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Use of a Novel Statistical Technique to Examine the Delivery of Breast Cancer Follow-up Care by Different Types of Oncology Providers

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Abstract

Rationale, aims and objectives—Frequent follow-up is recommended for the more than 3 million breast cancer survivors living in the U.S. Given the multidisciplinary nature of breast cancer treatment, follow-up may be provided by medical oncologists, radiation oncologists, surgeons, and primary care providers. This creates the potential for significant redundancy as well as gaps in care. The objective was to examine patterns of breast cancer follow-up provided by different types of oncologists and develop a statistical means of quantifying visit distribution over time.

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Methods—We identified stage I-III breast cancer patients who underwent breast conservation from 2000-2006 (n=12,139) within the SEER-Medicare linked database. Provider type was defined using Medicare specialty provider codes and AMA Masterfile. The coefficient of variation (CV) for time between oncologist follow-up visits was calculated. Ordinal logistic regression assessed factors associated with CV.

Results—Substantial variation in CV was observed. 67% of patients with low CV (high visit regularity) received follow-up from a single oncologist type, versus 8% with high CV (low visit regularity). The number of oncologist types participating in follow-up had the greatest association with high CV (odds ratio 7.4[6.7-8.3] and 15.4[13.6-17.6] for two and three oncologist types).

Conclusions—Using a novel means of quantifying follow-up visit regularity, we determined that breast cancer patients with dispersed follow-up with >1 oncologist have more disordered care. The CV could be used in electronic medical records to identify cancer survivors with more disordered care who may benefit from improved care coordination and streamlined follow-up.

Keywords

coefficient of variation; health care delivery; breast cancer; survivorship; surveillance; care coordination

Introduction

Frequent follow-up is recommended for the more than 3 million breast cancer survivors living in the U.S.¹⁻⁴ This follow-up is costly, and unnecessary follow-up represents a potential strain on both the oncology work force and patients who are striving to return to their activities of daily living. Significant variation in how follow-up care is delivered has been observed,⁵⁻¹⁰ both with regards to follow-up visit frequency as well as in who is providing that follow-up care. We have previously demonstrated that having more types of oncology providers participating in patients' follow-up is associated with increased visit frequency.¹⁰ Although this relationship is likely multifactorial, one contributing factor may be the inherent challenges associated with efficiently coordinating care amongst a multidisciplinary team. Given the multidisciplinary nature of breast cancer treatment, follow-up may be provided by medical oncologists, radiation oncologists, surgeons, and primary care providers. Current clinical practice guidelines do not provide guidance regarding which of these providers should participate in follow-up or how these visits should be coordinated (Table 1),^{2, 3} creating the potential for significant redundancy as well as gaps in care.

The objective of the present study was to examine patterns of breast cancer follow-up visits provided by different types of oncology providers, focusing on the distribution of visits over the surveillance period as a measure of how care may be coordinated. Although breast cancer follow-up is also provided by primary care providers, it is not possible to identify in administrative claims data which visits would be specifically for breast cancer follow-up; therefore, as a first step, this study focuses only on oncology providers. A key challenge in achieving our objective was determining metrics to quantify the distribution of follow-up visits (including both frequency and visit regularity), as no method has previously been

described. Therefore, our secondary objective was to develop a statistical means of quantifying the regularity of clinic visits.

Methods

Patient Selection

We used the linked Surveillance, Epidemiology and End Results (SEER)-Medicare database and identified patients with continuous Medicare coverage who underwent breast conservation (partial mastectomy and radiation) for stage I-III breast cancer from 2000-2006; patients receiving chemotherapy were excluded. We limited our focus to this cohort of breast cancer patients for a number of reasons. First, this was the predominant treatment strategy for women aged 65 and over during the time period of our study (44% of patients). Further, these women represent a cohort with favorable prognoses and a relatively low risk of recurrence in whom we could reasonably expect similar follow-up. Finally, because most elderly women undergoing breast conservation consult with medical and radiation oncology, as well as surgery, all three specialists may participate in follow-up. Consequently, follow-up care for women undergoing breast conservation may be most vulnerable to care coordination challenges. Streamlined algorithms which provide guidance on coordination of follow-up are likely to have a substantial impact for this group.

