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Trends in Hospital Volume and Patterns of Referral for Women With Gynecologic Cancers

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Abstract

Objective—To estimate trends in hospital volume and referral patterns for women with uterine and ovarian cancer.

Methods—The SEER-Medicare database was used to identify women aged 65 years or older with ovarian and uterine cancer who underwent surgery from 2000 to 2007. “Volume creep,” when a greater number of patients undergo surgery at the same hospitals, and “market concentration,” when a similar overall number of patients undergo a procedure but at a smaller number of hospitals, were analyzed.

Results—Among 4,522 patients with ovarian cancer, mean hospital volume increased from 3.1 cases during 2000–2001 to 3.4 cases during 2006–2007 ($P=0.62$) suggesting minimal volume creep. Similarly, there was little evidence of market concentration. In 2000–2001, 37.8% of women were treated at the top decile by volume hospitals compared to 41.4% in 2006–2007 ($P=0.14$). In 2006–2007, 201 (63.2%) of the hospitals had an ovarian cancer surgery volume of two or fewer cases. Among 9,908 women with uterine cancer, the mean hospital volume increased slightly from 4.5 in 2000–2001 to 5.4 in 2006–2007 ($P=0.10$). The percentage of patients treated at the top decile by volume of hospitals increased from 40.4% in 2000–2001 to 44.7% in 2006–2007 ($P<0.001$). In 2006–2007, 243 (49.3%) of the hospitals had a uterine cancer surgery volume of two or fewer cases.

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This study used the linked SEER-Medicare database. The interpretation and reporting of these data are the sole responsibility of the authors.

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Conclusion—There have been only modest changes in the referral patterns of women with ovarian and uterine cancer. A large number of hospitals have a very low procedural volume.

Introduction

The relationship between surgical volume and outcome is well-established; patients operated on by high-volume surgeons and at high-volume hospitals have superior outcomes compared to patients treated by low-volume providers.^{1–4} Although the importance of surgical volume has long been recognized, the concept gained prominence in the early 2000s after a series of studies showing the effect of volume on outcomes were reported.^{1–4} In one study that included over 2.5 million patients who underwent high-risk cardiovascular or oncologic surgery, outcomes were superior for all of the procedures when performed at high-volume centers.²

The recognition of the volume-outcome paradigm has led to a number of public health initiatives to attempt to improve patient outcomes.^{5,6} Public reporting of both surgical volume and outcomes has been advocated by many sources. One such group, the Leapfrog consortium, is a public reporting initiative that selects minimum procedural volume standards for high-risk procedures and reports actual hospital volumes. The intent of these initiatives is to drive evidence-based hospital referrals.⁷ For some high-risk surgical procedures there is evidence that these initiatives have led to regionalization of care and have been associated with improved outcomes.^{8–11}

While the association between high surgical volume and improved outcomes has been demonstrated for many procedures, for gynecologic cancer operations, the relationship is less robust.^{12–17} To date, the effect of volume centered initiatives on the patterns of care for women with gynecologic cancer has received little attention. We estimated the referral patterns of women with uterine and ovarian cancer undergoing cancer-directed surgery in the United States.

Materials and Methods

The Surveillance, Epidemiology, and End Results (SEER)-Medicare database was used.¹⁸ SEER is a population-based tumor registry maintained by the National Cancer Institute that provides data on tumor characteristics, treatment, and survival, as well as demographic and selected census tract-level information. The Medicare database includes information on patients with Medicare part A (inpatient) and part B (outpatient) including diagnoses and billed claims. Medicare provides coverage to women ≥ 65 years of age. Exemption from the Columbia University Institutional Review Board was obtained. The SEER-Medicare database has been validated and utilized in a number of outcomes studies.^{18–20}

We selected women >65 years of age with primary cancer of the uterus or ovary who underwent surgery between January 1, 2000 and December 31, 2007. We excluded patients who were enrolled in a non-Medicare health maintenance organization, Medicare beneficiaries due to end stage renal disease, patients diagnosed at autopsy or by death certificate, and those with tumors arising from other primary sites. For the purpose of analysis, surgery for ovarian cancer was considered any of the following procedures:

oophorectomy, hysterectomy, tumor debulking, exenteration, or omentectomy. For women with uterine cancer, the criterion for surgery was hysterectomy. For each primary tumor type, patients were classified as early (stage I-II) or advanced-stage (stage III-IV) based on the recorded SEER variable for stage. Separate analyses were performed for uterine and ovarian cancer.

