Published in final edited form as:

Obstet Gynecol. 2016 January ; 127(1): 81–89. doi:10.1097/AOG.0000000000001196.

Ovarian Cancer Treatment and Survival Trends Among Women Over 65 in the United States, 1995–2008

Jenny J. Lin, MD, MPH¹, Natalia Egorova, PhD², Rebeca Franco, MPH², Monica Prasad-Hayes, MD³, and Nina A. Bickell, MD, MPH²

¹Division of General Internal Medicine, Icahn School of Medicine at Mount Sinai, NY, NY

²Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, NY, NY

³Division of Gynecologic Oncology, Icahn School of Medicine at Mount Sinai, NY, NY

Abstract

Objective—To evaluate whether overall survival is improving among women in the United States with advanced ovarian cancer.

Methods—This retrospective cohort study evaluated trends in treatment and overall survival for women >65 years diagnosed with stage III and IV epithelial ovarian cancer between 1995 and 2008 using Surveillance, Epidemiology, and End Results (SEER)-Medicare data. Parametric and semi-parametric multivariate survival analyses were used to assess comparative treatment survival rates and factors affecting survival and recurrence.

Results—Of 7938 women who met study criteria, 2.9% received no treatment, 15.4% underwent surgery only, 24.8% received chemotherapy only, 41.8% underwent primary debulking surgery and chemotherapy in an optimal time frame and 15.1% had primary debulking surgery and chemotherapy but the timing was not optimal or patients did not complete all six cycles of chemotherapy. Those who underwent surgery only had similar survival as those who received no treatment (2.2 months vs. 1.7 months), whereas those who received chemotherapy only had a better overall survival (14.4 months). Optimal treatment was associated with the longest survival time ($p < 0.001$, median overall survival 39.0 months). Additionally, survival time associated with optimal treatment increased over the past decade. However, the proportion of women who received optimal treatment has decreased over the past decade.

Conclusion—Elderly women with advanced ovarian cancer have the best survival with optimal therapy. When this is not offered or possible, chemotherapy alone offers better survival than surgery alone.

Corresponding Author: Jenny J. Lin, MD, MPH, Division of General Internal Medicine, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, Box 1087, New York, NY 10029, Phone: (212) 824-7537, Fax: (212) 824-2317, jenny.lin@mssm.edu. Presented in part at the Society for General Internal Medicine Annual Meeting in San Diego, CA, April 25, 2014.

Financial Disclosure

The authors did not report any potential conflicts of interest.

Introduction

Ovarian cancer causes more deaths than any other cancer of the female reproductive system¹ and because there is no effective screening, most women are diagnosed at advanced stages when the probability of survival at 5 years is less than 30%.² However, it appears that women with ovarian cancer are living longer than they did 30 years ago, with 5 year survival rates increasing from 20% to near 40%.^{3,4} Ovarian cancer has become a “chronic disease” as evidenced by a greater proportion of women surviving through recurrences.⁵

Prior studies have shown that women with advanced ovarian cancer who receive optimal treatment (debulking surgery followed by chemotherapy) have improved survival than those suboptimally treated.^{6,7} In the Netherlands, optimal treatment rates have improved from 1989–2009 with a corresponding rise in 5-year survival rates and treatment rates, even for women >75 of age.⁸ Of concern, a recent study of women in the United States (US) showed that less than half of elderly women diagnosed with advanced ovarian cancer received the preferred treatment with debulking surgery followed by 6 cycles of chemotherapy.⁹ However, this study did not assess time trends in treatment or its effect on overall survival which leaves unanswered questions as to how to maximize treatment approaches for older U.S. women diagnosed with advanced ovarian cancer.

We undertook this study to assess recent trends of treatment patterns among U.S. women with advanced stage ovarian cancer and the resultant effect on overall survival.

Materials and Methods

This retrospective cohort study was conducted using data from the Surveillance, Epidemiology, and End Results (SEER) cancer registry linked to Medicare claims from 1995 to 2009. SEER is a national cancer registry that collects information on all incident cancer cases in selected areas, covering nearly 26% of the US population.¹⁰ We used linked Medicare inpatient and outpatient claims to identify cancer treatment. From SEER-Medicare, we selected women >65 who were diagnosed with stage III or IV epithelial ovarian cancer between 1995 and 2008 with Medicare claims through December 31, 2009 and mortality data through December 31, 2012 where ovarian cancer was the first cancer diagnosis. We excluded individuals in health care maintenance organizations or those without Part B Medicare insurance for whom we were unable to ascertain comorbidities and chemotherapy use.¹¹ We excluded cases of cancer diagnosed at death.

