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Surgical Readmission and Survival in Women with Ovarian Cancer: Are Short Term Quality Metrics Incentivizing Decreased Long Term Survival?

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Abstract

Objectives—To determine the association between treatment with neoadjuvant chemotherapy (NACT) or primary debulking surgery (PDS) and readmission after surgical hospitalization as well as overall survival among women with stage IIIC epithelial ovarian cancer (EOC).

Methods—We identified incident cases of stage IIIC EOC treated with both chemotherapy and surgery in the National Cancer Database (NCDB) from 2006-2012. 30-day readmissions were categorized as planned or unplanned. Log binomial models were used to estimate risk ratios and 95% confidence intervals. Survival analysis was performed using cox proportional hazards models.

Results—We identified 20,853 women with stage IIIC EOC. 15.6% (n=3242) were treated with NACT and 11.6% (n=2427) were readmitted within 30 days of surgery, 59% (n=1421) were unplanned. NACT was associated with a 48% reduction in the risk of any readmission (aRR 0.52 95% CI 0.45-0.60) compared to PDS with adjustment for age, race, insurance, histology, year of diagnosis, and Charlson co-morbidity index score. However, in the same population, receipt of neoadjuvant chemotherapy was also associated with a 33% increase in the rate of death (HR 1.33 95% CI 1.29-1.40) with adjustment for the same factors.

Conclusions—Among women with stage IIIC EOC, NACT is associated with both decreased rates of readmission and decreased survival compared to PDS. While selection bias may account

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for some of the observed differences in survival, the current focus on short-term hospital-wide quality metrics, such as postoperative readmission, in the ovarian cancer population, may be creating incentives inconsistent with long-term goals.

INTRODUCTION

Readmission within 30 days of a surgical procedure is a quality metric (1). The Centers for Medicare and Medicaid services currently penalizes hospitals based on higher than expected readmission rates for certain conditions and procedures (2). In response, hospitals have enacted programs aimed at reducing readmissions (3). This focus on hospital readmissions is a rather broad metric that has been applied to patients with both chronic health conditions as well those undergoing elective surgical procedures (2).

Patients with stage IIIC and IV ovarian cancer can be treated with upfront primary debulking surgery or neoadjuvant chemotherapy followed by interval debulking surgery. In randomized trials, patients randomized to neoadjuvant chemotherapy have experienced decreased rates of postoperative morbidity, including postoperative complications, compared to patients randomized to primary debulking surgery (4–6). However, the effect of primary treatment with neoadjuvant chemotherapy or primary debulking surgery and its association with postoperative hospital readmission has not yet been studied with the exception of a single institution series and a collaborative observation trial of 6 NCI designated comprehensive cancer centers (7). Furthermore, although two large randomized trials performed in Europe have found neoadjuvant chemotherapy to be non-inferior to primary debulking surgery (4, 5), these studies have been criticized for low rates of optimal cytoreduction and inferior survival compared to a US population (8, 9). Additionally, observational studies in the US population have found a potential benefit to primary debulking surgery (10, 11).

In this study, we examine how the broad focus of reducing postoperative hospital readmissions could affect patients with ovarian cancer and either incentivize or disincentivize currently available first line treatments. The objectives of this study are first, to determine the association between primary treatment with neoadjuvant chemotherapy or primary debulking surgery and readmission after surgical hospitalization among stage IIIC epithelial ovarian cancer patients. And second to determine the association between primary treatment and survival in the same cohort of patients.

METHODS

Data Source

The National Cancer Database (NCDB) was used to identify incident cases of ovarian cancer. The NCDB is a hospital-based cancer registry that records information for all incident cancer cases at participating institutions. To participate, institutions have to be Commission on Cancer (CoC) accredited. The NCDB captures approximately 70% of incident cases of invasive cancer in the United States each year (12). The Institutional Review Board at the University of North Carolina at Chapel Hill reviewed this study and declared it exempt from formal review.