Age was categorized as 65–69 years, 70–74 years, 74–79 years and 80 years of age or older while race was classified as white, black, Hispanic or other. Year of diagnosis was recorded from 1999–2007, marital status coded as married, unmarried or unknown and area of residence as metropolitan or non-metropolitan. Socioeconomic status (SES) was generated from a score derived from education, poverty level, and income from the 2000 census tract data and scores ranked on a scale of 1–5 with 1 being the lowest value. To estimate the prevalence of comorbid disease in our cohort, we used the Klabunde adaptation of the Charlson comorbidity index. Tumor grade was recorded as well, moderately, or poorly differentiated or unknown. For women with uterine cancer histology was classified as endometrioid, serous, carcinosarcoma, clear cell, leiomyosarcoma and other/unknown. For ovarian cancer histology was grouped as epithelial, germ cell and sex cord stromal and other/unknown. The SEER registries were categorized as: eastern (Connecticut, New Jersey), Midwestern (Detroit, Iowa, Utah, Atlanta, rural Georgia, Kentucky, Louisiana), and western (San Francisco, Hawaii, New Mexico, San Jose, Seattle, Los Angeles, greater California).

The hospital in which each patient's procedure was performed was identified; those patients for which the hospital identification information was missing were excluded. Subjects were then categorized into two year blocks (2000–01, 2002–03, 2004–05, 2006–07) based on the date of surgery. For each two-year block, the number of procedures performed in each hospital was calculated and hospitals ranked by volume.

Trends in hospital volume over time were analyzed as previously reported.⁸ “Volume creep” occurs when a greater number of patients undergo the procedure of interest in the hospitals under study. “Market concentration” occurs when the number of patients who undergo a procedure remains relatively constant but the number of hospitals in which the procedures are performed declines.⁸ The percentage of procedures concentrated in the highest decile and highest quartile by volume hospitals were analyzed as a measure of market concentration.

For each period of analysis, we estimated the mean and median hospital volumes with standard deviations and interquartile ranges, respectively. Mean and median changes in hospital volumes over time were analyzed using ANOVA and the Kruskal-Wallis test, respectively. Changes in the number of patients treated at top quartile and decile by volume hospitals over time were analyzed using chi square tests. A p-value of <0.05 was considered statistically significant. All analyses were conducted with SAS, version 9.13 (SAS Institute, Cary, NC). All statistical tests were two-sided.

Results

A total of 9908 patients with uterine cancer who underwent surgery were identified (Table 1). In 2000–2001, 2,424 patients were treated across 535 hospitals. By the years 2006–2007, 2,640 patients were treated at 493 hospitals (Table 2). The median per hospital volume remained 2 procedures for the years 2000–2001, 2002–2003, and 2004–2005 and increased to 3 cases by the 2006–2007 time period ($P=0.72$). The mean volume increased over time from 4.5 cases in 2000–2001, to 4.5 cases in 2002–2003, to 5.2 surgeries in 2004–2005 and to 5.4 procedures in 2006–2007 ($P=0.73$) (Figure 1).

For women with uterine cancer, there was evidence of market concentration at the highest volume hospitals (Table 2). For example, the percentage of patients treated at the highest quartile by volume hospitals increased over time from 63.9% in 2000–2001 to 66.1% in 2002–2003, to 71.0% in 2004–2005 and finally to 71.1% in 2006–2007 ($P<0.001$). Similar trends were noted when the analysis was limited to the highest decile by volume hospitals. In 2000–2001, 40.4% ($n=979$) of patients were treated at 52 hospitals. By 2006–2007, this had increased to 44.7% ($n=1181$) of the patients at 50 centers ($P<0.001$). Despite market concentration, the number of women treated at very low volume centers remained relatively constant; 35.3% of patients in 2000–2001 were treated at centers that only performed 1 procedure compared to 34.9% in 2006–2007 ($P=0.98$).