Data regarding tumor location and histology were obtained from SEER; histologic subtypes were classified as serous adenocarcinoma, clear cell, endometrioid, mucinous, and other epithelial using *International Classification of Diseases for Oncology*, Third Edition.¹² Using Medicare claims, we ascertained use of chemotherapy and debulking surgery.¹⁰ We classified patients as receiving optimal therapy if they received primary debulking surgery within 120 days of diagnosis followed by at least 6 cycles of chemotherapy with the first cycle occurring within 120 days of initial surgery with no further treatment for at least 6 months after the sixth chemotherapy cycle.^{13,14} Nonoptimal therapy was defined as surgery followed by chemotherapy but not within an optimal time frame (> 120 days), receipt of

chemotherapy prior to surgery, or receipt of <6 cycles of chemotherapy after surgery. Because the seminal studies of neoadjuvant treatment were not published until after the women in our cohort were treated, we included the few women in our cohort who received chemotherapy prior to surgery with the non-optimal therapy group. Sociodemographic information was obtained from SEER and Medicare databases. To evaluate the burden of comorbidities, we used the Elixhauser comorbidity algorithm.^{15,16}

The study outcome was overall (all-cause) survival as determined from Medicare data. Survival times were calculated from date of diagnosis to the date of death. Subjects still living as of December 31, 2012 were censored.

Statistical Analysis

Continuous variables were reported as means with standard deviation (SD) and analyzed using t-test. Categorical variables were reported as rates and analyzed using chi-squared test. Kaplan-Meier survival analysis method was used to compare the overall survival of women who received different treatments. Adjustment for multiple comparisons for the log-rank test was performed with Sidak test. The proportion of censored patients were 17.1% for those in the optimal treatment group, 9.1% for the non-optimal treatment group, 6.2% for the chemotherapy only group, 2.4% for the surgery only group, and 0.9% for the no treatment group. Median follow-up times were 35.8, 15.8, 14.8, 1.7 and 1.4 months, respectively. We used an accelerated failure time model with log-logistic distribution to assess median survival time and Cox proportional hazard models to evaluate overall survival. All baseline characteristics, including age, race, baseline comorbidities; SEER region; cancer stage, grade and histology; and year of diagnosis were included in the Cox or accelerated failure time model as covariates. All variables with p-values ≥ 0.25 were considered as candidates for inclusion in multivariable analysis. Only variables with $p < 0.05$ were left in the final models. The proportional hazard assumption was reviewed and was valid. We compared exponential, Weibull, log-normal, gamma and log-logistic distribution by assessing Akaike information criterion. The analysis showed that survival was best modeled with a log-logistic distribution. The trends in median survival were analyzed using linear regression. Trends in the proportion of patients with different treatments were analyzed using the Cochran-Armitage trend test. Because we were interested in treatment patterns and their effect on survival, we do not present propensity-based analyses used to assess comparative effectiveness of different treatments. All analyses were performed with SAS 9.3 (SAS, Cary, NC) using two tailed p-values. The Institutional Review Board at the Icahn School of Medicine at Mount Sinai approved this study.

Results

Of the 41,406 women with ovarian cancer, 7938 met the study criteria (see Figure 1). Of these, 89.3% were white, 5.1% were black, 2.4% were Asian and 1.6% were Hispanic (Table 1). Almost a quarter (23.7%) of the cohort fell into the 65–69 year age group, 24.9% in the 70–74 age group, 24.8% in the 75–79 group, 17.2% in the 80–84 group, and 9.4% were aged 85 or older. The mean Elixhauser comorbidity score was 18.3 (SD 8.6). Fifty-seven percent had stage 3 ovarian cancer and most (81.2%) had serous adenocarcinoma.

Only 3320 women (41.8%) received surgery and at least 6 cycles of chemotherapy in an optimal time frame, 1,226 (15.4%) received surgery alone, 1,965 (24.8%) received chemotherapy alone, 231 (2.9%) received no treatment, and 1996 (15.1%) received surgery and chemotherapy but not in an optimal time frame, received chemotherapy prior to surgery, or did not complete all 6 cycles of chemotherapy after surgery. Using an accelerated failure time model to adjust for age, race, stage, comorbidities, SEER region, tumor grade and histology, year of diagnosis and treatment, we found that overall median survival time improved from 19.2 months (SD=14.6) in 1995 to 26.9 months (SD=19.7) in 2008 ($P<0.001$). Compared with other treatments (including no treatment), optimal treatment was associated with longer survival time (risk-adjusted median overall survival 39.0 months (SD=12.3); $P<0.001$), and survival of patients receiving optimal treatment improved over time: median overall survival for women who received optimal treatment increased from 33.4 months (SD=8.7) in 1995 to 46.0 months (SD=15.6) in 2008 ($P<0.001$; Figure 2A). However, the proportion of women who received optimal treatment decreased over time from 43.7% in 1995–1999 to 40.7% in 2004–2008 ($p=0.047$, Figure 2B). Multivariable survival models controlling for demographics, cancer type and comorbidities showed that patients who received optimal treatment had longer survival.