Study Cohort

Our study cohort was derived from all patients with ovarian cancer recorded in the National Cancer Database from 2006-2012. Inclusion criteria for this study included stage IIIC disease, such that patients could be considered candidates for either primary debulking surgery or neoadjuvant chemotherapy, and epithelial histology. Additionally, all patients received treatment with both chemotherapy and surgery and all patients had to be operated on at the reporting facility as NCDB only captures surgical readmission to the same facility at which the surgery is performed.

Variables of Interest

For our first objective, our primary outcome was readmission to the same facility where the surgery was performed within 30 days of surgery. Readmissions were categorized as planned versus unplanned according to the definitions of the NCDB (13). Planned readmissions included admissions for scheduled events such as a revision of a colostomy or an inpatient chemotherapy port. Both overall and unplanned readmissions were analyzed and reported given the possibility of miscategorization between unplanned and planned readmission. Our independent variable of interest was primary treatment received. This was defined by the systemic surgery sequence variable in the NCDB as receipt of either primary debulking surgery followed by adjuvant chemotherapy or neoadjuvant chemotherapy followed by debulking surgery. We examined potential confounders of the relationship between primary treatment and readmission. These covariates included age, race, insurance, histology, grade, and Charlson co-morbidity index score. Charlson comorbidity index score was reported using the Deyo classification and is categorized as 0, 1, and 2 in the NCDB (14). Data regarding disease burden prior to surgery beyond stage are not available in the NCDB. We used modified Poisson regression to estimate risk ratios between primary treatment and post-surgical readmission and then used the same models to perform an adjusted analysis including the above confounders.

Survival Analysis

For our second objective, our primary outcome was overall survival which was defined as time from diagnosis to death from any cause or last patient contact. Patients alive at last contact were censored. Our independent variable of interest was primary treatment for ovarian cancer, defined as above. Covariates examined as potential confounders included age, race, histology, grade, insurance, and Charlson co-morbidity index score. A Kaplan Meier plot was used to graphically represent overall survival and the log rank test was used to calculate the difference in median overall survival. A Cox proportional hazards regression was used to estimate the association between primary treatment and overall survival adjusted for the aforementioned confounders. The proportional hazards assumption was tested for the adjusted model using Schoenfeld's residuals.

RESULTS

We identified 20,853 women with stage IIIC epithelial ovarian cancer (Table 1). Of these women, 15.6% of patients were treated with neoadjuvant chemotherapy. Patients who received neoadjuvant chemotherapy were more likely to be older (64.7 years v 61.0 years,

$p<0.001$) and be of black race (7.7% versus 6.4%, $p=0.02$) compared to those patients receiving primary debulking surgery. Patients receiving neoadjuvant chemotherapy were also less likely to have private insurance (39.5% versus 51.4%, $p<0.001$) and more likely to have higher Charlson comorbidity index scores. They were more likely to have histologies that were serous or epithelial histologies not-further specified. The use of neoadjuvant chemotherapy also increased over the studied time period from 11.3% in 2006 to 22.3% in 2012.

For the entire population, 11.6% ($n=2427$) of all patients were readmitted to the same hospital within 30 days of surgery (Table 2). 58.6% ($n=1421$) of these readmissions were categorized as unplanned by the NCDB. Patients who were readmitted were less likely to have private insurance (48.0% versus 49.8%, $p=0.15$). However, there was no significant difference in readmission between patients based on age, race, or comorbidities. There was a trend towards decreased readmission rates over the study period, from 13.1% in 2007 to 11.0% in 2012 ($p=0.03$).

Patients who underwent primary debulking surgery had a 12.6% ($n=2,219$) readmission rate whereas patients who underwent neoadjuvant chemotherapy had a 6.4% ($n=208$) readmission rate. Similarly for unplanned readmission, patients undergoing primary debulking were also more likely to be readmitted than those undergoing neoadjuvant chemotherapy (7.3% versus 4.4%, $p<0.001$). Given the inherent differences between patients undergoing neoadjuvant chemotherapy and primary debulking surgery described earlier, we performed an adjusted analysis to determine if the association between primary treatment and readmission was modified after adjustment for age, race, insurance status, Charlson comorbidity score, histology, and year of diagnosis. We found that the increased risk of readmission for patients treated with primary debulking surgery persisted. Patients who underwent neoadjuvant chemotherapy experienced a 48% reduction in the risk of any readmission and a 40% reduction in the risk of an unplanned readmission (Table 3).