For patients with advanced stage uterine cancer, both mean (1.6 to 2.5, $P<0.001$) and median (1 to 2, $P<0.001$) volume increased from 2000–2001 to 2006–2007 (Table 1). The increase in hospital volume for patients with advanced stage disease was predominantly due to volume creep; in 2000–2001, 151 hospitals cared for 243 patients with stage III–IV uterine cancer (10.0% of all patients treated during that time period). By 2006–2007, 225 hospitals provided care for 565 similarly staged patients (21.4% of all uterine cancer patients during 2006–2007). There was no apparent market concentration for advanced stage uterine cancer.

Overall, 4522 patients with ovarian cancer were identified (Table 1). In 2000–2001, 1235 patients were treated at 396 hospitals. By the years 2006–2007, 1095 patients underwent surgery at 318 facilities (Table 3). The median hospital volume remained constant at 2 across all eight years of the study ($P=0.84$). There was a non-statistically significant increase in the mean hospital procedural volume with time, from 3.1 cases in 2000–2001 to 3.2 cases in 2002–2003, to 3.1 procedures in 2004–2005, and to 3.4 cases in the final years of the study, 2006–2007 ($P=0.62$) (Figure 2).

For ovarian cancer, there was modest market concentration to the highest volume hospitals over the years of study. The percentage of patients who underwent surgery at the highest quartile by volume hospitals increased from 62.9% in 2000–2001, to 63.8% in 2002–2003, to 64.1% in 2004–2005, and to 69.0% in 2006–2007 ($P=0.01$). The analysis was then limited to the highest decile by volume hospitals. In 2000–2001, 37.8% ($n=467$) of patients were treated at the 35 highest decile by volume hospitals compared to 41.4% ($n=453$) of women who underwent surgery at the 33 highest volume centers in 2006–2007 ($P=0.14$).

The percentage of women treated at hospitals that performed 1 procedure per time period was 47.5% in 2000–2001, 48.0% in 2002–2003, 48.5% in 2004–2005, and 45.3% in 2006–

2007 ($P=0.85$). Among women with advanced stage ovarian cancer, similar trends were noted, mean volume increased from 2.7 to 3.2 ($P=0.39$) while median volume increased from 1 to 2 cases ($P=0.40$).

Discussion

Our findings suggest that, for women with ovarian and uterine cancer, public health initiatives to promote volume concentration have had a minimal impact in elderly women. Over the last decade, we noted modest market concentration with a small increase in the number of patients referred to high-volume hospitals. A large number of women with gynecologic cancers are still treated at very low volume centers.

A number of reports have suggested that several high-risk or technically complex operations, particularly oncologic procedures, have been increasingly regionalized to high-volume centers.^{8,10,11,21–25} A study of Medicare beneficiaries who underwent cancer resections or cardiovascular surgery noted increases in hospital volume for all four of the oncologic procedures studied (esophagectomy, pancreatectomy, lung resection, and cystectomy). The median hospital volume for cystectomy increased from 5 procedures in 1999–2000 to 10 procedures in 2007–2008, while the median pancreatectomy volume more than tripled from 5 to 16 cases over the same time period. The underlying cause for the increased hospital volume was accounted for by both volume creep and market concentration. For example, for esophagectomy the number of patients who underwent the procedure remained relatively constant but the number of hospitals that performed the procedure declined; in contrast, for pancreatectomy, not only did the number of hospitals performing the procedure decline, but the number of patients undergoing the procedure increased by more than 50%.⁸

Studies examining regionalization of care for gynecologic cancers have been limited.^{26–28} A report that analyzed referral patterns in Maryland found an increase in treatment at high-volume hospitals and by high-volume surgeons for women with ovarian cancer in 2001–2008 compared to those treated in the 1990s.²⁷ Similar data were noted in a report from Norway.²⁸ Our findings were clearly more modest; we found no change in the median number of ovarian cancer procedures and a small increase in hospital procedural volume for endometrial cancer.