We compared women who received optimal treatment in 1995 and in 2008 and found there was no difference in age distribution, race, comorbidity score, or cancer histology. However, there were several differences. Women who received optimal treatment in 1995 were more likely to have stage 3 ovarian cancer but were also more likely to have hypertension, diabetes, peripheral vascular disease, anemia, renal failure, liver disease, depression and obesity (Table 2). We also compared baseline characteristics of women who received different treatments (optimal therapy, non-optimal therapy, chemotherapy only, surgery only and no treatment) as a group overall (Table 3) and compared baseline characteristics of women who received different treatments in 1995–1997 vs. 2005–2008 (Table 4). Overall, women who received no treatment, chemotherapy only or surgery only were older, had more comorbidities and were more likely to have other epithelial cell histology compared to those who received optimal therapy or non-optimal therapy ($p<0.01$ for all comparisons). Those who received chemotherapy alone or surgery alone were also more likely to have stage 4 (vs. stage 3) cancer compared to the other treatment groups ($p<0.01$).

Importantly, median overall survival for women who received surgery alone was similar to those who did not receive any treatment (2.2 months [SD=0.9] vs. 1.7 months [SD=0.9]). In contrast, women who received chemotherapy alone had a median overall survival of 14.4 months (SD=7.6, see Figure 3). Survival probability improved over time among women who received chemotherapy alone or surgery alone but remained substantially lower compared to patients who underwent optimal treatment.

Discussion

Optimal treatment with primary debulking surgery followed by chemotherapy for elderly US women with advanced-stage ovarian cancer is associated with increasing survival time over the past decade. Women who received only surgery without chemotherapy had similar survival to those who received no treatment, whereas those who received chemotherapy

alone had much improved survival over those who received surgery alone. While the proportions of women who received surgery alone or chemotherapy alone remained stable, the proportion of women who received optimal treatment appears to be declining over time.

A recent study using SEER-Medicare data from 1995–2005 found that less than two-fifths of elderly women with advanced ovarian cancer received surgery with at least six cycles of chemotherapy.⁹ However, the authors did not investigate patterns of survival associated with different types of treatment. We found that receipt of optimal treatment was associated with increasing survival times, whereas treatment with surgery or chemotherapy alone was associated with worse survival and not associated with changes in survival rates over time. Advances in surgical technique for primary debulking, as well as effective chemotherapy with platinum-based combination therapy, may explain this observed improvement in survival with optimal treatment. Furthermore, physicians may have become more selective about who may benefit most from undergoing optimal treatment so that it is offered only to those who will be able to undergo both procedures successfully. This may also partially explain the decreasing proportion of women >65 who received optimal treatment over time.

In the US, advanced ovarian cancer is usually treated with primary debulking surgery followed by chemotherapy. However, some women, particularly those who have poorer performance status or more comorbidities, may experience post-surgical complications and may not be able to tolerate chemotherapy after surgery.^{17–23} Consequently, they will have received surgery alone with lower survival rates. Alternatively, women may be offered neoadjuvant chemotherapy prior to primary debulking surgery. Vergote et al. showed in a prospective randomized study that neoadjuvant chemotherapy followed by debulking surgery was non-inferior to primary debulking surgery followed by chemotherapy,²⁴ and some women are now being offered neoadjuvant chemotherapy.²⁵ Therefore, if a woman receives neoadjuvant chemotherapy and is subsequently unable to tolerate primary debulking surgery, she will at least have received chemotherapy, which is associated with better survival rates than surgery alone.

Ideally, women should receive both surgery and chemotherapy but we found a decline in the proportion of women receiving optimal treatment. Barriers to optimal treatment are likely multifactorial. Some regions may have experienced a contraction of hospitals or may have fewer gynecologic oncologists to perform debulking surgery with recent economic and healthcare changes.^{26–28} Yet it is unclear that access to care has decreased and even after controlling for geographic area, there is still a decrease in receipt of optimal treatment over time. Physician recommendations may affect treatment receipt: some physicians may be less likely to offer debulking surgery to older women or those with more comorbidities who have higher surgical risk. However, the mean age of women with advanced ovarian cancer has remained stable over time and even after adjusting for age and comorbidities, we found that optimal treatment rates declined over the past decade. Lastly, patient preferences and beliefs about treatment efficacy or lack of social supports may affect treatment receipt.