We then examined survival in the same cohort of patients. This Kaplan Meier curve shows that although patients who underwent neoadjuvant chemotherapy experienced decreased readmission rates, they also experienced decreased survival (Figure 1, $p=0.001$). This corresponds to a 43% increased rate of death for patients undergoing neoadjuvant chemotherapy (HR 1.43 95% CI 1.36-1.50). In a Cox proportional hazards model adjusted for age, race, insurance status, Charlson comorbidity score, histology, and year of diagnosis, neoadjuvant chemotherapy remained associated with a 33% increase in the rate of death compared with primary debulking surgery (HR 1.33 95% CI 1.27-1.40).

DISCUSSION

In this study, we demonstrate that use of neoadjuvant chemotherapy for women with stage IIIC epithelial ovarian cancer is associated with a near 50% reduction in the risk of postoperative readmission when compared with primary debulking surgery. This is true for both all readmissions and unplanned readmissions. However, in the same cohort of patients, we found receipt of neoadjuvant chemotherapy was also associated with decreased long-term survival. This inferior survival persisted even after adjusting for some of the differences

between patients undergoing neoadjuvant chemotherapy and primary debulking surgery. However, patients who receive neoadjuvant chemotherapy are likely to have worse functional status, more aggressive tumor biology and higher disease burden which could not be adjusted for in this observational study design. This may explain some of the improved survival seen in the primary debulking surgery group. However, it is important to note that all of these same factors are risk factors for postsurgical readmission. It is therefore notable that we observed such a drastic decrease in readmissions in the neoadjuvant chemotherapy group which we would expect to have a higher rate of readmission based on baseline characteristics in the absence of the different treatments they received.

Hospital systems and clinicians are increasingly being incentivized to decrease readmission rates. Hospital readmissions have been noted to be costly and some have held them up as the anti-thesis of high value care. As we move to alternative payment models and bundled payments, health systems will not gain additional reimbursement for these costly readmissions and efforts to decrease readmission rates are likely to increase (15). In randomized trials, primary debulking surgery has consistently been associated with a significant increase in postoperative complications compared to treatment with neoadjuvant chemotherapy (4–6). Additionally, these effects are most pronounced in patients undergoing aggressive cytoreductive efforts (6). Postoperative complications are known to be a major driver of early (30 day) postoperative readmissions and this increased rate of complications is likely a factor in the increased rate of readmission among patients receiving primary debulking surgery (16). If neoadjuvant chemotherapy is associated with decreased readmissions and non-inferior survival compared with primary debulking surgery, as demonstrated in large European randomized studies, then neoadjuvant chemotherapy is the preferred strategy for high value care.

However, aggressive cytoreduction to no gross residual disease is a central tenant of current ovarian cancer treatment paradigms and is associated with improved overall survival (17–19). Aggressive surgical procedures are also associated with increased complications (6). Currently, the ASCO and SGO guidelines recommend primary debulking surgery as the treatment of choice for patients who are felt to have resectable disease and who are able to tolerate surgery (20). Neoadjuvant chemotherapy, in contrast, is the treatment of choice for patients who are unlikely to tolerate surgery or who have disease felt to be unresectable preoperatively. Patient for patient, even including those patients who have upfront resectable disease, giving neoadjuvant chemotherapy prior to operating is likely to decrease the disease burden and lead to a less complex, less complication prone, operation. Currently, if providers are incentivized to decrease their postoperative readmissions, one has to wonder if this will cause an increase in the use of neoadjuvant chemotherapy over primary debulking surgery to decrease postoperative complications and resulting postoperative readmissions.