The goal of regionalization of care is to reduce perioperative mortality and several reports have suggested that this is, in fact, feasible for some procedures.^{8,9,22,29} A study examining trends in operative mortality suggested that increased procedural volume for six cancer operations was associated with a reduction in inpatient mortality ranging from 0.1–2.3%.⁹ The report by Finks and colleagues of Medicare recipients described above found that increased hospital volume was directly associated with a 32% reduction in mortality for esophagectomy, a 37% reduction in the risk of death for cystectomy, and a 67% reduction in death after pancreatectomy.⁸ A population-based analysis from Norway that examined centralization of the care of ovarian cancer patients to a teaching hospital reported improved survival after centralization.²⁹ A priori, the goal of our study was to assess whether changing

referral patterns were associated with reductions in mortality for gynecologic cancer; however the minimal change in hospital volume precluded examination of mortality.

Regionalization of care tends to be most pronounced for those procedures with the strongest correlation between volume and outcome. Compared to other cancer resections, the association between volume and outcome for gynecologic tumors has been weaker.^{12–17} A report of elderly women with ovarian cancer found that high hospital procedural volume was associated with a small decrease in 2-year mortality but had no effect on overall survival.¹³ Similarly, an analysis of women undergoing abdominal hysterectomy for endometrial cancer found that, while patients treated by high-volume physicians had decreased perioperative morbidity, hospital volume had no effect on complications; neither hospital nor surgeon volume were associated with perioperative mortality.¹² The limited change in hospital referral patterns we noted may stem, at least in part, from the modest effect of volume on outcome for gynecologic cancer surgery.

Although the effect of procedural volume on outcome for gynecologic cancers is relatively small, the specialty of the surgeon appears to have an important influence on survival for both endometrial and ovarian cancer.^{30–34} A population-based analysis of women with ovarian cancer found higher rates of tumor cytoreduction for advanced stage disease, a higher rate of receipt of chemotherapy, and improved survival for patients treated by gynecologic oncologists compared to general gynecologists or surgeons.³⁰ Similarly, Chan and co-workers found that treatment by a gynecologic oncologist was an independent predictor of improved survival for women with endometrial cancer.³¹ Referral based on physician specialty and not hospital volume may, in part, underlie the minimal regionalization that we noted.

While our study benefits from the inclusion of a large number of hospitals and patients, we recognize a number of important limitations. Foremost, our data represents relative and not absolute changes in volume. Our dataset did not include patients <65 years age, non-Medicare recipients, or patients treated outside of the SEER registries studied. While our data is a proxy for overall hospital volume, prior work has shown a high correlation between volume calculated using SEER-Medicare data and the actual rank order of hospitals based on volume.³⁵ We did not examine how physician volume and physician characteristics influence referral patterns. Given the importance of physician characteristics in the treatment of gynecologic cancer, this clearly warrants further investigation. We only analyzed data from 2000 to 2007 and cannot exclude the possibility that regionalization may have occurred prior to that time. Finally, within each cohort patients often underwent ancillary procedures such as lymphadenectomy or extended cytoreductive procedures. To limit this bias, separate analyses were performed for early and advanced stage patients for both primary tumor sites.

Should regionalization of care for gynecologic malignancies be encouraged? Although regionalization may be attractive, it is often difficult to implement.^{36–39} Referral to high-volume centers is often met with resistance by both patients and providers, leads to disparities in which minorities and the underinsured are less likely to receive referral to a high-volume center, and is problematic in many regions that lack high-volume facilities.^{36–39} Furthermore, for lower-risk patients undergoing high-risk surgery, the

benefits of volume-based referral are questionable; it appears that the greatest benefits are derived in the highest-risk patient population undergoing the highest risk surgeries.⁴⁰ Given these difficulties, some authors have suggested that regionalization should primarily be encouraged for high morbidity procedures with strong volume-outcome relationships like pancreatectomy and esophagectomy.⁸ Given the modest association between volume and survival for gynecologic cancer, it is difficult to endorse volume-based referral, and our data suggest that, to date, there has been minimal regionalization. For gynecologic cancer, it would appear that initiatives to promote referral to gynecologic oncologists would offer the greatest benefit to patients.

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Figure 1.

