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Rural Disparities in Surgical Care from Gynecologic Oncologists Among Midwestern Ovarian Cancer Patients

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Abstract

Objective—Up to one-third of women with ovarian cancer in the United States do not receive surgical care from a gynecologic oncologist specialist despite guideline recommendations. We aim

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to investigate the impact of rurality on receiving surgical care from a specialist, referral to a specialist, and specialist surgery after referral, and the consequences of specialist care.

Methods—We utilized a retrospective cohort created through extension of standard cancer surveillance in three Midwestern states. Multivariable adjusted logistic regression was utilized to assess gynecologic oncologist treatment of women 18–89 years old, who were diagnosed with primary, histologically confirmed, malignant ovarian cancer in 2010–2012 in Kansas, Missouri and Iowa by rurality.

Results—Rural women were significantly less likely to receive surgical care from a gynecologic oncologist specialist (adjusted odds ratio (OR) 0.37, 95% confidence interval (CI) 0.24–0.58) and referral to a specialist (OR 0.37, 95% CI 0.23–0.59) compared to urban women. There was no significant difference in specialist surgery after a referral (OR 0.56, 95% CI 0.26–1.20). Rural women treated surgically by a gynecologic oncologist versus non-specialist were more likely to receive cytoreduction and more complete tumor removal to ≤ 1cm.

Conclusion—There is a large rural-urban difference in receipt of ovarian cancer surgery from a gynecologic oncologist specialist (versus a non-specialist). Disparities in referral rates contribute to the rural-urban difference. Further research will help define the causes of referral disparities, as well as promising strategies to address them.

Introduction

Ovarian cancer is the fifth leading cause of cancer death and eighth most common incident cancer in women in the United States.[1] From 2009 to 2015, women with ovarian cancer had a 5-year relative survival rate of 47.6%.[1] Without effective, available screening methods for the population, ovarian cancer is often diagnosed at an advanced stage. Ovarian cancer survival is determined by stage at diagnosis, as well as adherence to guideline recommended care of surgery, chemotherapy, and systemic therapy.[2–4]

Gynecologic oncologists, or cancer surgeon specialists of the female reproductive tract, achieve surgical results most in line with guideline recommendations.[5–10] Consequently, the National Comprehensive Cancer Network, Centers for Disease Control and Prevention (CDC), National Institutes of Health, American College of Obstetrics and Gynecologists, and Society of Gynecologic Oncologists suggest that ovarian cancer patients pursuing surgical treatment receive surgical care from a gynecologic oncologist.[11,12] Nevertheless, among ovarian cancer patients in the United States that pursue surgical care as treatment for their ovarian cancer (versus palliative care and non-surgical care) up to one-third do not receive their cancer-directed surgery from gynecologic oncologists.[13–16] Instead, they receive care from non-specialists, such as general surgeons and obstetrician-gynecologists. There is a critical need to investigate the contributing barriers to gynecologic oncologist surgical care.[13–16] Studies outside and within the United States of women diagnosed in the late 1990s and early 2000s have provided preliminary evidence that rurality may be an important contributing barrier.[16–18]

Throughout the last two decades, it has been suggested that rurality has grown as a barrier under the Centers of Excellence model, where patients need to travel to receive care from specialists at urban, tertiary medical centers.[19] According to a 2011 report from the CDC,

over 99% of gynecologic oncologists in the United States work in metropolitan counties, while one-fifth of their ovarian cancer patients live in rural counties.[12] Furthermore, over half of the counties in the United States are located greater than 50 miles from a county with a gynecologic oncologist.[20] Self-reports from gynecologic oncologists confirm that at least one-third of the ovarian cancer patients travel more than 50 miles for surgery with a specialist.[19] Under the Centers of Excellence model, rural patients may face patient-level barriers, such as out-of-network insurance costs and travel difficulties, and system-level barriers, such as rural referral network restrictions and knowledge limitations.[21–24]

The primary aim of this study was to investigate the impact of rurality on receiving surgical care from a gynecologic oncologist among women that pursue surgical care while controlling for important confounding patient-level and system-level factors, such as the socioeconomic status of a patient's census tract, in three Midwestern states.[20,25] The secondary aim was to assess the impact rurality has on receiving a referral to a surgical specialist and receiving surgery after a surgical referral is made. Finally, our third aim was to investigate consequences of specialist care by rurality, such as time from diagnosis-to-surgery, travel distance to surgery, type of surgery received, and extent of tumor clearance.