If only evaluated by short term outcomes such as complication rates and readmission rates, neoadjuvant chemotherapy is superior to primary debulking surgery. However, although randomized European trials have shown non-inferior survival with neoadjuvant chemotherapy compared to primary debulking surgery, questions remain about the applicability to the US population (8, 9). Additionally, for patients with low disease burden (<5cm), primary debulking surgery has been associated with a survival benefit in a

randomized trial (5). Our study, as well as other retrospective studies of patients in the United States have found a survival benefit for primary debulking surgery among patients with stage IIIC disease (10, 11). These studies are subject to selection bias and confounding by indication, however, at this time, primary cytoreductive surgery for patients who are selected to undergo it, seems to be associated with the longest survival (21, 22). It is, therefore, possible that for patients with resectable disease, upfront cytoreductive surgery is associated with both increased short-term complications and increased long-term survival (23, 24). In this instance, a quality program for ovarian cancer patients that focuses on only short term outcomes would mean that upfront cytoreductive surgery is disincentivized, even for patients with resectable disease. Given the value placed on increased survival in the quality-outcome hierarchy, incentives along these lines are not likely to increase the delivery of high value care (25). Furthermore, patients may value short-term and long-term outcomes differently and although health systems disincentivize readmissions, those with resectable disease may be willing to accept aggressive surgery which results in higher readmissions for improved long-term survival.

This study is subject to several limitations. First, the readmission data in the NCDB only reports readmission to the reporting facility and so the absolute rates of readmission in this study may be under-estimated. However, we would not expect this to differentially affect patients undergoing neoadjuvant chemotherapy compared with primary debulking surgery and therefore we would not anticipate that it would alter our conclusions. Second, our results regarding the improved survival for patients undergoing primary debulking surgery should be interpreted with caution. Although we were able to adjust for confounders such as age and comorbidities, we were unable to adjust for disease burden, functional status and other confounders. These confounders may partially or completely account for the observed improved survival of the primary debulking surgery group. Lastly, NCDB does not record disease specific survival, just overall survival, and this biases towards an increased rate of death in the neoadjuvant chemotherapy group which may partially explain our findings.

Policies that prioritize decreased readmission rates inherently encourage neoadjuvant chemotherapy over primary debulking surgery due to the large reduction in readmission we have reported. The survival data we have presented question whether this priority for neoadjuvant chemotherapy over primary debulking surgery is wise for all patients with IIIC ovarian cancer, specifically, for those with resectable disease. Policies and incentive programs for ovarian cancer patients should be developed to include both short and long term outcomes to ensure we are not prioritizing decreased short term morbidity at the expense of long term survival.

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References

1. Ashton CM, Wray NP. A conceptual framework for the study of early readmission as an indicator of quality of care. *Social science & medicine*. 1996; 43(11):1533–41. [PubMed: 8961397]