Trends in hospital volume for women with uterine cancer. A. Mean and median hospital volume for all patients. B. Mean and median hospital volume for patients with advanced stage disease. C. Patients treated at low-volume (one or two patients) hospitals. D. Patients with advanced stage disease treated at low-volume (one or two patients) hospitals.

Figure 2.

Trends in hospital volume for women with ovarian cancer. A. Mean and median hospital volume for all patients. B. Mean and median hospital volume for patients with advanced stage disease. C. Patients treated at low-volume (one or two patients) hospitals. D. Patients with advanced stage disease treated at low-volume (one or two patients) hospitals

Table 1

Clinical and Demographic Characteristics of the Cohort Stratified by Tumor Site

	Uterine cancer		Ovarian cancer	
	n	(%)	n	(%)
Age (years)				
65–69	2395	(24.2)	1001	(22.1)
70–74	2741	(27.7)	1263	(27.9)
75–79	231	(23.4)	1206	(26.7)
80 or older	2455	(24.8)	1052	(23.3)
Race				
White	8879	(89.6)	4084	(90.3)
Black	570	(5.8)	182	(4.0)
Hispanic	126	(1.3)	68	(1.5)
Other or unknown	333	(3.4)	188	(4.2)
Year of diagnosis				
1999	40	(0.4)	23	(0.5)
2000	1225	(12.4)	642	(14.2)
2001	1255	(12.7)	596	(13.2)
2002	1171	(11.8)	581	(12.9)
2003	1172	(11.8)	588	(13.0)
2004	1290	(13.0)	532	(11.8)
2005	1204	(12.2)	502	(11.1)
2006	1368	(13.8)	618	(13.7)
2007	1183	(11.9)	440	(9.7)
Marital status				
Married	4418	(44.6)	2102	(46.5)
Unmarried	5045	(50.9)	2242	(49.6)
Unknown	445	(4.5)	178	(3.9)
Area of residence				
Metropolitan	9002	(90.9)	4126	(91.2)
Nonmetropolitan	906	(9.1)	396	(8.8)
Socioeconomic status				
First (lowest)	1019	(10.3)	391	(8.7)
Second	1818	(18.4)	782	(17.3)
Third	2265	(22.9)	1049	(23.2)
Fourth	2282	(23.0)	1049	(23.2)
Fifth (highest)	2517	(25.4)	1251	(27.7)
SEER registry				
Eastern	3724	(37.6)	1644	(36.4)
Midwest	2520	(25.4)	1157	(25.6)
West	3664	(37.0)	1721	(38.1)
Comorbidity				

	Uterine cancer		Ovarian cancer	
	n	(%)	n	(%)
0	5109	(51.6)	2543	(56.2)
1	2767	(27.9)	1171	(25.9)
2 or more	2032	(20.5)	808	(17.9)
Histology (uterine cancer)				
Endometrioid	7479	(75.5)	-	-
Serous	691	(7.0)	-	-
Carcinosarcoma	606	(6.1)	-	-
Clear cell	146	(1.5)	-	-
Leiomyosarcoma	123	(1.2)	-	-
Other or unknown	863	(8.7)	-	-
Histology (ovarian cancer)				
Epithelial	-	-	3800	(84.0)
Germ cell and sex cord stromal	-	-	40	(0.9)
Other or unknown	-	-	682	(15.1)
Grade				
Well differentiated	3212	(32.4)	187	(4.1)
Moderately differentiated	3002	(30.3)	697	(15.4)
Poorly differentiated	2623	(26.5)	2610	(57.7)
Unknown	1071	(10.8)	1028	(22.7)
Stage				
I	7156	(72.2)	614	(13.6)
II	480	(4.8)	422	(9.3)
III	754	(7.6)	2096	(46.4)
IV	854	(8.6)	1081	(23.9)
Unknown	664	(6.7)	309	(6.8)

SEER, Surveillance, Epidemiology, and End Results.