Primary Outcome Variable

Our primary events of interest were oncology follow-up visits. To ensure we only captured follow-up (rather than post-operative or radiation) visits, we defined the evaluable follow-up window to begin 12 months after diagnosis¹¹ and end at the earliest of the following events: 1) 3 years of follow-up; 2) death; 3) 12/31/2009; or 4) 3 months prior to a new ICD-9 diagnosis code for secondary cancer [excluding breast and unspecified site¹⁸], a 2nd SEER breast cancer diagnosis, or resumption of treatment after a 90-day gap.¹²⁻¹⁴ Our follow-up window ended three months prior to any recurrence events to minimize bias associated with inappropriately capturing clinic visits for work-up of recurrence or ongoing treatment (which would upwardly bias the rate of visits attributed to ongoing follow-up). We defined oncology provider visits using the Medicare specialty provider code and linked AMA Masterfile.^{15, 16} If both were missing, physician claims were evaluated to determine whether his/her clinical practice was consistent with being an oncology provider.¹⁵ We considered general surgeons who performed 10 mastectomies during our study period to be providers of breast surgical oncology care; for the purposes of this study, we define these individuals as “surgical oncologists”, recognizing that many may be general surgeons with a broad practice mix. We excluded visits with these general surgeons that did not have an associated breast ICD-9 diagnosis code to avoid capturing visits unrelated to breast cancer (hernia, abdominal pain, etc.). Patients whose number of follow-up visits within the surveillance period exceeded the 99th percentile were excluded, as these outliers did not represent the typical early-stage breast cancer patient. Additionally, patients with fewer than 4 follow-up visits were excluded due to difficulty in establishing a pattern of follow-up.

Patient-related variables

Basic demographics and tumor characteristics were obtained from the SEER data. We chose to evaluate tumor size and lymph node status as separate variables (as opposed to AJCC stage) as these factors may have a differential impact on how follow-up is delivered. Socioeconomic status was assessed using census tract median level of household income and median level of education. Residence location was assessed using the Rural Urban Commuting Area codes. The Deyo implementation¹⁷ of the Charlson Comorbidity Index¹⁸ was used to assess patient comorbidities.

Analysis

Visit *frequency* was defined as the number of visits divided by the total time in the follow-up window. The inverse of frequency (1/frequency) represents the average time visits. We categorized visit frequency into three categories: low (once every 6 months or less), medium (at least once every 3 months but less than every 6 months), and high (more often than once every three months). To quantify visit *regularity*, we calculated the coefficient of variation (CV) for the time between oncology providers' follow-up visits for each patient. The CV is the ratio of the standard deviation to the average time between follow-up visits. This coefficient represents a measure of how regular or "evenly spaced" patients follow-up visits are, with smaller ratios representing more regular visits. We then categorized subjects into low, medium and high values of CV to roughly represent the 25th and 75th quartiles (rounded to the nearest tenth). In subsequent analyses, ordinal logistic regression identified patient characteristics associated with more versus less regular visits, adjusting for sociodemographics and tumor characteristics.

This study was approved by the University of Wisconsin Institutional Review Board.

Results

Demographic and tumor characteristics are presented in Table 2. Survivors had a median 3.0 follow-up visits/year, with a mean inter-visit interval of 4.0 months. Overall, 2% of visits were multidisciplinary, i.e. more than one oncology provider type was seen by the patient. Follow-up frequency in our identified cohort was variable, with 33% being seen more frequently than every 3 months, 52% every 3-<6 months, and 14% less frequently than every 6 months. The majority of survivors (83%) had a medical oncologist perform follow-up, either as the sole provider (17%) or in combination with a radiation oncologist (17%), a surgeon (23%), or both (26%). Overall, approximately half had at least some follow-up with a surgeon (63%) or a radiation oncologist (55%).

Patterns of follow-up visits for randomly selected breast cancer survivors in each of nine categories of visit frequency cross-classified by visit regularity are represented in figure 2. A low CV (high regularity) was observed in 23% of patients, intermediate CV in 44%, and high CV (low regularity) in 33%. 67% of patients in the low CV category received follow-up from a single type of oncology provider, versus only 8% of patients in the high CV group. However, as demonstrated by patient #2 in figure 2a and patient #2 in figure 2d, well-spaced

care did occur in some cases where more than one type of oncology provider was involved in follow-up.