Methods

Study Population

We utilized the retrospective cohort addressing *Patterns of Ovarian Cancer Care and Survival in the Midwestern Region of the United States—a CDC Investigation*.[26] This cohort consists of a random population-based sample of 1003 women with ovarian cancer who were residents of Iowa and Missouri at the time of their ovarian cancer diagnosis in 2011–2012, and were residents of Kansas at the time of their ovarian cancer diagnosis in 2010–2012. Kansas cases were abstracted from 2010 due their low number sampling frame. The cohort aimed to include 1000 patient cases with 200–350 coming from each registry; 253 cases (31.5%) were from Iowa, 273 cases (34.0%) from Kansas, and 278 cases (34.6%) from Missouri. Over these time periods, the total number of women diagnosed with ovarian cancer were 441 in Iowa, 549 in Kansas, and 773 in Missouri. Based on this information, the percent of the total women included in this cohort was 57% (253/441) in Iowa, 50% (273/549) in Kansas, and 36% (278/773) in Missouri. We do not know the total number of patients that received cancer-directed surgery in these states. The states included in this CDC investigation were chosen because they have a high prevalence of rural women, and they are located in the Midwestern United States where there is a paucity of specialists, high ovarian cancer mortality, and a prevalence of low access counties located greater than 50 miles from gynecologic oncologists.[12,26–28] Thirty-two percent of women in Iowa, Kansas, and Missouri reside in a rural residence.

The women included in the cohort were diagnosed with a primary, histologically confirmed epithelial, sex-cord or germ cell (International Classification of Diseases for -Oncology [ICD-O]-3 8000–8576, 8930–9110) malignant tumor of the ovary, fallopian tube or primary peritoneum (ICD-O-3 C56.9, C57.0, C48.1, C48.2 and C48.8) between the ages of 18 and 89 years. Women with low malignant potential histology (ICD-O-3 codes 8442, 8451, 8462,

8472, 8473), a diagnosis at autopsy or by death certificate, or a synchronous tumor within six months of their ovarian cancer diagnosis were excluded from the cohort.

We analyzed the subset of women who received surgical care in *Patterns of Ovarian Cancer Care and Survival in the Midwestern Region of the United States—a CDC Investigation.* Our analysis included only women who had cancer-directed surgery for their ovarian cancer, and excluded women who did not receive cancer-directed surgery (Image 1).

Data Sources

All the variables in our analysis were obtained through an extension of standard surveillance protocols for state cancer registries. Trained cancer registrars used standardized definitions and abstraction manuals to abstract data from the medical record of each participant. Alternative options, such as follow-up with medical providers, were pursued when data were not available in the medical record. Abstraction and dataset creation lasted 18 months over the years 2017 and 2018. An institutional review board (IRB) at the CDC and each of the respective IRBs for the three state cancer registries approved this cohort study.

Variables

Our primary exposure of interest was the rurality of the census tract where the ovarian cancer patient lived at the time of diagnosis. This variable was created based on the 6-category National Center for Health Statistics (NCHS) rural-urban classification scheme framework.[29] A rural census tract was defined as a non-metropolitan population with an urban cluster population of 10,000–49,999 persons or a non-metropolitan/non-core population. An urban census tract was defined as populations greater than 50,000 persons. This binary cut-point was chosen in accordance with NCHS recommendations and compared against metropolitan and micropolitan statistical areas, proximity to metropolitan centers, urbanization county maps, and growth rate maps in the three states for appropriateness.[29,30]

Our primary outcome was the specialty of the physician who performed the primary ovarian cancer-directed surgery. This variable was operationalized as gynecologic oncologist versus another specialty (i.e., general surgeon, obstetrician-gynecologist, and other/unknown). Cancer-directed surgery refers to surgery with the main purpose of removing and/or debulking the ovarian cancer. Diagnostic procedures that have no impact on cancer removal (i.e., paracentesis or tapping a pleural effusion), are not considered cancer-directed surgery. Laparotomy and operative laparoscopy without intention of resection of any ovarian mass may be staging, but not cancer-directed surgery. Incidental surgeries that discover cancer, but do not treat cancer, are not considered cancer-directed surgery. Our secondary outcome was referral to a gynecologic oncologists (binary). ‘Referral’ means that there was documentation of the referring provider suggesting, recommending, or scheduling their patient to see a gynecologic oncologist for surgical care. Referrals were documented irrespective of whether they resulted in a visit.

Covariates were selected using a theoretical framework and directed acyclic graphs. They are age at diagnosis, Charlson comorbidity score at diagnosis, census tract percentage of residents with less than a high school level of education, census tract median income,

insurance status of the patient at time of surgery, the patient's race/ethnicity, and stage of cancer at diagnosis. The Charlson comorbidity score was calculated based on the original conditional weighting of patient comorbidities at time of diagnosis, meaning the ovarian cancer tumor is not included in the score.[31–33] Patient race/ethnicity was determined from the medical record, and due to the limited number of non-white patients, was categorized as non-Hispanic white versus non-white. Stage was obtained from the medical record and reported according to the International Federation of Gynecology and Obstetrics (FIGO 2013, www.figo.org).

In the description of our study population, we detailed the histologies of patients' tumors as epithelial or non-epithelial disease in accordance with ICD-O-3 morphology codes.[34] Grade was classified according to Surveillance, Epidemiology, and End Results (SEER) standards and site of origin was classified as ovarian (ICD-O-3 code C56.9), fallopian tube (C57.0), or peritoneal (C48.1, C48.2, and C48.8) cancers.[35] Distance to surgical care was calculated as straight distance miles using latitudes and longitudes for Great Circle Distance in ArcGIS between the patient's residence at diagnosis and the location of the primary cancer-directed surgical care. Hospital type was obtained through the American Hospital Association (AHA) Annual Survey of Hospitals and was categorized as government (federal, state and local government hospitals) and private (non-profit private and private investor-owned).