There are a few limitations to this study. Based on the dataset, we were only able to analyze women >65. Younger women may have had different survival or treatment trends. Treatment definitions were based on Medicare claims data only; it is possible that some

patients received treatment whose claims were not submitted to Medicare. Furthermore, we were unable to assess whether surgery was optimal vs. suboptimal debulking. We were unable to assess whether patient-specific characteristics, such as treatment preferences, or physician factors might have affected treatment receipt. We attempted to conduct propensity score analyses to adjust for potential treatment selection biases but the treatment groups were too different to create comparable propensity matches. Furthermore, we did not seek to evaluate the comparative effectiveness of different treatments as these differences have been well documented.^{29,30}

Elderly women with advanced ovarian cancer have the best survival if they are able to undergo optimal therapy with primary debulking surgery and chemotherapy. Use of recently-developed preoperative scoring systems may help physicians' decide which women will benefit most from optimal therapy.^{31,32} For women who may not be able to undergo both procedures, chemotherapy should be offered first since chemotherapy alone offers significantly improved survival over surgery alone.

Acknowledgments

Supported by the National Cancer Institute at the National Institutes of Health (1R01CA157176 and 1K07CA166462 to Jenny J. Lin).

The authors thank the efforts of the Applied Research Program, NCI; the Office of Research, Development and Information, CMS; Information Management Services (IMS), Inc.; and the Surveillance, Epidemiology, and End Results (SEER) Program tumor registries in the creation of the SEER-Medicare database.

References

1. United States Cancer Statistics: 1999–2010 Incidence and Mortality Web-based Report. Department of Health and Human Services, Centers for Disease Control and Prevention, and National Cancer Institute; 2013. at www.cdc.gov/uscs [Accessed August 29, 2014]
2. Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ. Cancer statistics, 2009. *CA Cancer J Clin*. 2009; 59:225–49. [PubMed: 19474385]
3. Britain) NifHaCEG, Britain) NCCfCG. Ovarian cancer : the recognition and initial management of ovarian cancer [electronic resource] / developed for NICE by the National Collaborating Centre for Cancer. Cardiff, Wales: National Collaborating Centre for Cancer; 2011.
4. Welch HG, Schwartz LM, Woloshin S. Are increasing 5-year survival rates evidence of success against cancer? *JAMA*. 2000; 283:2975–8. [PubMed: 10865276]
5. Pujade-Lauraine E. How to approach patients in relapse. *Ann Oncol*. 2012; 23(Suppl 10):x128–31. [PubMed: 22987947]
6. Fairfield KM, Lucas FL, Earle CC, Small L, Trimble EL, Warren JL. Regional variation in cancer-directed surgery and mortality among women with epithelial ovarian cancer in the Medicare population. *Cancer*. 2010; 116:4840–8. [PubMed: 20578182]
7. Goff BA, Matthews BJ, Wynn M, Muntz HG, Lishner DM, Baldwin LM. Ovarian cancer: patterns of surgical care across the United States. *Gynecol Oncol*. 2006; 103:383–90. [PubMed: 17005244]
8. van Altena AM, Karim-Kos HE, de Vries E, Kruitwagen RF, Massuger LF, Kiemeny LA. Trends in therapy and survival of advanced stage epithelial ovarian cancer patients in the Netherlands. *Gynecol Oncol*. 2012; 125:649–54. [PubMed: 22370602]
9. Thrall MM, Gray HJ, Symons RG, Weiss NS, Flum DR, Goff BA. Trends in treatment of advanced epithelial ovarian cancer in the Medicare population. *Gynecol Oncol*. 2011; 122:100–6. [PubMed: 21496889]