Using ordinal logistic regression to model visit regularity, the odds of irregularly-spaced visits was strongly associated with the number of types of oncology providers involved (odds ratio of 7.4 [6.7-8.3] and 15.4 [13.6-17.6] for two and three (versus one) types of oncology providers, respectively). Irregularly-spaced visits were additionally associated with other clinical factors, including: a higher Charlson comorbidity score (OR 1.1 (1.0-1.2) for score 1 vs. 0, OR 1.2 (1.1-1.4) for 2 or more vs. 0), and single (versus married) status (1.1 [1.0-1.3]). Larger tumor size (OR 0.6 [0.4-0.9] for >5 cm tumor versus <2 cm tumor) and less frequent visits (OR 0.9 [0.86-0.90]) were associated with more regular visits (Table 3).

Discussion

Providing follow-up care for the 200,000 women diagnosed annually with local-regional, potentially curable breast cancer is challenging and the burden of coordinating these follow-up visits is immense.⁴ The most common treatment for early stage breast cancer in older women is breast conserving therapy (including radiation), followed by endocrine therapy. These women typically receive care from surgery, radiation oncology, and medical oncology and these providers, as well as primary care providers, collaborate to provide follow-up for breast cancer recurrence, new second primary cancers, and treatment toxicity. Given the multidisciplinary nature of both breast cancer treatment and follow-up, the lack of guidance regarding what types of providers should participate in follow-up creates the potential for significant redundancy and inefficiency (Table 1). Therefore, it is necessary to clarify our current clinical practice guidelines to ensure we provide follow-up in a manner that optimizes value for patients and the health care system as a whole.

One obstacle to accomplishing this is our limited understanding of how multidisciplinary breast cancer follow-up is currently delivered, combined with a lack of metrics which would quantify how follow-up visits are distributed. In this study we address these gaps by describing a novel statistical approach for quantifying the frequency and regularity of breast cancer follow-up. The method described produces a three-level ordinal score for visit regularity. This score is unit-free and is designed to be comparable regardless of patients' follow-up visit frequency. Importantly, our measure of visit regularity exhibits a high level of face validity, which can be seen by plotting the visit patterns of randomly selected patients in each category of visit "regularity" (Figure 2).

We found significant variation in what types of oncology providers participated in patients' follow-up. This variation was directly associated with how care was delivered, with patients with follow-up with more than one oncology provider having more disordered (less regular) follow-up visits. The variation observed raises the question of what really constitutes high quality breast cancer follow-up. When reviewing Figure 2d, 2e, and 2f, the increased "irregularity" with increasing CV is obvious. One interpretation would be to look at Figure 2f (where patients are seen every 3-6 months with low regularity [a high CV]), and conclude that significant redundancy of care exists. Is there substantial additive value when a patient routinely sees medical oncology, radiation oncology and surgery within a few weeks of each

other (as seen with patients #6 and #10)? However, an alternative interpretation could be that patients #1, #5 or #6 in figure 2d are being undertreated and receiving inadequate care. If surgeons or radiation oncologists provide unique services from what is provided by medical oncologists, then under this assumption, those patients only receiving follow-up from one type of oncology provider are missing valuable care. In this scenario, patients such as #6 and #10 in figure 2f, rather than receiving redundant care, may actually be receiving more comprehensive and complete care. Although our findings do not allow us to draw conclusions regarding the relationship between the patterns of care observed and care quality, it does suggest that some patients are potentially being both over- and under-treated.

Understanding what each type of oncology provider contributes to the follow-up of breast cancer survivors is critical to explaining the observed variation in care delivery. Currently, each provider must make individual determinations regarding whether to participate in follow-up for a given patient. It is unclear how these determinations are made; factors such as oncologists' personal sense of responsibility surrounding some component of follow-up (e.g. assessment of lymphedema, evaluation of ongoing medication side-effects), a perceived need to ensure that *someone* is providing follow-up, and patient preference likely play a role. Additional sources of variation may stem from the specific challenges that surround the coordination of follow-up amongst the multidisciplinary breast team. We cannot assume that the CV is a direct proxy for care coordination, as it is possible that some irregularly-spaced visits may actually have been intentionally scheduled that way. However, the patterns of care depicted in Figure 2 suggest some link between the measured CV and care coordination is likely. Overall, providing guidance regarding what types of providers should participate in follow-up and what each provider is responsible for during follow-up will improve both the quality and the efficiency of care.