Theoretical Framework

The selection of covariates for analyses was based on the Behavioral Model of Health Services Use, which was first published by Andersen in 1973 as an adaptation of his earlier and broader behavioral model published in 1968. This model provides a casual framework for multilevel modeling of patient- and system-level factors impacting utilization of a specialist.[36–38] The theory has three major constructs including predisposing factors, enabling factors, and need factors.[36–39] Predisposing factors are subcategorized into demographic factors, social structure factors, and beliefs.[36–39] Enabling factors are subcategorized into family and community level factors.[36–39] Finally, need factors, sometimes referred to as illness factors, are subcategorized into perceived factors and evaluated/proven need factors.[36–39] Our exposure of interest was a community level enabling factor, while the other categorization of our covariates can be found in Supplemental Image 1.

Statistical Analysis

We compared the patient, tumor, and treatment characteristics of women at the time of cancer diagnosis who had rural versus urban residences. All comparisons used an alpha of 0.05. Categorical variables were compared against rurality using a Pearson Chi-squared test and rurality was compared by continuous variables using a 2-sample independent group t-test.

We created three multivariable logistic regression models to investigate our primary and secondary aims. The multivariable model for our primary aim calculated the adjusted odds of receiving surgery from a gynecologic oncologist (versus a non-specialist) among all ovarian cancer patients who had cancer-directed surgery after adjusting for rurality and all

previously described covariates. The second multivariable model estimated the adjusted odds of receiving a surgical referral to a gynecologic oncologist (versus not receiving a referral to a specialist) among all ovarian cancer patients who had cancer-directed surgery after adjusting for rurality and all covariates stated previously. The third model estimated the adjusted odds of receiving surgery from a gynecologic oncologist (versus a non-specialist) among the patients that received surgical care and received a referral to a gynecologic oncologist prior to their surgical care after adjusting for rurality, age at diagnosis, and stage at diagnosis. We limited the number of covariables in the third multivariable logistic regression model to prevent over parameterization.[40] Covariates were selected *a priori*.

For our third aim, we subdivided our cohort into two strata: women who received surgery from a gynecologic oncologist and women who received surgery from another specialty. Within each stratum, we compared rural and urban women by their receipt of cytoreductive surgery, amount of tumor remaining, hospital type, great circle distance to surgical care, time from diagnosis-to-surgery among women who received adjuvant chemotherapy, and time from diagnosis-tosurgery among women who did not receive adjuvant chemotherapy.[41] We also compared rural women and urban women in each stratum with their counterpart in the other stratum. Finally, we conducted an exploratory analysis among the subset of women who did not have surgery with a gynecologic oncologist, by comparing surgeon specialties and reasons for not being referred to a gynecologic oncologist by rurality.

Results

The average age of the women in this study was 61.7 years among rural women (N=252) and 60.8 years among urban women (N=552). The majority of women in the study had Charlson scores of zero (rural and urban, 79% and 81%), lived in census tracts with 0–10% of their residents having less than a high school level of education (50% and 69%), had poorly to undifferentiated grade tumors (63% and 66%), had epithelial histologies (97% and 97%), were insured (96% and 96%), had a primary site of the ovary (83% and 81%), were of non-Hispanic white race/ethnicity (99% and 91%), had stage III and IV cancer (66% and 64%), and had surgery performed by a gynecologic oncologist (73% and 88%) (Table 1). Per two-sample Chi-square tests, rural women differed from urban women in percentage of the census tract with less than a high school education, average income of their census tract, distance to surgeon, race/ethnicity, and surgeon specialty (Table 1).

Among all women treated surgically, rural women had lower odds of receiving both a surgical referral to a gynecologic oncologist (odds ratio (OR) 0.37, 95% confidence interval (CI) 0.23–0.59) and surgery from a gynecologic oncologist (OR 0.37, 95% CI 0.24–0.58) (Table 2). Likewise, similar patterns were observed in older women (76–89 years) versus 18–45-year-old women. In contrast, women who had stage III/ IV and unknown cancer (versus I/II) had greater odds of receiving a referral to a gynecologic oncologist (OR 2.02, 95% CI 1.29–3.19) and receiving surgery from a gynecologic oncologist (2.30, 95% CI 1.52–3.48). Lastly, among all women treated surgically, the odds of receiving a referral to a gynecologic oncologist were also nearly significantly lower in women with Charlson scores of 2+ (versus zero) (OR 0.44, 95% CI 0.20–1.00).

