

Influence of Primary Care on Breast Cancer Outcomes Among Medicare Beneficiaries

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ABSTRACT

PURPOSE We used the Surveillance Epidemiology and End Results (SEER)-Medicare database to explore the association between primary care and breast cancer outcomes.

METHODS Using a retrospective cohort study of 105,105 female Medicare beneficiaries with a diagnosis of breast cancer in SEER registries during the years 1994-2005, we examined the total number of office visits to primary care physicians and non-primary care physicians in a 24-month period before cancer diagnosis. For women with invasive cancers, we examined the odds of diagnosis of late-stage disease, according to the American Joint Commission on Cancer (AJCC) (stages III and IV vs stages I and II), and survival (breast cancer specific and all cause) using logistic regression and proportional hazards models, respectively. We also explored whether including noninvasive cancers, such as ductal carcinoma in situ (DCIS), would alter results and whether prior mammography was a potential mediator of associations.

RESULTS Primary care physician visits were associated with improved breast cancer outcomes, including greater use of mammography, reduced odds of late-stage diagnosis, and lower breast cancer and overall mortality. Prior mammography (and resultant earlier stage diagnosis) mediated these associations in part, but not completely. Similar results were seen for non-primary care physician visits. Results were similar when women with DCIS were included in the analysis.

CONCLUSIONS Medicare beneficiaries with breast cancer had better outcomes if they made greater use of a primary care physician's ambulatory services. These findings suggest adequate primary medical care may be an important factor in achieving optimal breast cancer outcomes.

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INTRODUCTION

Primary care physicians play an important role in early cancer detection. A recommendation from a primary care physician, for example, is consistently one of the strongest predictors of cancer screening.¹⁻¹⁰ Patients who are referred to or are assigned a primary care physician are more likely to undergo most forms of cancer screening, including mammograms¹¹⁻¹³ and clinical breast examinations.¹¹ Primary care physicians may also ensure more timely diagnosis after screening abnormalities and prevent diagnostic delay.¹⁴

Understanding the effects of primary medical care is important because a fundamental shift is occurring in our nation's health care system. Since 1970 there has been marked growth in the number of specialist physicians, with primary care making up a progressively lower proportion of the overall physician workforce.^{15,16} In most nations, primary care physicians account for 50% of the physician workforce.¹⁷ In the United States, however, they now make up less than one-third of all physicians, and their proportion is expected to decline to about 25% in the next 10 years.¹⁸ The number of medical students interested in primary care careers has also

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progressively declined,^{15,19-23} and only 7% of graduating medical students plan careers in adult primary care.²⁴ If these trends continue, the decline in our nation's primary health care system may have important implications for the goal of improving cancer-related outcomes.

Ecologic studies have found that a higher primary care physician supply is associated with improved health outcomes, such as overall mortality; cardiovascular, infant, and cancer mortality; and earlier cancer stage at diagnosis.²⁵⁻³⁸ All these studies are subject to the ecological fallacy, however; it is not possible to determine whether individuals with better outcomes in these studies are the same individuals who received care from primary care physicians.

Despite the important role played by primary care physicians in preventive care, the actual effect of primary medical care on cancer outcomes has not been well studied. The degree to which primary medical care affects outcomes, such as stage at diagnosis and cancer mortality, is uncertain. Understanding the relationship between primary medical care and cancer outcomes is important in preparing for the major changes that are occurring to our nation's health care system.