Our analysis did not include primary care provider visits. In this administrative claims dataset, identifying which primary care visits may be related to breast cancer follow-up is not feasible. For most patients in the United States, primary care providers do not assume the primary responsibility for breast cancer follow-up but instead share the responsibility of follow-up with oncology providers.^{19, 20} Therefore, it is likely that the disordered care observed actually underestimates what would have been observed had it been feasible to include primary care provider visits in the analysis.

Our study is associated with the usual limitations for a SEER-Medicare study, namely that our findings cannot be extrapolated to patients <65 years of age. Additionally, although 70% of our cohort was estrogen receptor positive, we are unable within the SEER-Medicare database determine which of these estrogen receptor positive patients were receiving an oral endocrine therapy and cannot explicitly assess the impact of receiving this treatment on follow-up received. Because many oncology providers practice in multiple clinical settings, it was not feasible to assess whether patterns of follow-up vary based on whether providers are within the same institution. Additionally, we were unable to assess system level factors (such as NCI cancer center designation), as most breast cancer care takes place in the outpatient setting. SEER-Medicare does not provide patient zip code within the PEDSF file and these restricted variables are only releases through a special approval process. As we did not have this data, relevant factors such as travel distance to providers could not be assessed.

Within this administrative claims database, the reason for each clinic visit was unknown and some visits may have been “problem-focused” rather than true surveillance visits; sensitivity analyses were performed to address this with no change in the study conclusions. Finally, we did not consider how other non-physician visits related to the breast cancer diagnosis (such as an interval mammography appointment) fits into the patterns of care observed; this may further underestimate the amount of interaction with the health care system each survivor has around their breast cancer diagnosis.

Conclusions

We provide a novel approach for examining patterns of follow-up visits encompassing frequency, regularity, and the number and types of specialists involved. This quantification provides a useful framework for considering different scenarios of follow-up and generating questions for future research. How poorly-spaced can visits be before they become a burden to either patients or providers? Is it valuable for more than one provider type to be involved in follow-up? How do we balance the need and/or desire to have multiple different types of providers involved in follow-up with our obligation to deliver both efficient and high quality care? Future research should target these questions to optimize coordination of follow-up care for breast cancer survivors. Clinical practice guidelines are an important strategy used to deliver high quality cancer care. Unfortunately, current guidelines provide little direction regarding *who* should participate in follow-up or what providers’ responsibilities are. Incorporating such guidance into consensus guidelines has the potential to greatly improve both the quality and efficiency of care. The implementation of such guidelines into clinical practice could then be tracked through administrative data or electronic medical records using the statistical method described in our study. Data could readily be queried to identify cancer survivors with high CV's in their follow-up visits, and these individuals could be flagged for review to identify opportunities for streamlining their care, and these individuals could be flagged for review to identify opportunities for streamlining their care. This might include a decision to restrict follow-up to one provider type or a staggered visit schedule with clearly delineated responsibilities. In traditional fee for service Medicare payment system there is no significant incentive to encourage clinicians to engage in such care coordination, particularly when clinicians work at different sites. However, as population management strategies and efforts to bundle care grow, such population management strategies will grow in importance. Perhaps most importantly, such efforts may be patient-centered if they avoid the need for duplicate visits.

In sum, the coefficient of variation metric is a tool to identify cancer survivors who may benefit from streamlining and care coordination. It can be implemented within a health care system using billing or administrative data and has the potential to improve the efficiency and value of cancer care. Given the increasing number of cancer survivors in the United States, these findings have immediate relevance to the burden of care coordination for not only breast cancer survivors but for many other cancer survivors who require multidisciplinary follow-up care such as colorectal and prostate cancer survivors.