2. Hospital Readmissions Reduction Program (HRRP). <https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/readmissions-reduction-program.html>. Accessed January 7th, 2017
3. Kripalani S, Theobald CN, Anctil B, Vasilevskis EE. Reducing hospital readmission rates: current strategies and future directions. *Annu Rev Med*. 2014; 65:471–85. [PubMed: 24160939]
4. Kehoe S, Hook J, Nankivell M, Jayson GC, Kitchener H, Lopes T, et al. Primary chemotherapy versus primary surgery for newly diagnosed advanced ovarian cancer (CHORUS): an open-label, randomised, controlled, non-inferiority trial. *Lancet*. 2015; 386(9990):249–57. [PubMed: 26002111]
5. Vergote I, Trope CG, Amant F, Kristensen GB, Ehlen T, Johnson N, et al. Neoadjuvant chemotherapy or primary surgery in stage IIIC or IV ovarian cancer. *The New England journal of medicine*. 2010; 363(10):943–53. [PubMed: 20818904]
6. Fagotti A, Ferrandina G, Vizzielli G, Fanfani F, Gallotta V, Chiantera V, et al. Phase III randomised clinical trial comparing primary surgery versus neoadjuvant chemotherapy in advanced epithelial ovarian cancer with high tumour load (SCORPION trial): Final analysis of peri-operative outcome. *European journal of cancer*. 2016; 59:22–33. [PubMed: 26998845]
7. Worley MJ Jr, Guseh SH, Rauh-Hain JA, Williams KA, Muto MG, Feltmate CM, et al. Does neoadjuvant chemotherapy decrease the risk of hospital readmission following debulking surgery? *Gynecologic oncology*. 2013; 129(1):69–73. [PubMed: 23375727]
8. Chi DS, Musa F, Dao F, Zivanovic O, Sonoda Y, Leitao MM, et al. An analysis of patients with bulky advanced stage ovarian, tubal, and peritoneal carcinoma treated with primary debulking surgery (PDS) during an identical time period as the randomized EORTC-NCIC trial of PDS vs neoadjuvant chemotherapy (NACT). *Gynecologic oncology*. 2012; 124(1):10–4. [PubMed: 21917306]
9. Schorge JO, Clark RM, Lee SI, Penson RT. Primary debulking surgery for advanced ovarian cancer: are you a believer or a dissenter? *Gynecologic oncology*. 2014; 135(3):595–605. [PubMed: 25316177]
10. Rauh-Hain JA, Melamed A, Wright A, Gockley A, Clemmer JT, Schorge JO, et al. Overall Survival Following Neoadjuvant Chemotherapy vs Primary Cytoreductive Surgery in Women With Epithelial Ovarian Cancer: Analysis of the National Cancer Database. *JAMA Oncol*. 2017; 3(1): 76–82. [PubMed: 27892998]
11. Meyer LA, Cronin AM, Sun CC, Bixel K, Bookman MA, Cristea MC, et al. Use and Effectiveness of Neoadjuvant Chemotherapy for Treatment of Ovarian Cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2016
12. Bilimoria KY, Stewart AK, Winchester DP, Ko CY. The National Cancer Data Base: a powerful initiative to improve cancer care in the United States. *Annals of surgical oncology*. 2008; 15(3): 683–90. [PubMed: 18183467]
13. The American College of Surgeons. National Cancer Database Data Dictionary PUF. 2015. Accessed at: ncdbpuf.facs.org/content/readmission-within-30-days. Accessed 12 September 2017
14. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *Journal of clinical epidemiology*. 1992; 45(6):613–9. [PubMed: 1607900]
15. Eapen ZJ, Reed SD, Curtis LH, Hernandez AF, Peterson ED. Do heart failure disease management programs make financial sense under a bundled payment system? *American heart journal*. 2011; 161(5):916–22. [PubMed: 21570523]
16. Barber EL, Doll KM, Gehrig PA. Hospital readmission after ovarian cancer surgery: Are we measuring surgical quality? *Gynecologic oncology*. 2017
17. Aletti GD, Dowdy SC, Gostout BS, Jones MB, Stanhope CR, Wilson TO, et al. Aggressive surgical effort and improved survival in advanced-stage ovarian cancer. *Obstetrics and gynecology*. 2006; 107(1):77–85. [PubMed: 16394043]
18. Winter WE 3rd, Maxwell GL, Tian C, Carlson JW, Ozols RF, Rose PG, et al. Prognostic factors for stage III epithelial ovarian cancer: a Gynecologic Oncology Group Study. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2007; 25(24):3621–7. [PubMed: 17704411]