10. Warren JL, Klabunde CN, Schrag D, Bach PB, Riley GF. Overview of the SEER-Medicare data: content, research applications, and generalizability to the United States elderly population. *Med Care*. 2002; 40:IV-3–18.
11. Klabunde CN, Harlan LC, Warren JL. Data sources for measuring comorbidity: a comparison of hospital records and medicare claims for cancer patients. *Med Care*. 2006; 44:921–8. [PubMed: 17001263]
12. Fritz, AG., editor. International Classification of Diseases for Oncology: ICD-O. 3. World Health Organization; 2000.
13. Bookman MA, Brady MF, McGuire WP, et al. Evaluation of new platinum-based treatment regimens in advanced-stage ovarian cancer: a Phase III Trial of the Gynecologic Cancer Intergroup. *J Clin Oncol*. 2009; 27:1419–25. [PubMed: 19224846]
14. van der Burg ME, van Lent M, Buyse M, et al. The effect of debulking surgery after induction chemotherapy on the prognosis in advanced epithelial ovarian cancer. Gynecological Cancer Cooperative Group of the European Organization for Research and Treatment of Cancer. *N Engl J Med*. 1995; 332:629–34. [PubMed: 7845426]
15. van Walraven C, Austin PC, Jennings A, Quan H, Forster AJ. A modification of the Elixhauser comorbidity measures into a point system for hospital death using administrative data. *Med Care*. 2009; 47:626–33. [PubMed: 19433995]
16. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care*. 1998; 36:8–27. [PubMed: 9431328]
17. Gerestein CG, Nieuwenhuijzen-de Boer GM, Eijkemans MJ, Kooi GS, Burger CW. Prediction of 30-day morbidity after primary cytoreductive surgery for advanced stage ovarian cancer. *Eur J Cancer*. 2010; 46:102–9. [PubMed: 19900801]
18. Bristow RE, Montz FJ, Lagasse LD, Leuchter RS, Karlan BY. Survival impact of surgical cytoreduction in stage IV epithelial ovarian cancer. *Gynecol Oncol*. 1999; 72:278–87. [PubMed: 10053096]
19. Guidozzi F, Ball JH. Extensive primary cytoreductive surgery for advanced epithelial ovarian cancer. *Gynecol Oncol*. 1994; 53:326–30. [PubMed: 8206406]
20. Chi DS, Zivanovic O, Levinson KL, et al. The incidence of major complications after the performance of extensive upper abdominal surgical procedures during primary cytoreduction of advanced ovarian, tubal, and peritoneal carcinomas. *Gynecol Oncol*. 2010; 119:38–42. [PubMed: 20609464]
21. Eisenkop SM, Spirtos NM, Montag TW, Nalick RH, Wang HJ. The impact of subspecialty training on the management of advanced ovarian cancer. *Gynecol Oncol*. 1992; 47:203–9. [PubMed: 1468698]
22. Aletti GD, Santillan A, Eisenhauer EL, et al. A new frontier for quality of care in gynecologic oncology surgery: multi-institutional assessment of short-term outcomes for ovarian cancer using a risk-adjusted model. *Gynecol Oncol*. 2007; 107:99–106. [PubMed: 17602726]
23. Patankar S, Burke WM, Hou JY, et al. Risk stratification and outcomes of women undergoing surgery for ovarian cancer. *Gynecol Oncol*. 2015; 138:62–9. [PubMed: 25976399]
24. Vergote I, Trope CG, Amant F, et al. Neoadjuvant chemotherapy or primary surgery in stage IIIC or IV ovarian cancer. *N Engl J Med*. 2010; 363:943–53. [PubMed: 20818904]
25. Ledermann JA, Raja FA, Fotopoulou C, Gonzalez-Martin A, Colombo N, Sessa C. Newly diagnosed and relapsed epithelial ovarian carcinoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2013; 24(Suppl 6):vi24–32. [PubMed: 24078660]
26. Kuo TM, Mobley LR, Bazzoli GJ. Changes in the health care safety net 1992–2003: disparities in access for uninsured persons in Florida. *Int J Health Serv*. 2013; 43:551–66. [PubMed: 24066421]
27. Bazzoli GJ, Lee W, Hsieh HM, Mobley LR. The effects of safety net hospital closures and conversions on patient travel distance to hospital services. *Health Serv Res*. 2012; 47:129–50. [PubMed: 22091871]
28. Bristow RE, Chang J, Ziogas A, Randall LM, Anton-Culver H. High-volume ovarian cancer care: survival impact and disparities in access for advanced-stage disease. *Gynecol Oncol*. 2014; 132:403–10. [PubMed: 24361578]

29. Fader AN, Rose PG. Role of surgery in ovarian carcinoma. *J Clin Oncol.* 2007; 25:2873–83. [PubMed: 17617518]
30. 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. *J Clin Oncol.* 2002; 20:1248–59. [PubMed: 11870167]
31. Barber EL, Rutstein S, Miller WC, Gehrig PA. A preoperative personalized risk assessment calculator for elderly ovarian cancer patients undergoing primary cytoreductive surgery. *Gynecol Oncol.* 2015
32. Stashwick C, Post MD, Arruda JS, et al. Surgical risk score predicts suboptimal debulking or a major perioperative complication in patients with advanced epithelial ovarian, fallopian tube, or primary peritoneal cancer. *Int J Gynecol Cancer.* 2011; 21:1422–7. [PubMed: 21997170]

Figure 1.
Flow diagram. SEER, Surveillance, Epidemiology, and End Results; HMO, health maintenance organization.