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References

1. Siegel R, Desantis C, Virgo K, et al. Cancer treatment and survivorship statistics, 2012. *CA Cancer J Clin.* 2012; 62(4):220–41. [PubMed: 22700443]
2. Khatcheressian JL, Wolff AC, Smith TJ, Grunfeld E, Muss HB, Vogel VG, Halberg F, Somerfield MR, Davidson NE. American Society of Clinical Oncology 2006 update of the breast cancer follow-up and management guidelines in the adjuvant setting. *J Clin Oncol.* 2006; 24(31):5091–7. [PubMed: 17033037]
3. National Comprehensive Cancer Network. National Comprehensive Cancer Network Clinical Practice Guidelines in Oncology: Breast Cancer. 2010
4. Howlader, N.; Noone, AM.; Krapcho, M., et al. SEER Cancer Statistics Review, 1975–2010. National Cancer Institute; Bethesda, MD: 2012. http://seer.cancer.gov/csr/1975_2010/, based on November 2 SEER data submission, posted to the SEER web site, 3.
5. Donnelly P, Hiller L, Bathers S, Bowden S, Coleman R. Questioning specialists' attitudes to breast cancer follow-up in primary care. *Ann Oncol.* 2007; 18(9):1467–76. [PubMed: 17525086]
6. Grunfeld E, Hodgson DC, Del Giudice ME, Moineddin R. Population-based longitudinal study of follow-up care for breast cancer survivors. *J Oncol Pract.* 2010; 6(4):174–81. [PubMed: 21037867]
7. Margenthaler JA, Allam E, Chen L, Virgo KS, Kulkarni U, Patel A, Johnson FE. Patient surveillance following curative-intent treatment for breast carcinoma: Current practice patterns. *J Clin Oncol.* 2010; 28:15s.
8. van Hezewijk M, Hille ET, Scholten AN, Marijnen CA, Stiggelbout AM, van de Velde CJ. Professionals' opinion on follow-up in breast cancer patients; perceived purpose and influence of patients' risk factors. *Eur J Surg Oncol.* 2011; 37(3):217–24. [PubMed: 21273027]
9. Watson EK, Sugden EM, Rose PW. Views of primary care physicians and oncologists on cancer follow-up initiatives in primary care: an online survey. *J Cancer Surviv.* 2010; 4(2):159–66. [PubMed: 20182813]
10. Neuman HB, Weiss JM, Schrag D, Ronk K, Havlena J, LoConte NK, Smith MA, Greenberg CC. Patient demographic and tumor characteristics influencing oncologist follow-up frequency in older breast cancer survivors. *Ann Surg Oncol.* 2013; 20(13):4128–36. [PubMed: 23943027]
11. Keating NL, Landrum MB, Guadagnoli E, Winer EP, Ayanian JZ. Factors related to underuse of surveillance mammography among breast cancer survivors. *J Clin Oncol.* 2006; 24(1):85–94. [PubMed: 16382117]
12. Lamont EB, Herndon JE 2nd, Weeks JC, Henderson IC, Earle CC, Schilsky RL, Christakis NA. Measuring disease-free survival and cancer relapse using Medicare claims from CALGB breast cancer trial participants (companion to 9344). *J Natl Cancer Inst.* 2006; 98(18):1335–8. [PubMed: 16985253]

13. Smith BD, Gross CP, Smith GL, Galusha DH, Bekelman JE, Haffty BG. Effectiveness of radiation therapy for older women with early breast cancer. *J Natl Cancer Inst.* 2006; 98(10):681–90. [PubMed: 16705122]
14. Stokes ME, Thompson D, Montoya EL, Weinstein MC, Winer EP, Earle CC. Ten-year survival and cost following breast cancer recurrence: estimates from SEER-Medicare data. *Value Health.* 2008; 11(2):213–20. [PubMed: 18380633]
15. Pollack LA, Adamache W, Ehemann CR, Ryerson AB, Richardson LC. Enhancement of identifying cancer specialists through the linkage of Medicare claims to additional sources of physician specialty. *Health Serv Res.* 2009; 44(2 Pt 1):562–76. [PubMed: 19207588]
16. Baldwin LM, Adamache W, Klabunde CN, Kenward K, Dahlman C, J LW. Linking physician characteristics and Medicare claims data: issues in data availability, quality, and measurement. *Med Care.* 2002; 40(8 Suppl):IV–82–95. [PubMed: 12187173]
17. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol.* 1992; 45(6):613–9. [PubMed: 1607900]
18. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis.* 1987; 40(5):373–83. [PubMed: 3558716]
19. Klabunde CN, Han PK, Earle CC, Smith T, Ayanian JZ, Lee R, Ambs A, Rowland JH, Potosky AL. Physician roles in the cancer-related follow-up care of cancer survivors. *Fam Med.* 2013; 45(7):463–74. [PubMed: 23846965]
20. Friese CR, Martinez KA, Abrahamse P, Hamilton AS, Graff JJ, Jagsi R, Griggs JJ, Hawley ST, Katz SJ. Providers of follow-up care in a population-based sample of breast cancer survivors. *Breast Cancer Res Treat.* 2014; 144(1):179–84. [PubMed: 24481682]

Figure 1.
Cohort Selection.