Among the 669 women who received a surgical referral to a gynecologic oncologist, 30 women (5%) did not receive surgery from a gynecologic oncologist (Table 3). Among the women that received a surgical referral to a gynecologic oncologist, rural residence at diagnosis (versus urban) did not statistically impact the odds of receiving surgery from a gynecologic oncologist (OR 0.56, 95% CI 0.26–1.20). Likewise, age categories (46–60, 61–75, and 76–89-year-old women versus 18–45-year-old women) did not impact the odds of receiving surgery from a gynecologic oncologist (OR 1.32, 1.88, 1.69; 95% CI 0.47–3.70, 0.63–5.62, 0.39–7.21, respectively). However, after receiving a referral to a gynecologic oncologist, women with stage III/ IV and unknown cancer continued to have greater odds of receiving surgery from a gynecologic oncologist (OR 2.27, 95% CI 1.06–4.86).

There was no difference between rural and urban women in surgery received, amount of tumor remaining, and time from diagnosis-to-surgery for women who did not have adjuvant chemotherapy among women who received surgery from a gynecologic oncologist and among women who did not receive surgery from a gynecologic oncologist (Table 4). Among women who received surgery from a gynecologic oncologist, rural women were more likely than urban women to have surgery at a government hospital (45% versus 33%, p value 0.013) and to have a shorter time from diagnosis-to-surgery for women who had adjuvant chemotherapy (mean: 76 versus 105 days, p value 0.039). Additionally, among women who received surgery from a gynecologic oncologist, rural women were more likely than urban women to travel a greater distance to surgery (mean: 80.7 miles versus 24.9 miles, p value <0.001).

Rural women who were treated surgically by a gynecologic oncologist were more likely to receive cytoreductive surgery than rural women who were not treated surgically by a gynecologic oncologist (89% versus 69%, p value <0.001). As well, rural women treated surgically by a gynecologic oncologist were more likely to have more complete tumor removal to one centimeter or less (63% versus 39%, p value <0.001). This difference in complete tumor removal to one centimeter or less persisted when we limited our analysis to stages III and IV patients (56% versus 41%, p value 0.014). Rural women treated surgically by a gynecologic oncologist (versus non-gynecologic oncologist) were not more likely to have greater time from diagnosis-to-surgery for women who did not have adjuvant chemotherapy. Similar trends were seen in urban women when compared by surgeon specialty. Neither rural women nor urban women experienced differences in travel distance and hospital type by surgeon specialty (Table 4). Urban patients (all stages: 64% versus 26%, p value <0.001; stages III and IV disease:53% versus 20%, p value 0.004) with a gynecologic oncologist surgeon versus a non-gynecologic oncologist surgeon were also less likely to receive complete cytoreductive surgery.

The subgroup of women who did not have surgery performed by a gynecologic oncologist had surgery performed by general surgeons or obstetrician-gynecologists (Table 5). No differences in surgeon specialty were observed by rurality. More urban (versus rural) women in this subgroup saw a gynecologic oncologist after their initial surgery with a non-gynecologic oncologist (37% versus 12%).

Discussion

There is a large rural-urban difference in receipt of ovarian cancer surgery by a specialist among ovarian cancer patients that had surgical care. Rural ovarian cancer patients have 63% lower odds of receiving surgery by a gynecologic oncologist and receiving a surgical referral to a gynecologic oncologist. The adjusted odds ratio results obtained in our study agree with prior studies, but exceed the magnitudes previously reported.[16–18] It is unclear why rural women who receive ovarian cancer-directed surgery are less likely to be given a referral to a gynecologic oncologist. It is possible rural general surgeons and obstetrician-gynecologists are more comfortable performing ovarian cancer surgery, are unaware of or place less importance on the guideline recommendation, are more likely to place importance on local care and geographic convenience, or are more likely to care for patients who prefer local care.[8,42,43] It is also possible barriers in rural referral networks, such as long wait times and poor provider-to-provider communication, reduce rural providers' perceived ability to make a referral to a gynecologic oncologist.[8,12,24,44] Additionally, it is possible rural providers perceive their patients have greater patient-level barriers, such as transportation limitations, financial concerns, and apprehension about receiving care at a higher level care center, and thus selectively do not make the recommended referral.[24,45]

Among the ovarian cancer patients who received a surgical referral to a gynecologic oncologist, rural women were as likely to receive surgery from a specialist. Consequently, it appears the disparity in receipt of surgery from a gynecologic oncologist may be largely due to referral differences versus patient-level differences. Furthermore, given that rural women have lower odds of receiving surgery from a gynecologic oncologist independent of age, disease severity, and the socioeconomic status of the census tract, it seems unlikely that the difference in specialist surgical care is due to patient wellness and the local community resources available. It is possible this study failed to detect all rural barriers patients face after receiving a referral, such as differences that extend from disparities in provider encouragement and patient-provider relationships.[46,47] Rural cancer patients have been shown to play a less active role in care decisions and in researching alternative options.[46,47] They have also been shown to choose local care more often, especially if they have a strong relationship with their provider.[24,48] It is also possible the importance of traveling to a gynecologic oncologist for surgical care is not communicated to rural patients effectively.[24] Studies have shown rural patients utilize healthcare and specialists less.[49] Thus, extended explanations about why it is important to seek surgical care from a gynecologic oncologist may be important for rural patients. Further studies may help to explain the disparities rural patients face after receiving referrals to surgical specialists.