Figure 2. Trends in median survival and proportion of patients receiving treatment, 1995–2008. **A.** Risk-adjusted median survival by treatment over time. **B.** Proportion of patients receiving treatment over time.

Chemotherapy only	1,965	1,099	671	414	292	177	113	74	44	30	19
No treatment	231	20	13	≤11	≤11	≤11	≤11			≤11	0
Nonoptimal treatment	1,196	673	457	332	244	165	116	86	69	51	37
Optimal treatment	3,320	2,984	2,211	1,628	1,197	814	569	405	299	218	158
Surgery only	1,226	197	125	91	66	48	35	26	25	17	12

Figure 3. Unadjusted Kaplan-Meier survival curves by treatment type. Women who received optimal treatment had longest overall survival. Those who received no treatment or surgery only had the shortest overall survival.

Table 1

Demographic characteristics of study cohort (N=7938)

Characteristic	Value
Age Group, N (%)	
65–69	1,882 (23.7)
70–74	1,980 (24.9)
75–79	1,969 (24.8)
80–84	1,365 (17.2)
85+	742 (9.3)
Race/Ethnicity, N (%)	
White	7,086 (89.3)
Black	408 (5.1)
Asian	188 (2.4)
Hispanic	123 (1.4)
Other	141 (1.7)
SEER Region, N (%)	
West	3,699 (46.6)
Northeast	1,649 (20.8)
Midwest	1,410 (17.7)
South	1,180 (14.9)
Histology, N (%)	
Serous Adenocarcinoma	6,447 (81.2)
Other Epithelial	593 (7.5)
Endometrioid	482 (6.1)
Mucinous	298 (3.8)
Clear Cell	118 (1.5)
Tumor Grade, N (%)	
1	161 (2.0)
2	947 (11.9)
3	3,228 (40.7)
4	862 (10.9)
Unknown	2,740 (34.5)
Cancer stage, N (%)	
Stage 3	4,518 (56.9)
Stage 4	3,420 (43.1)
Comorbidity Score$\pm$SD	18.3 $\pm$ 8.6
Treatment, N (%)	
Optimal treatment	3,320 (41.8)
Chemotherapy only	1,965 (24.8)
Surgery only	1,226 (15.4)
Not optimal chemotherapy and surgery	1,196 (15.1)
No treatment	231 (2.9)

Table 2

Comparison of women who received optimal treatment in 1995 and 2008

Characteristic	1995 (N=166)	2008 (N=321)	P-value
Age Group, (%)			0.32
65–69	38.6%	29.3%	
70–74	25.9%	31.2%	
75–79	23.5%	25.5%	
80+	12.0%	14.0%	
Tumor Grade, (%)			0.05
1	6.0%	3.1%	
2	17.5%	11.2%	
3	46.4%	47.7%	
4	12.7%	21.5%	
Unknown	19.9%	17.8%	
Cancer stage, (%)			<0.01
Stage 3	53.0%	69.5%	
Stage 4	47.0%	30.5%	
Histology, (%)			0.08
Serous Adenocarcinoma	83.7%	81.9%	
Other Epithelial	6.0%	3.1%	
Endometrioid	6.0%	11.2%	
Mucinous	6.0%	3.1%	
Clear Cell	6.0%	3.1%	
Race, (%)			0.98
White	92.2%	91.0%	
Black	6.0%	4.0%	
Asian	6.0%	3.1%	
Other Race	6.0%	3.1%	
Hispanic	6.0%	3.1%	
Elixhauser Comorbidity Score Comorbidities, (%)	15.5	16.8	0.07
Hypertension	41.6%	73.8%	<0.01
Congestive heart failure	6.0%	8.7%	0.29
Peripheral vascular disease	6.6%	14.0%	0.02
Chronic pulmonary disease	12.7%	17.4%	0.17
Diabetes	9.0%	33.0%	<0.01
Renal failure	6.0%	4.7%	<0.01
Liver disease	6.0%	4.4%	0.02
Anemia	15.1%	32.4%	<0.01
Obesity	6.0%	9.0%	<0.01
Depression	6.0%	11.2%	<0.01