Figure 2.

Patterns of follow-up visits for 10 randomly selected patients representing each of a low (high regularity), intermediate and high (low regularity) coefficient of variation category, cross-classified by visit frequency.

The number of patients for each category is presented. R= radiation oncology visit, M=medical oncology visit, S=surgery visit, X=multidisciplinary visit, CV= coefficient of variation.

Table 1

Current Practice Guidelines for Breast Cancer Follow-up Care

	NCCN	ASCO
Frequency of follow-up visits	<ul style="list-style-type: none">•Every 4-6 mos for 5 yrs•Annual after 5 yrs	<ul style="list-style-type: none">•Every 3-6 mos for 3 yrs,•Every 6-12 mos for next 2 yrs•Annual after 5 yrs
Who Provides	Optimally performed by members of the treatment team	Physician experienced in the surveillance of patients with cancer and in breast examination. Follow-up with a PCP seems to lead to the same health outcomes as specialist follow-up.

NCCN, National Comprehensive Cancer Network; ASCO, American Society of Clinical Oncology

Table 2

Patient Demographic and Tumor Characteristics

Characteristic	N=12,139	%
Demographics		
Age		
66-70	3,430	28%
71-75	3,605	30%
76-80	3,161	26%
81+	1,943	16%
Race		
White	11,130	92%
Black	489	4%
Other	512	4%
Marital Status		
Married	6,201	51%
Widowed	3,984	33%
Unmarried	1,616	13%
Charlson Comorbidity index		
0	8,470	70%
1	2,618	22%
2	1,018	8%
Residence location		
Urban	11,440	94%
Rural	699	6%
Tumor Characteristics		
Primary tumor size		
0-2 cm	10,034	83%
2-5 cm	2,002	16%
>5 cm	97	1%
Nodal status		
Negative	9,753	80%
Positive	1,259	10%
Unstaged	1,127	10%
Estrogen/Progesterone Receptor		
Positive	8,537	70%
Negative	2,425	20%
Unknown	1,177	10%

Characteristic	N=12,139	%
Grade		
Well Differentiated	3,883	34%
Moderately Differentiated	5,479	48%
Poorly or Undifferentiated	1,997	18%
<i>Oncology Providers</i>		
Number of types of oncology providers involved in follow-up		
1	3,028	25%
2	6,006	49%
3	3,105	26%

Table 3Ordinal Risk-Adjusted Analysis of the Coefficient of Variation for Breast Cancer Follow-up Visits[†]

Characteristic	Odds Ratio (95% Confidence Interval)
Demographics	
Age	1.0 (1.0-1.01)
Marital Status	
Married	Base
Widowed	1.0 (0.95-1.2)
Unmarried	1.1 (1.0-1.3)
Charlson Comorbidity index	
0	Base
1	1.1 (1.0-1.2)
2	1.2 (1.1-1.4)
Residence location	
Urban	Base
Rural	0.97 (0.82-1.1)
Tumor Characteristics	
Primary tumor size	
0-2 cm	Base
2-5 cm	0.97 (0.88-1.1)
>5 cm	0.65 (0.43-0.98)
Nodal status	
Negative	Base
Positive	0.93 (0.82-1.1)
Unstaged	0.83 (0.54-1.3)
Estrogen/Progesterone Receptor	
Positive	Base
Negative	0.99 (0.90-1.1)
Unknown	1.0 (0.89-1.2)
Grade	
Well Differentiated	Base
Moderately Differentiated	1.1 (1.0-1.2)
Poorly or Undifferentiated	1.1 (0.97-1.2)
Oncology Providers	
Number of types of oncology providers involved in follow-up	
1	Base

Characteristic	Odds Ratio (95% Confidence Interval)
2	7.5 (6.7-8.3)
3	15.4 (13.6-17.6)
Average time between visits	0.88 (0.86-0.90)

*controlled for race, income, education level

[†]Low coefficient of variation= regularly spaced visits; High coefficient of variation= irregularly spaced visits