Table 2

Trends in Hospital Volume For Women With Uterine Cancer

	2000–2001	2002–2003	2004–2005	2006–2007	P
All Patients					
<i>Volume</i>					
Hospitals	535	514	486	493	
Patients	2424	2333	2511	2640	
<i>Volume</i>					
Mean	4.5	4.5	5.2	5.4	0.10
SD	5.7	5.6	7.3	7.3	
Median	2	2	2	3	0.73
IQR	1–5	1–5	1–6	1–6	
Hospitals with 1 patient (%)	189 (35.3%)	186 (36.2%)	172 (35.4%)	172 (34.9%)	0.98
Hospitals with 2 patients (%)	91 (17.0%)	80 (15.6%)	85 (17.5%)	71 (14.4%)	0.54
<i>Market concentration</i>					
Top decile					
Patients	979	939	1114	1181	
% patients	40.4%	40.3%	44.4%	44.7%	<0.001
Hospitals	52	48	47	50	
Top quartile					
Patients	1550	1542	1783	1878	
% patients	63.9%	66.1%	71.0%	71.1%	<0.001
Hospitals	126	128	127	131	
Advanced Stage Cancer					
<i>Volume</i>					
Hospitals	151	145	217	225	
Patients	243	260	540	565	
<i>Volume</i>					
Mean	1.6	1.8	2.5	2.5	<0.001
SD	1.4	1.6	2.4	2.3	
Median	1	1	1	2	<0.001

	2000–2001	2002–2003	2004–2005	2006–2007	P
IQR	1–2	1–2	1–3	1–3	
Hospitals with 1 patient	108 (71.5%)	93 (64.1%)	116 (53.5%)	109 (48.4%)	<0.001
Hospitals with 2 patients	25 (16.6%)	28 (19.3%)	32 (14.8%)	45 (20.0%)	0.47
<i>Market concentration</i>					
Top decile					
Patients	67	75	174	180	
% patients	27.6%	28.8%	32.2%	31.9%	0.48
Hospitals	12	12	20	22	
Top quartile					
Patients	135	111	297	294	
% patients	55.6%	42.7%	55.0%	52.0%	0.007
Hospitals	43	24	48	47	

SD, standard deviation; IQR, interquartile range.

Table 3

Trends in Hospital Volume For Women With Ovarian Cancer

	2000–2001	2002–2003	2004–2005	2006–2007	P
All Patients					
<i>Volume</i>					
Hospitals	396	371	332	318	
Patients	1235	1168	1024	1095	
<i>Volume</i>					
Mean	3.1	3.2	3.1	3.4	0.62
SD	3.8	3.7	3.9	4.2	
Median	2	2	2	2	0.74
IQR	1–3	1–3	1–3	1–4	
Hospitals with 1 patient	188 (47.5%)	178 (48.0%)	161 (48.5%)	144 (45.3%)	0.85
Hospitals with 2 patients	69 (17.4%)	64 (17.3%)	60 (18.1%)	57 (17.9%)	0.99
<i>Market concentration</i>					
Top decile					
Patients	467	430	401	453	
% patients	37.8%	36.8%	39.2%	41.4%	0.14
Hospitals	35	34	31	33	
Top quartile					
Patients	777	745	656	756	
% patients	62.9%	63.8%	64.1%	69.0%	0.01
Hospitals	95	90	82	90	
Advanced-stage cancer					
<i>Volume</i>					
Hospitals	304	286	260	259	
Patients	804	819	738	816	
<i>Volume</i>					
Mean	2.7	2.9	2.8	3.2	0.31
SD	2.9	3.0	3.3	3.5	
Median	1	2	2	2	0.39

	2000–2001	2002–2003	2004–2005	2006–2007	P
IQR	1–3	1–3	1–3	1–4	
Hospitals with 1 patient	162 (53.3%)	136 (47.6%)	129 (49.6%)	121 (46.7%)	0.39
Hospitals with 2 patients	48 (15.8%)	54 (18.9%)	49 (18.9%)	47 (18.2%)	0.73
<i>Market concentration</i>					
Top decile					
Patients	293	271	279	276	
% patients	36.4%	33.1%	37.8%	33.8%	0.17
Hospitals	30	26	25	22	
Top quartile					
Patients	474	488	439	526	
% patients	59.0%	59.6%	59.5%	64.5%	0.08
Hospitals	70	67	58	66	

SD, standard deviation; IQR, interquartile range.