A surgical referral to a gynecologic oncologist was 67% less likely in older women ages 76–89 versus 18–45 years old, 56% less likely (nearly significant) in women with Charlson scores of 2+ versus 0, and 102% more likely in women who had late stage cancer. These findings are not surprising given the Behavioral Model of Health Services Use, which suggests age is a predisposing factor impacting the need for a specialist, and overall health (proxied by the Charlson score) and stage are the perceived and evaluated factor providers and patients utilize in care decision-making.[36–38] Young women may be more motivated to obtain care through a specialist for fertility preservation, and older women may face greater

barriers obtaining transportation to Centers of Excellence.[50] Women with greater comorbidities may need more ancillary services during and after their surgical care.[19] Advanced stage patients may be more often referred to a gynecologic oncologist due to a higher chance of having a preoperative diagnosis or being perceived to require a more technically difficult operation with a larger amount of lymph node and organ sampling/removal.[51] However, women without suspicion of cancer prior to surgery, should have still received cancer-directed surgery with a gynecologic oncologist after their cancer was discovered regardless of stage.

Rural women traveled 56 miles further than their urban counterparts when receiving surgical care by a specialist. This agrees with the Centers of Excellence Model of practicing gynecologic oncologists, within which, specialists are located in urban centers.[19] The Centers of Excellence Model is preferred by some gynecologic oncologists. Some gynecologic oncologists have reported select quality-of-care concerns about performing operations at non-specialized facilities or rural hospitals.[19,52] Furthermore, rural women with a non-gynecologic oncologist traveled 32 miles further than urban women with a gynecologic oncologist. While the difference among rural and urban patients was not statistically different by surgeon specialty, the difference in average distance to surgery for rural women receiving surgery by a gynecologic oncologist was 24 miles further than rural women receiving surgery from a non-gynecologic oncologist, while it was less than one mile difference by surgeon specialty for urban women. Promising strategies to lessen the resulting rural-urban distance disparities would be useful. When receiving care from a non-specialist, there was no statistical difference in travel distance between rural and urban patients. Furthermore, women traveled shorter distances to non-specialists, which likely suggests often non-specialists are local providers. The specific drivers of local care can be further defined in future studies.

Receiving surgical care by a gynecologic oncologist increased the odds of receiving cytoreduction and having optimal cytoreduction with removal of residual tumor to less than one centimeter. This is consistent with prior literature and remains a resounding reason that women with ovarian cancer are recommended to be referred to a surgical specialist.[53,54] Having surgery performed by a gynecologic oncologist (versus another provider type) reduced rural women's' time from diagnosis-to-surgery for women receiving adjuvant chemotherapy by about one month. This finding could be due to greater care coordination, or reduced courses of chemotherapy treatment. Further research is needed into disparities in health service among ovarian cancer patients receiving adjuvant chemotherapy.

Finally, while we were unable to assess exact reasons patients were not referred due to missing information, three times more urban women saw a gynecologic oncologist for at least a consult after surgery relative to rural women. This may be concerning because it suggests a potential continuation of rural-urban differences in specialty care even after emergency surgery or non-specialist surgical care. This finding warrants further investigation.

Strengths and Limitations

The quality and representativeness of the data are strengths of this study. The data were created from statewide population-based cancer surveillance and were abstracted by highly trained cancer registrars. The specific study variables were collected using a standardized tool and included thorough quality control checks to ensure appropriateness and accurateness of reported values. Complete cancer surveillance data for ovarian cancer is generally three years behind and often times more for special studies. Since 2010, there have not been substantial changes in guidelines pertaining to the importance of surgical care. As well, the distribution of Centers of Excellence likely has changed very little in these three states in the last 10 years. In addition, all sampled cases were histologically confirmed, limiting diagnostic misclassification.

Our primary outcome indicated the primary surgeon. The involvement of a specialist in a consulting or standby role was not abstracted. However, future investigations could investigate patterns of care across different consulting methods. Not all potential covariates were available in the dataset, such as patient-level wealth, strength of social support network, and attitudes about specialists.[55] Actual driving distance was not available, but straight mile distance served as a proxy. This likely made our estimates of travel distance conservative. The findings in these three Midwestern states do not necessarily represent all women diagnosed with ovarian cancer in the United States. As well, they are a focused investigation of ovarian cancer patients that pursued cancer-directed surgery, and thus findings are not generalizable of all ovarian cancer patients, such as those pursuing palliative treatment. This study was designed by the CDC to be able to detect differences among women living in rural areas compared to others, as opposed to assessing other documented disparities in treatment, such as racial and ethnic differences. While regionalization patterns were well established in these states prior to 2010 to 2012, patterns of care may not be generalizable across time, and may not be generalizable to other states. There are nuances to treating ovarian cancer. While we analyzed the outcome of cytoreductive surgery for the cohort overall similar to previously published studies, we acknowledge some specific cases may not have required cytoreduction and appropriately received an alternative therapy. [56–59]