METHODS

This study utilized a retrospective cohort design to assess primary care utilization and cancer outcomes. The 282,869 women with a diagnosis of breast cancer within the Surveillance Epidemiology and End Results (SEER)-Medicare linked data set during the years 1994 to 2005 represented our cohort of interest. This sample does not include women with premalignant lesions, such as lobular carcinoma in situ. We placed exclusions on the analytic sample to ensure that relevant clinical information was available and to help control for selection bias and confounding by unmeasured factors. Because of clinical complexity, we excluded women who were eligible for Medicare because of end-stage renal disease ($n = 897$) and women whose first SEER-registered cancer was not actually their first cancer diagnosis ($n = 5,945$). We then excluded women whose first diagnosis was not breast cancer and women who developed a type of cancer other than breast within 1 year of their first diagnosis ($n = 11,948$). A 24-month period was required to provide a stable estimate of physician visits. To ensure that patients had at least 24 months of Medicare claims before their cancer diagnosis, we excluded women with breast cancer diagnosed before the age of 67 years ($n = 102,582$). We also excluded breast cancer cases in which the diagnosis was based solely on death certificates or at autopsy ($n = 1,936$). Because patients enrolled in a Medicare health maintenance organization

(HMO) have no claims history, we excluded all women enrolled in a Medicare HMO during the year of cancer diagnosis and the year before diagnosis ($n = 42,429$). For similar reasons, we excluded women that did not have continuous Part A and Part B Medicare coverage during this 2-year period ($n = 12,027$). The final analytic sample included 105,105 women.

There is considerable empiric evidence that preventive care in general and cancer screening in particular are health services that are overwhelmingly delivered in the ambulatory setting.³⁹⁻⁴⁸ We therefore examined Medicare claims (National Claims History, NCH) for the following ambulatory-based evaluation and management services representing routine office visits: 99201-99205, 99211-99215.

Similar to earlier research, we identified the physician specialty associated with each claim using the unique physician identification number and the Medicare provider specialty field found in NCH claims.^{49,50} We defined primary care physicians as having the following specialties: general practice, family medicine, primary care internal medicine, geriatric medicine, obstetrics-gynecology, and physicians practicing in multispecialty group practices without a defined specialty. The distribution of physician visits by specialty was as follows: general practice 9.5%, family medicine 26.8%, primary care internal medicine 50.0%, geriatric medicine 0.5%, obstetrics-gynecology 6.0%, and multispecialty group practice 7.1%. For each woman, we assessed primary care and non-primary care physician office visits during a 24-month period before the cancer diagnosis.

Because physician visit patterns are likely to change during the time that a potential cancer is being diagnosed, we excluded the 3-month period immediately before diagnosis and assessed physician claims during the 24 months before this period (ie, the 3 to 27 months before diagnosis).⁵¹ Previous studies suggest that the overwhelming majority of patients complete diagnostic evaluations within this time.^{14,52}

Stage at diagnosis was classified using the American Joint Commission on Cancer (AJCC) staging system (0, I, II, III, and IV). The SEER database provided data on vital status and underlying cause of death for all patients through 2005. The following variables were used as potential confounders in multivariable models: age at diagnosis, race-ethnicity, marital status at diagnosis, census-derived measures of median household income (categorized by quintiles within each registry), education attainment (percentage of persons with less than a high school education, categorized by quintiles within each registry), metropolitan statistical area, influenza vaccination (as a marker of preventive behaviors), year of diagnosis, SEER geographic registry,

Charlson comorbidity index⁵³ (determined from both inpatient and outpatient claims), and histologic cancer type categorized as ductal, lobular, combined ductal/lobular, favorable (medullary, tubular, papillary, mucinous), or unfavorable (inflammatory, Paget's).

We examined the relationship between primary care and non-primary care physician ambulatory claims and likelihood of late-stage diagnosis (stage III, IV vs stage I, II) using multivariable logistic regression. Because the malignant potential of ductal carcinoma in situ (DCIS) is uncertain, we first examined only women having invasive breast cancer (in situ cases excluded), and then repeated our analysis including women with DCIS. We excluded women whose cancer stage was unknown at diagnosis from these analyses ($n = 10,694$). We also examined whether an unknown stage was related to measures of primary care physician visits. We estimated odds ratios of late-stage diagnosis and its 95% confidence intervals, comparing each category of physician utilization to its referent group.