19. Bristow RE, Tomacruz RS, Armstrong DK, Trimble EL, Montz FJ. Survival effect of maximal cytoreductive surgery for advanced ovarian carcinoma during the platinum era: a meta-analysis. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2002; 20(5):1248–59. [PubMed: 11870167]
20. Wright AA, Bohlke K, Armstrong DK, Bookman MA, Cliby WA, Coleman RL, et al. Neoadjuvant Chemotherapy for Newly Diagnosed, Advanced Ovarian Cancer: Society of Gynecologic Oncology and American Society of Clinical Oncology Clinical Practice Guideline. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2016; 34(28): 3460–73. [PubMed: 27502591]
21. Dao F, Schlappe BA, Tseng J, Lester J, Nick AM, Lutgendorf SK, et al. Characteristics of 10-year survivors of high-grade serous ovarian carcinoma. *Gynecologic oncology*. 2016; 141(2):260–3. [PubMed: 26968641]
22. Chi DS, Eisenhauer EL, Zivanovic O, Sonoda Y, Abu-Rustum NR, Levine DA, et al. Improved progression-free and overall survival in advanced ovarian cancer as a result of a change in surgical paradigm. *Gynecologic oncology*. 2009; 114(1):26–31. [PubMed: 19395008]
23. Aletti GD, Dowdy SC, Podratz KC, Cliby WA. Relationship among surgical complexity, short-term morbidity, and overall survival in primary surgery for advanced ovarian cancer. *American journal of obstetrics and gynecology*. 2007; 197(6):676 e1–7. [PubMed: 18060979]
24. Mueller JJ, Zhou QC, Iasonos A, O’Cearbhaill RE, Alvi FA, El Haraki A, et al. Neoadjuvant chemotherapy and primary debulking surgery utilization for advanced-stage ovarian cancer at a comprehensive cancer center. *Gynecologic oncology*. 2016; 140(3):436–42. [PubMed: 26777991]
25. Porter ME. What is value in health care? *The New England journal of medicine*. 2010; 363(26): 2477–81. [PubMed: 21142528]

Figure 1.
Survival of Patients Undergoing Neoadjuvant Chemotherapy versus Primary Debulking Surgery

Table 1

Population Characteristics and Association with Receipt of Neoadjuvant Chemotherapy

	Overall (n=20853)	PDS (n=17611, 84.4%)	NACT (n=3242, 15.6%)	p-value
Age	61.6 (11.8)	61.0 (11.8)	64.7 (11.1)	<0.001
Race				0.02
White	18473 (88.6)	15648 (88.9)	2825 (87.1)	
Black	1375 (6.6)	1124 (6.4)	251 (7.7)	
Asian	642 (3.1)	536 (3.0)	106 (3.3)	
Other/unknown	363 (1.7)	303 (1.7)	60 (1.9)	
Insurance				<0.001
Private	10334 (49.6)	9054 (51.4)	1280 (39.5)	
Medicare	8259 (39.6)	6666 (37.9)	1593 (49.1)	
Medicaid	1199 (5.8)	976 (5.5)	223 (6.9)	
Uninsured	792 (3.8)	685 (3.9)	107 (3.3)	
Unknown	269 (1.3)	230 (1.3)	39 (1.2)	
Charlson score				0.002
0	16945 (81.3)	14390 (81.7)	2555 (78.8)	
1	3250 (15.6)	3686 (15.3)	564 (17.4)	
2+	658 (3.2)	654 (3.0)	123 (3.8)	
Grade				<0.001
1	657 (3.2)	602 (3.4)	55 (1.7)	
2	2322 (11.1)	2114 (12.0)	208 (6.4)	
3	12141 (58.2)	10392 (59.0)	1749 (54.0)	
Undifferentiated	3120 (15.0)	2639 (15.0)	481 (14.8)	
Unknown	2613 (12.5)	1864 (10.6)	749 (23.1)	
Histology				<0.001
Papillary serous	16397 (78.6)	13845 (78.6)	2552 (78.7)	
Clear cell	677 (3.3)	606 (3.4)	71 (2.2)	
Mixed adenocarcinoma	1084 (5.2)	971 (5.5)	113 (3.5)	
Endometrioid	907 (4.4)	856 (4.9)	51 (1.6)	
Mucinous	359 (1.7)	329 (1.9)	30 (0.9)	
Epithelial NOS	1429 (6.9)	1004 (5.7)	425 (13.1)	
Year of Diagnosis				<0.001
2006	2988 (14.3)	2648 (15.0)	340 (10.5)	
2007	3053 (14.6)	2702 (15.3)	351 (10.8)	
2008	2907 (13.9)	2540 (14.4)	367 (11.3)	
2009	2907 (13.9)	2485 (14.1)	422 (13.0)	
2010	3031 (14.5)	2506 (14.2)	525 (16.2)	
2011	3045 (14.6)	2461 (14.0)	584 (18.0)	

	Overall (n=20853)	PDS (n=17611, 84.4%)	NACT (n=3242, 15.6%)	p-value
2012	2922 (14.0)	2269 (12.9)	653 (20.1)	

Data represented as mean (SD) for continuous variables and n(%) for categorical variables.