Conclusion

Independent of census tract-level socioeconomic status, rural women were significantly less likely to receive a referral to, and surgery from, a gynecologic oncologist. Among women that received a surgical referral to a gynecologic oncologist, rural women were as likely as their urban counterparts to receive surgical care by a specialist. Rural women traveled further than urban women when they received surgical care from a specialist. Additionally, rural women who received care from a gynecologic oncologist (versus a non-specialist) were more likely to have guideline-recommended cytoreduction surgery and tumor removal to ≤1cm. As a result, rural women who are treated by a non-specialist are at greater risk of receiving substandard care and unnecessarily high recurrence and death rates. Further research in this area will help to determine the causes of the rural-urban differences in referral rates to specialists and into disparities faced by rural women after a surgical referral is received to a specialist. Likewise, system-level efforts that attempt to reduce the barriers

rural ovarian cancer patients face when seeking surgical care from a gynecologic oncologist, such as travel burdens and greater time from diagnosis to surgery may be helpful.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Rural ovarian cancer patients are 63% less likely to receive a referral to a gynecologic oncologist for surgery
- Rural ovarian cancer patients are significantly less likely to receive surgery from a gynecologic oncologist
- After a surgical referral, rural ovarian cancer patients are just as likely to receive surgery from a specialist
- Specialist-provided surgery increases receipt of cytoreduction and complete tumor removal for rural ovarian cancer patients
- Rural women (versus urban) who receive surgery from a gynecologic oncologist travel farther to surgical care

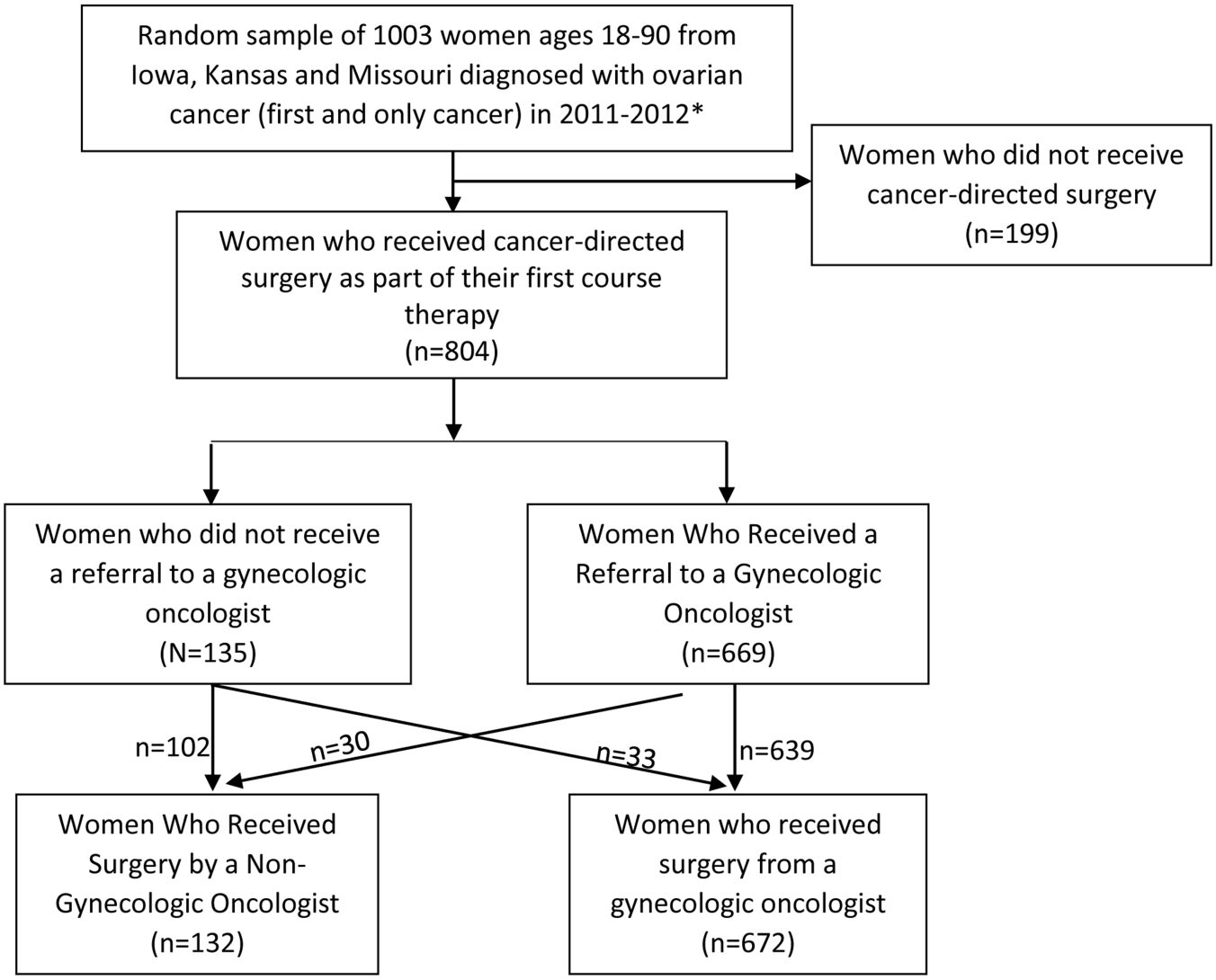

Image 1.
Flow Chart of Inclusion and Exclusion
*In order to meet desired sample size, Kansas included 178 cases diagnosed in 2010.