As one probable mechanism by which primary care would lead to earlier diagnosis, we also explored whether the primary care physician visits were associated with greater likelihood of receiving a mammogram in the 2-year period before diagnosis. To avoid capturing tests performed at the time of breast cancer diagnosis, we assessed whether women had any bilateral mammogram in the 2-year period from 3 months to 27 months before diagnosis.⁵⁴ We did not try to differentiate screening and diagnostic mammograms because of the inherent difficulty in distinguishing this information from claims data.^{55,56} To determine whether physician visits were associated with late-stage diagnosis above and beyond receipt of a mammogram, we reran logistic models including a variable for a prior mammogram.

We examined mortality (all-cause and breast cancer mortality) among women having invasive breast cancers (in situ cancers were excluded, but cancers missing a diagnostic stage were included). The SEER-Medicare database provided vital status through December 31, 2007, and information on specific cause of death through December 31, 2005. All-cause mortality was therefore assessed from date of diagnosis to date of death or last known follow-up (December 31, 2007). Mortality from breast cancer was assessed from date of diagnosis through December 31, 2005. Among the 90,537 women having invasive breast cancer (including those with an unknown diagnostic stage), there were 35,496 deaths overall and 8,898 deaths due to breast cancer during the follow-up period. In all-cause mortality analyses, women who were alive at the end of follow-up were censored; additionally, in assessment of breast cancer mortality, those who died of causes other than breast cancer were also censored.

We also analyzed mortality using Cox proportional regression modeling, adjusting for potential confounding factors described above with further adjustment for tumor characteristics that may affect mortality (tumor grade, estrogen/progesterone receptor status, tumor size as a continuous variable). To determine whether associations between primary care physician visits and lower breast cancer mortality were primarily the result of earlier stage at diagnosis, hazard models were first performed excluding stage at diagnosis and tumor size and then repeated with stage (including an indicator variable for a missing stage) and tumor size.

RESULTS

Table 1 describes the final analytic sample. The mean age of the sample was 76.5 years (median 76 years, range 67 to 107 years, SD, 6.6 years). Most breast cancers were either ductal or lobular, and most women (80.9%) had early-stage (AJCC 0, I, II) disease. Women had on average 14 physician office visits (both primary care and non-primary care) in the 24-month prediagnostic period (SD, 13, median 11 visits). Primary care and non-primary care physician visits tended to be correlated (Spearman correlation coefficient 0.15, $P < .001$).

There were 57,769 (55%) women who had a mammogram in the 3- to 27-month period before a cancer diagnosis (83.7% of mammograms were ordered by a primary care physician). Table 2 describes predictors of mammography in the 3- to 27-month period before a cancer diagnosis for women having invasive breast cancers (stage I to IV, or unknown staging). The odds of a prior mammogram increased with an increasing number of primary care physician visits. Women who had more than 10 visits had 4.0 times greater odds of prior mammography compared with women having 0 or 1 encounter. The odds of prior mammography also increased with an increasing number of non-primary care physician visits in a similar fashion, with women who had more than 10 visits having 3.3 times greater odds of prior mammography compared with women having 0 or 1 encounter.

Table 3 shows the relationship between ambulatory visits and the odds of late AJCC stage disease (III, IV) at diagnosis. The odds of late-stage disease decreased with increasing number of ambulatory primary care and non-primary care physician visits. Women having 11 or more primary care visits had 50% lower odds of late-stage disease compared with women having 0 or 1 primary care visit.

Prior mammography was associated with reduced odds of late-stage disease (adjusted odds ratio 0.36; 95% CI, 0.34-0.38, $P < .001$). The association between primary care physician visits and late-stage disease was also attenuated when a variable for prior mam-

mogram was included in the logistic models (adjusted odds ratios [AORs] for primary care physician visits: 0 to 1 visit, AOR = 1.0 [referent]; 2 to 4 visits, AOR = 0.68 [95% CI, 0.64-0.73]; 5 to 10 visits, AOR = 0.62 [95% CI, 0.59-0.66]; ≥ 11 visits, AOR = 0.65 [95% CI, 0.61-0.69]).