PDS, primary debulking surgery; NACT, neoadjuvant chemotherapy; NOS not otherwise specified

Table 2

Association between Patient Characteristics and Any Postoperative Readmission

	Overall (n=20853)	No Readmission (n=18426, 88.4%)	Readmission (n=2427, 11.6%)	p-value
Age	61.6 (11.8)	61.7 (11.8)	61.2 (11.8)	0.07
Race				0.57
White	18473 (88.6)	16314 (88.5)	2159 (89.0)	
Black	1375 (6.6)	1216 (6.6)	159 (6.6)	
Asian	642 (3.1)	578 (3.1)	64 (2.6)	
Other/unknown	363 (1.7)	318 (1.7)	45 (1.9)	
Insurance				0.15
Private	10334 (49.6)	9168 (49.8)	1166 (48.0)	
Medicare	8259 (39.6)	7290 (39.6)	969 (39.9)	
Medicaid	1199 (5.8)	1054 (5.7)	145 (6.0)	
Uninsured	792 (3.8)	684 (3.7)	108 (4.6)	
Unknown	269 (1.3)	230 (1.3)	39 (1.6)	
Charlson score				0.31
0	16945 (81.3)	14998 (81.4)	1947 (80.2)	
1	3250 (15.6)	2846 (15.4)	404 (16.7)	
2+	658 (3.2)	582 (3.2)	76 (3.1)	
Grade				0.001
1	657 (3.2)	578 (3.1)	79 (3.3)	
2	2322 (11.1)	1997 (10.8)	325 (13.4)	
3	12141 (58.2)	10730 (58.2)	1411 (58.1)	
Undifferentiated	3120 (15.0)	2782 (15.1)	338 (13.9)	
Unknown	2613 (12.5)	2339 (12.7)	274 (11.3)	
Histology				0.025
Papillary serous	16397 (78.6)	14484 (78.6)	2195 (78.8)	
Clear cell	677 (3.3)	610 (3.3)	67 (2.8)	
Mixed adenocarcinoma	1084 (5.2)	939 (5.1)	145 (6.0)	
Endometrioid	907 (4.4)	819 (4.4)	88 (3.6)	
Mucinous	359 (1.7)	305 (1.7)	54 (2.2)	
Epithelial NOS	1429 (6.9)	1269 (6.9)	160 (6.6)	
Year of Diagnosis				0.03
2006	2988 (14.3)	2629 (14.3)	359 (14.8)	
2007	3053 (14.6)	2652 (14.4)	401 (16.5)	
2008	2907 (13.9)	2556 (13.9)	351 (14.5)	
2009	2907 (13.9)	2572 (14.0)	335 (13.8)	
2010	3031 (14.5)	2686 (14.6)	345 (14.2)	
2011	3045 (14.6)	2729 (14.8)	316 (13.0)	

	Overall (n=20853)	No Readmission (n=18426, 88.4%)	Readmission (n=2427, 11.6%)	p-value
2012	2922 (14.0)	2602 (14.1)	320 (13.2)	

Data represented as mean (SD) for continuous variables and n(%) for categorical variables.

NOS, not otherwise specified

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Table 3

Risk Reduction in Readmission Associated with Neoadjuvant Chemotherapy versus Primary Debulking Surgery

	RR	95% CI	aRR	95% CI
Any Readmission	0.51	0.44-0.59	0.52	0.45-0.60
Unplanned Readmission	0.60	0.51-0.72	0.60	0.50-0.72

RR relative risk; aRR adjusted relative risk

aRR adjusted for age, race, insurance status, Charlson comorbidity score, histology, and year of diagnosis