Table 1.

Patient and Tumor Characteristics Among Women Who Received Surgical Care for Ovarian Cancer Treatment

		Population: Women Who Received Surgical Care for Ovarian Cancer Treatment N=804		
		Rural N=252	Urban N=552	*P* value
		%	%	
Age (Years)	18–45	12	11	0.059
	46–60	32	36	
	61–75	37	41	
	76–89	19	12	
Charlson Score	0	79	81	0.756
	1	15	14	
	2+	6	5	
Census Tract Percentage of Residents with Less Than a High School Education	0–10%	50	69	**<0.001**
	11–20%	39	25	
	21%+	11	6	
Census Tract Median Income	$1–39,999	29	19	**<0.001**
	$40,000–50,999	44	19	
	$51,000–65,999	22	28	
	$66,000+	5	35	
Distance to Surgeon (Miles)	0–20	15	68	**<0.001**
	21–60	38	21	
	61+	47	11	
Grade	Well-Moderately Differentiated	23	22	0.764
	Poorly-Undifferentiated	63	66	
	Unknown	13	12	
Histology	Epithelial	97	97	0.842
	Non-Epithelial	3	3	
Insurance Status	Insured	96	96	0.991
	Uninsured	4	4	
Primary Site	Ovary	83	81	0.517
	Fallopian Tube and Peritoneum	17	19	
Race/Ethnicity	Non-Hispanic White	99	91	**<0.001**
	Non-White	1	9	
Receipt of Neoadjuvant Chemotherapy Care	Yes	12	10	**0.405**
	No	88	90	
Stage	I	24	28	0.540
	II	9	7	
	III	49	45	

		Population: Women Who Received Surgical Care for Ovarian Cancer Treatment N=804		
		Rural N=252	Urban N=552	*P* value
		%	%	
	IV	17	19	
	Unknown	1	1	
Surgeon Specialty	Gynecologic Oncologist	73	88	**<0.001**
	General Surgeon	10	2	
	Obstetrician-Gynecologist	13	8	
	Other/Unknown	4	2	

* Bolding indicates a significance at 0.05.

* 60 miles was selected a priori due to theoretically meaningful travel/drive times in a rural state and due to concerns a larger cut point was needed for the rural states than the 50 mile cut point selected in Stewart et.al. 2014 for the continental United States.

Table 2.

Adjusted Odds of Receiving a Surgical Referral and Surgery from a Gynecologic Oncologist Among Women Who had Ovarian Cancer-directed Surgery

Population: Women Who Received Surgical Care for Ovarian Cancer Treatment N=804		**Odds of Receiving a Surgical Referral to a Gynecologic Oncologist (Versus No Referral) N=669 versus N=135**		**Odds of Receiving Surgery from a Gynecologic Oncologist (Versus Non-specialist) N=672 versus N=132**	
		OR*	**95% CI**	**OR***	**95% CI**
Rurality	Urban	Reference			
	Rural	**0.37**	**0.23–0.59**	**0.37**	**0.24–0.58**
Age (Years)	18–45	Reference			
	46–60	0.99	0.45–2.17	1.10	0.57–2.13
	61–75	0.81	0.37–1.77	1.03	0.52–2.03
	76–89	**0.33**	**0.14–0.75**	**0.43**	**0.21–0.91**
Charlson Score	0	Reference			
	1	0.84	0.46–1.53	1.08	0.60–1.93
	2+	**0.44**	**0.20–1.00**	0.61	0.27–1.36
Census Tract Percentage of Residents with Less Than a High School Education	0–10%	Reference			
	11–20%	0.85	0.50–1.44	0.47	0.47–1.25
	21%+	0.48	0.21–1.10	0.24	0.24–1.07
Census Tract Median Income	$1–39,999	Reference			
	$40,000–50,999	0.56	0.29–1.07	0.59	0.33–1.06
	$51,000–65,999	0.61	0.29–1.26	0.74	0.38–1.42
	$66,000+	0.52	0.23–1.21	0.52	0.25–1.10
Insurance Status	Insured	Reference			
	Uninsured	0.56	0.20–1.63	0.73	0.27–1.95
Race/Ethnicity	Non-Hispanic White	Reference			
	Non-White	1.10	0.39–3.10	1.02	0.42–2.48
Stage	I/II	Reference			
	III/IV + Unknown	**2.02**	**1.29–3.19**	**2.30**	**1.52–3.48**

* Bolding indicates a significance at 0.05. All odds ratios are adjusted for all variables in table.

Table 3.