Table 4 presents the relationship between ambulatory visits and breast cancer mortality. In unadjusted analysis and analysis adjusting for confounders other than stage and tumor size, an increase in both primary care and non-primary care physician visits was associated with lower breast cancer mortality. Women having more than 10 primary care physician visits had 41% lower breast cancer mortality compared with women having 0 to 1 visit when adjusting for confounders other than stage and size. Results were attenuated when stage at diagnosis and tumor size were included in logistic models, although these relationships persisted. All-cause mortality also diminished with increasing numbers of primary care physician visits (adjusted hazard ratios [AHRs]: 0 to 1 visit, AHR = 1.0 [referent group]; 2 to 4 visits, AHR = 0.76 [95% CI, 0.73-0.78]; 5 to 10 visits, AHR = 0.70 [95% CI, 0.68-0.73]; ≥ 11 visits, AHR = 0.73 [95% CI, 0.70-0.75]).

Results were similar when analyses were repeated with DCIS cases included. Associations between primary care physician visits and cancer outcomes were also similar when analyzed separately within categories of non-primary care physician utilization (0 to 1, 2 to 4, 5 to 10, ≥ 11 visits).

DISCUSSION

We found that an increasing number of primary care physician office visits were associated with improved

Table 1. Characteristics of Women With a Diagnosis of Breast Cancer (N = 105,105)

Characteristic	Value	Characteristic	Value
Total ambulatory primary care physician visits, n (%)		Histologic type, n (%)	
0-1	21,469 (20.4)	Ductal	74,760 (71.1)
2-4	19,355 (18.4)	Lobular	17,176 (16.3)
5-10	33,364 (31.7)	Ductal/lobular	347 (0.3)
≥ 11	30,917 (29.4)	Favorable	5,961 (5.7)
Total ambulatory non-primary care physician visits, n (%)		Unfavorable	1,315 (1.3)
0-1	39,031 (37.1)	Undefined	5,546 (5.3)
2-4	23,308 (22.2)	Estrogen receptors, n (%)	
5-10	23,230 (22.1)	Positive/borderline	49,010 (46.6)
≥ 11	19,536 (18.6)	Negative	9,147 (8.7)
Age at diagnosis, y (%)		Missing	46,948 (44.7)
67-75	51,290 (48.8)	Progesterone receptor, n (%)	
76-85	42,913 (40.83)	Positive/borderline	40,265 (38.3)
≥ 86	10,902 (10.37)	Negative	17,027 (16.2)
Race/ethnicity, n (%)		Missing	47,813 (45.5)
White, non-Hispanic	90,372 (86.0)	Tumor size, mm	
Black, non-Hispanic	6,694 (6.4)	Mean (SD)	20.2 (20.6)
Hispanic	3,931 (3.7)	Median (minimum-maximum)	15 (0-990)
Asian/American Indian/ Pacific Islander	3,425 (3.3)	AJCC stage at diagnosis, n (%)	
Other	683 (0.7)	0 (in situ)	14,568 (13.9)
Marital status, n (%)		I	42,830 (40.8)
Single (never married)	7,564 (7.2)	II	27,602 (26.3)
Married	43,030 (40.9)	III	6,012 (5.7)
Separated/divorced	6,913 (6.6)	IV	3,399 (3.2)
Widowed	43,280 (41.2)	Unknown	10,694 (10.2)
Unknown	4,318 (4.1)	Charlson comorbidity index, n (%) ^a	
MSA of residence, n (%)		0	61,466 (58.5)
Large metropolitan	60,122 (57.2)	1	24,979 (23.8)
Metropolitan	29,272 (27.9)	≥ 2	18,660 (17.8)
Urban	6,360 (6.1)	Influenza vaccination, n (%)	
Less urban	7,632 (7.3)	No	46,673 (44.4)
Rural	1,714 (1.6)	Yes	58,432 (55.6)
Year of diagnosis, n (%)			
1994-1997	24,139 (23.0)		
1998-2000	23,597 (22.5)		
2001-2005	57,369 (54.6)		

AJCC = American Joint Commission on Cancer; MSA = metropolitan statistical area.

