 124(4):743–751.
43. Perlow HK, Ramey SJ, Silver B, et al. Assessment of oropharyngeal and laryngeal cancer treatment delay in a private and safety net hospital system. *Otolaryngol Head Neck Surg*. 2018;159(3):484–493.
44. Hoffman C, Paradise J. Health insurance and access to health care in the United States. *Ann N Y Acad Sci*. 2008;1136:149–160.
45. Glance LG, Kellermann AL, Osler TM, Li Y, Li W, Dick AW. Impact of risk adjustment for socioeconomic status on risk-adjusted surgical readmission rates. *Ann Surg*. 2016;263(4):698–704.
46. McHugh M, Kang R, Hasnain-Wynia R. Understanding the safety net: inpatient quality of care varies based on how one defines safety-net hospitals. *Med Care Res Rev*. 2009;66(5):590–605.
47. Werner RM, Goldman LE, Dudley RA. Comparison of change in quality of care between safety-net and non-safety-net hospitals. *JAMA*. 2008;299(18): 2180–2187.
48. ASCO Announces New Task Force To Address Rural Cancer Care Gap. 2019. https://www.asco.org/about-asco/press-center/news-releases/asco-announces-new-task-force-address-rural-cancer-care-gap. Accessed April 11, 2019.
49. ASCO Resource Stratified Guidelines. 2019. https://www.asco.org/practice-guidelines/quality-guidelines/guidelines/resource-stratified. Accessed April 11, 2019.
50. Rolleri C. Cancer Care by Zip Code: Examining Geographic Health Disparities in the United States. 2019. https://connection.asco.org/magazine/features/cancer-care-zip-code-examining-geographic-health-disparities-united-states. Accessed March 7, 2019.
51. Friedman NL, Banegas MP. Toward addressing social determinants of health: a health care system strategy. *Perm J*. 2018;22:18–95.
52. UnitedHealthcare and the AMA Collaborate to Understand and Address Social Barriers Preventing People's Access to Better Health. 2018. https://www.unitedhealthgroup.com/newsroom/2019/2019-04-02-uhc-ama-social-barriers.html. Accessed April 16, 2019.