Adjusted Odds of Receiving Surgery from a Gynecologic Oncologist Among Women Who Were Referred to a Gynecologic Oncologist for Surgical Care

Sub-Analysis Population: Women Who Had Surgery and Received a Surgical Referral to a Gynecologic Oncologist Prior to Surgery N=669		**Odds of Receiving Surgery from a Gynecologic Oncologist (Versus Non-specialist) N=639 versus N=30**	
		OR*	**95% CI**
Rurality	Urban	Reference	
	Rural	0.56	0.26–1.20
Age (Years)	18–45	Reference	
	46–60	1.32	0.47–3.70
	61–75	1.88	0.63–5.62
	76–89	1.69	0.39–7.21
Stage	I/II	Reference	
	III/IV + Unknown	**2.27**	**1.06–4.86**

* Bolding indicates a significance at 0.05. All odds ratios are adjusted for all variables in table.

Table 4.

Investigating Surgical Care Disparities Among Women Who Received Surgery for Ovarian Cancer Treatment

		Women Who Received Surgery from a Gynecologic Oncologist N=672			Women Who Did Not Receive Surgery from a Gynecologic Oncologist N=132			Comparison of Women Who Received Care by a Gynecologic Oncologist (Versus Non-Specialist)	
								Rural Women	Urban Women
		Rural N=185	Urban N=487	*P* value	Rural N=67	Urban N=65	*P* value	*P* value	*P* value
		%	%		%	%			
Received Cytoreductive Surgery[A]	Yes	89	91	0.320	69	65	0.884	**<0.001**	**<0.001**
	No	11	9		31	35			
Amount of Tumor Remaining[A]	≤1cm	63	64	0.775	39	26	0.173	**<0.001**	**<0.001**
	>1cm	24	22		12	22			
	Unknown[B]	12	14		49	52			
Hospital Type Where Surgery was Received[C]	Government	45	33	**0.013**	38	28	0.271	0.355	0.288
	Private	55	66		62	72			
Distance to Surgery (Miles)	Mean (95% CI)	80.7 (74.3–87.1)	24.9 (22.0–27.9)	**<0.001**	56.7 (10.1–103.4)	24.2 (4.6–43.8)	0.206	0.126	0.932
	Standard Deviation (Range)	44.3 (0–225)	32.6 (0–285)		191.2 (1–1526)	79.1 (1–617)			
Time from Diagnosis to Surgery (Days) among patients who received adjuvant chemotherapy[D]	Mean (95% CI)	75.7 (54.8–96.7)	104.9 (87.7–122.1)	**0.039**	--	--	--	--	--
	Range	0–230	0–288		--	--			
Time from Diagnosis to Surgery (Days) among patients who did not receive adjuvant chemotherapy[D]	Mean (95% CI)	8.7 (6.4–10.9)	10.0 (7.4–12.6)	0.564	6.7 (3.2–10.2)	5.0 (1.9–8.2)	0.486	**0.376**	0.175
	Range	0–97	0–376		0–69	0–69			

"—" Indicates results were not reported due to N<5.

* Bolding indicates a significance at 0.05.

A. Cytoreduction is standard of care surgery, also known as optimal debulking, and involves removal of as much cancer as possible in the pelvis and/or abdomen.

B. Persons in this category either had cytoreductive surgery and the tumor remaining was unknown, or they did not have cytoreductive surgery and tumor remaining was not reported.

[C] Unknown hospital type was not included in this analysis. Government hospitals are based on Healthcare Cost and Utilization Project (HPUC) and defined as a government owned, nonfederal, public hospital.

(https://www.hcupus.ahrq.gov/db/vars/hosp_control/nisnote.jsp)

[D] Date of diagnosis coincides with the first mention and concern of an ovarian cancer in the medical record. Date of diagnosis does not require histologic confirmation of this cancer.

Table 5.

Information on Women Who Did Not Have Surgery with a Gynecologic Oncologist (N=132)

		Rural N=67	Urban N=65	*P* value
		%	%	
Specialty of Non-Gynecologic Oncologist Physician Who Performed Surgery	General Surgeon	36	20	0.142
	Obstetrician-Gynecologist	48	63	
	Other or Unknown	17	17	
Reason Patient was Not Referred to a Gynecologic Oncologist^	There was no gynecologic oncologist practicing at the hospital where the surgery was performed	18	14	**0.022**
	Insurance issues	0	0	
	Patient is too ill or died	4	5	
	Patient was referred to a gynecologic oncologist after surgical care	12	37	
	Other or Unknown	66	45	

*Bolding indicates a significance at 0.05.

^Registrars were instructed to review the medical record and record the above preset list of reasons for the patient not being referred to a gynecologic oncologist for surgical care. The registrars were also able to write in responses if they were unsure of the best category for the reason. This was a select all that apply response-option question. The selection of a response indicates it was stated in the medical record by the physician as a reason for not providing a referral or performing the surgery themselves. For example, for insurance issues to be selected, the physician would need to state insurance issues were a reason that the patient was not referred. It does not indicate that the abstractor verified that all patients were insured.