^a Scored on a range from 3-35, where higher scores indicate increased morbidity.

breast cancer outcomes. Women having 10 or more office visits were 50% less likely to have late-stage cancer diagnosed and had 41% lower breast cancer mortality, as well as 27% lower overall mortality, compared with women having 0 to 1 visit. Improved breast cancer outcomes among women with greater numbers of primary care physician office visits were in part, but not completely, explained by greater use of mammography and resultant earlier stage diagnosis.

A number of studies have linked the supply of primary care physicians to earlier stage of breast cancer

at diagnosis, lower breast cancer mortality, and lower overall mortality.⁵⁷⁻⁶¹ Research has also suggested a strong relationship between the receipt of primary medical care and recommendations for breast cancer screening.^{1,62,63} Our study confirms the findings of others that Medicare beneficiaries having greater numbers of primary care physician visits were more likely to receive mammography before diagnosis and were more likely to have early-stage breast cancer.⁶¹ Factors other than mammography might also mediate the association between primary care physician encounters and breast cancer stage. For example, having a primary care physician may lead to earlier diagnosis after the onset of breast cancer symptoms or an abnormal mammogram,¹⁴ or it may encourage healthier behaviors that affect breast cancer stage.⁶⁴⁻⁶⁶

The association between breast cancer mortality and visits to a primary care physician appeared to be mediated in large part by earlier stage at diagnosis. This association remained, however, even after controlling for stage, suggesting the possibility of additional factors associated with primary care. Potential roles of primary care after cancer diagnosis include assisting with treatment decisions, facilitating access to treatments, ensuring compliance with treatments and surveillance, and facilitating psychosocial care.⁶⁷⁻⁷² Although it is possible such actions could influence breast cancer mortality,⁴⁹ it is not certain whether such care is typical in primary care encounters.^{73,74}

Visits to primary care physicians were also associated with lower overall mortality for women with diagnosed breast cancer. Potential mechanisms by

Table 2. Predictors of Mammography (n = 90,537)

Characteristic	Adjusted OR ^a	95% Wald CL	P Value	Characteristic	Adjusted OR ^a	95% Wald CL	P Value
Total ambulatory primary care physician visits				Education level of residence			
0-1 (referent)	1.00	–	–	Quintile 1 (lowest) (referent)	1.00	–	–
2-4	2.78	2.65, 2.92	<.001	Quintile 2	1.04	0.99, 1.09	0.17
5-10	3.67	3.51, 3.83	<.001	Quintile 3	1.16	1.10, 1.23	<.001
≥11	4.04	3.86, 4.23	<.001	Quintile 4	1.23	1.16, 1.30	<.001
Total ambulatory non–primary care physician visits				Quintile 5	1.34	1.25, 1.43	<.001
0-1 (referent)	1.00	–	–	Income level of residence			
2-4	1.72	1.65, 1.78	<.001	Quintile 1 (lowest) (referent)	1.00	–	–
5-10	2.15	2.06, 2.23	<.001	Quintile 2	0.99	0.94, 1.04	.71
≥11	3.31	3.16, 3.46	<.001	Quintile 3	0.97	0.92, 1.02	.26
Age at diagnosis				Quintile 4	0.95	0.90, 1.01	.13
67-75 y (referent)	1.00			Quintile 5	0.96	0.90, 1.03	.28
76-85 y	0.61	0.59, 0.63	<.001	MSA of residence			
≥86 y	0.25	0.24, 0.27	<.001	Large metropolitan (referent)	1.00	–	–
Race/ethnicity				Metropolitan	1.01	0.97, 1.06	.55
White, non-Hispanic (referent)	1.00	–	–	Urban	0.99	0.92, 1.06	.73
Black, non-Hispanic	1.01	0.95, 1.08	.66	Less urban	0.93	0.86, 1.00	.04
Hispanic	0.80	0.73, 0.86	<.001	Rural	1.05	0.92, 1.19	.48
Asian/American Indian/Pacific Islander	0.73	0.66, 0.81	<.001	Year of diagnosis			
Other	0.95	0.79, 1.15	.62	1994-1997 (referent)	1.00	–	–
Marital status				1998-2000	1.35	1.29, 1.41	<.001
Married (referent)	1.00	–	–	2001-2005	1.64	1.58, 1.71	<.001
Never married	0.77	0.72, 0.81	<.001	Charlson comorbidity index			
Separated/divorced	0.71	0.67, 0.75	<.001	0 (referent)	1.00	–	–
Widowed	0.72	0.69, 0.74	<.001	1	0.74	0.72, 0.77	<.001
Unknown	0.73	0.67, 0.79	<.001	≥2	0.49	0.47, 0.51	<.001
				Influenza vaccination			
				No (referent)	1.00	–	–
				Yes	1.69	1.64, 1.75	<.001