Table 3

Characteristics of women who received different treatment types

Characteristic	Optimal Treatment (N=3320)	Non-optimal Treatment (N=1196)	Chemotherapy Only (N=1965)	Surgery Only (N=1226)	No Treatment (N=231)	P-value
Age Group (%)						<0.01
65–69	30.8	25.4	19.2	12.5	11.7	
70–74	30.1	27.2	21.9	16.6	9.5	
75–79	25.5	25.8	23.9	24.2	21.2	
80–84	11.3	16.5	22.2	24.0	26.8	
85+	2.4	5.2	12.8	22.7	30.7	
Race (%)						<0.01
White	91.2	89.1	87.4	87.8	85.3	
Black	3.6	5.4	6.4	6.3	9.1	
Asian	2.3	2.6	2.7	2.0	4.8	
Hispanic	1.3	1.1	1.4	2.3	4.8	
Other	1.6	1.8	2.1	1.7	4.8	
SEER Region (%)						<0.01
West	48.5	48.6	43.4	44.8	45.9	
Northeast	17.1	18.9	22.1	20.7	22.1	
Midwest	21.0	19.8	15.8	19.7	17.8	
South	13.5	12.7	18.6	14.9	14.3	
Histology (%)						<0.01
Serous Adenocarcinoma	83.6	82.9	80.4	76.6	70.6	
Other Epithelial	4.1	3.9	13.8	7.3	22.1	
Endometroid	8.3	6.4	2.1	6.9	4.8	
Mucinous	2.2	5.4	2.9	7.4	5.2	
Clear Cell	1.9	1.4	0.8	1.8	4.8	
Stage 3 (%)	69.0	62.5	36.8	55.7	68.4	<0.01
Stage 4 (%)	31.0	37.5	63.2	44.3	31.6	<0.01
Tumor Grade (%)						<0.01
1	2.3	2.3	0.8	3.2	4.8	
2	14.8	13.5	5.0	15.3	4.8	

Characteristic	Optimal Treatment (N=3320)	Non-optimal Treatment (N=1196)	Chemotherapy Only (N=1965)	Surgery Only (N=1226)	No Treatment (N=231)	P- value
3	51.5	46.7	20.3	42.2	20.4	Lin et al.
4	14.6	12.7	5.0	10.0	4.8	
Unknown	17.0	24.92	68.9	29.5	70.6	
Elixhauser Score Comorbidities (%)	17.5	18.1	18.3	20.3	21.3	
Hypertension	66.0	67.1	68.3	73.6	76.2	<0.01
Congestive heart failure	10.39	15.4	22.9	27.5	32.0	<0.01
Peripheral vascular disease	12.9	15.0	18.3	23.5	22.9	<0.01
Chronic pulmonary disease	22.3	24.8	28.2	28.8	31.6	<0.01
Diabetes	19.9	25.3	26.9	27.1	31.2	<0.01
Renal failure	2.1	3.1	5.6	6.9	12.6	<0.01
Liver disease	2.9	3.0	4.7	3.8	6.1	<0.01
Anemias	28.0	32.1	34.5	39.8	44.2	<0.01
Obesity	4.5	6.2	5.9	4.9	6.9	0.06
Depression	8.7	9.6	9.5	12.6	19.9	<0.01

Comparison of women who received different treatments in 1995–1997 and 2006–2008

Table 4

Characteristic	Optimal Treatment				Non-optimal Treatment				Chemotherapy Only				Surgery Only				No Treatment			
	1995– 1997 (N=400)	2006– 2008 (N=866)	P- Value		1995– 1997 (N=166)	2006– 2008 (N=285)	P- Value		1995– 1997 (N=200)	2006– 2008 (N=612)	P- Value		1995– 1997 (N=207)	2006– 2008 (N=277)	P- Value		1995– 1997 (N=24)	2006– 2008 (N=67)	P- Value	
Age Group (%)			0.07				0.05				0.01				0.23				0.18	
65–69	31	30.5			33.1	27.7			19.5	20.9			13.5	12.6			41.7	14.9		
70–79	58.8	55			51.2	47			54.5	42.7			34.8	42.2			41.7	34.3		
80+	10.2	14.6			15.7	25.3			26	36.4			51.7	45.1			70.8	55.2		
Race (%)			0.33				0.82				0.21				0.58				0.31	
White	90.6	91.4			87.4	87			89	86.4			86.5	89.2			87.5	80.6		
Black	3.3	4.2			7.2	6.3			3.5	6.9			6.3	5.8			41.7	14.9		
Other	6.1	4.5			5.4	6.7			7.5	6.7			7.3	5.1			41.7	14.9		
SEER Region (%)			<0.01				<0.01				<0.01				<0.01				0.01	
West	55.5	46.5			48.2	43.9			54.5	42.5			48.3	38.3			70.8	37.3		
Northeast	14.5	22.8			12.7	21.8			15	19.6			12.1	22.7			41.7	22.4		
Midwest	30	10.8			39.2	11.9			29.5	11.1			39.6	12.3			41.7	19.4		
South	0	20.5			0	22.5			5.0	26.8			0	26.7			41.7	20.9		
Histology (%)			0.2				0.19				0.2				0.55					
Serous	82.5	84.7			79.5	87.4			81.5	80.2			76.3	73.7			79.2	73.1		
Adenocarcinoma																				
Other Epithelial	5.3	3.7			6.0	3.5			12.5	14.2			7.3	10.1			41.7	23.9		
Endometrioid	6.9	7.9			6.0	4.6			5.0	1.6			8.2	7.6			41.7	14.9		
Mucinous	3.1	1.5			6.6	3.5			5.0	2.6			7.7	6.9			41.7	14.9		
Clear Cell	2.2	2.1			6.0	3.5			5.0	1.6			4.8	3.6			41.7	14.9		
Stage 3 (%)	61.4	38.6	0.001		55.4	63.9	0.08		33.5	34.8	0.74		54.1	52.7	0.76		41.7	70.8	0.75	
Stage 4 (%)	70.1	29.9	0.001		44.6	36.1	0.08		66.5	65.2	0.74		45.9	47.3	0.76		41.7	74.6	0.75	
Grade			<.001				0.13				0.08				0.04				0.04	
1	3.9	1.7			6.0	3.5			5.0	1.6			4.8	3.6			41.7	14.9		
2	19.8	12.2			16.9	10.9			9	4.3			21.7	12.3			41.7	14.9		
3	47.4	51.1			47	46.3			24.5	21.2			41.6	41.8			41.7	17.9		
4	13.7	17.8			10.2	16.5			5.0	5.4			12.6	12.6			41.7	14.9		
Unknown	15.3	17.3			23.5	25.3			61	68.6			22.7	31.4			66.7	79.1		
Elixhauser Score Comorbidities (%)			0.49		17	17.7	0.41		16.9	18.3	0.03		19.9	20.1	0.86		17.5	22.9	0.03	
Hypertension	51	72	<0.01		51.2	71.9	<0.01		58	71.9	<0.01		53.1	82.3	<0.01		45.8	86.6	<0.01	
Congestive heart failure	8.6	8.9	0.84		15.1	13.7	0.69		18	19.9	0.55		26.1	24.9	0.77		41.7	32.8	0.19	
Peripheral vascular disease	11.2	12.4	0.51		12.7	18.6	0.1		13	19.8	0.03		15	27.4	0.001		41.7	26.8	0.83	
Chronic pulmonary disease	20.6	21.6	0.72		22.9	24.9	0.63		20	28.4	0.02		23.7	31.4	0.06		41.7	26.9	0.02	
Diabetes	13.3	23.6	<0.01		21.1	28.4	0.09		19	29.6	<0.01		19.8	32.9	<0.01		41.7	40.3	0.09	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Characteristic	Optimal Treatment			Non-optimal Treatment			Chemotherapy Only			Surgery Only			No Treatment		
	1995– 1997 (N=490)	2006– 2008 (N=866)	P- Value	1995– 1997 (N=166)	2006– 2008 (N=285)	P- Value	1995– 1997 (N=200)	2006– 2008 (N=612)	P- Value	1995– 1997 (N=207)	2006– 2008 (N=277)	P- Value	1995– 1997 (N=24)	2006– 2008 (N=67)	P- Value
Renal failure	2.0	3.4	<0.01	6.0	5.6	0.06	5.0	7.8	<0.01	4.8	14.1	<0.01	41.7	23.9	0.01
Liver disease	2.0	4.6	0.02	6.0	3.5	0.75	5.0	5.7	0.03	4.8	5.1	0.02	41.7	14.9	1
Anemia	17.4	31.0	<0.01	22.3	37.9	<0.01	27.0	31.1	0.28	30.9	45.5	<0.01	41.7	44.8	0.79
Obesity	2.2	6.8	<0.01	6.0	7.7	0.04	5.0	8	0.03	4.8	7.6	<0.01	41.7	14.9	0.18
Depression	4.7	10.9	<0.01	7.8	8.8	0.73	5.0	11.8	<0.01	7.3	14.4	0.01	41.7	24.9	0.57