CL = confidence limits; MSA = metropolitan statistical area.

Note: Patients with stage 0 carcinoma (in situ) were excluded.

^aThe multivariable logistic models also included indicator variables for specific cancer registry (data not presented).

Table 3. Adjusted Associations of Late-Stage Diagnosis (AJCC III, IV) of Breast Cancer (n = 79,843)

Characteristic	Adjusted OR ^a	95% Wald CL	P Value	Characteristic	Adjusted OR ^a	95% Wald CL	P Value
Total ambulatory primary care physician visits				Education level of residence			
0-1 (referent)	1.00	–	–	Quintile 1 (lowest) (referent)	1.00	–	–
2-4	0.57	0.53, 0.61	<.001	Quintile 2	0.98	0.91, 1.05	.54
5-10	0.49	0.46, 0.52	<.001	Quintile 3	0.94	0.86, 1.02	.12
≥11	0.50	0.47, 0.53	<.001	Quintile 4	0.87	0.79, 0.95	.002
Total ambulatory non–primary care physician visits				Quintile 5	0.81	0.73, 0.90	<.001
0-1 (referent)	1.00	–	–	Income level of residence			
2-4	0.62	0.58, 0.66	<.001	Quintile 1 (lowest) (referent)	1.00	–	–
5-10	0.55	0.51, 0.58	<.001	Quintile 2	1.00	0.93, 1.08	.90
≥11	0.46	0.42, 0.49	<.001	Quintile 3	1.05	0.97, 1.14	.22
Age at diagnosis				Quintile 4	1.08	0.99, 1.19	.09
67-75 (referent)	1.00	–	–	Quintile 5	1.06	0.95, 1.18	.28
76-85	1.21	1.15, 1.27	<.001	MSA of residence			
≥86	1.67	1.55, 1.79	<.001	Large metropolitan (referent)	1.00	–	–
Race/ethnicity				Metropolitan	0.97	0.91, 1.04	.42
White, non-Hispanic (referent)	1.00	–	–	Urban	0.96	0.86, 1.08	.49
Black, non-Hispanic	1.38	1.27, 1.50	<.001	Less urban	0.84	0.75, 0.95	.004
Hispanic	1.32	1.19, 1.48	<.001	Rural	0.83	0.68, 1.00	.06
Asian/American Indian/Pacific Islander	0.84	0.72, 0.98	.03	Year of diagnosis			
Other	0.76	0.53, 1.08	.13	1994-1997 (referent)	1.00	–	–
Marital status				1998-2000	0.90	0.84, 0.97	.004
Married (referent)	1.00	–	–	2001-2005	1.09	1.02, 1.16	.01
Never married	1.38	1.27, 1.50	<.001	Charlson comorbidity index			
Separated/divorced	1.25	1.14, 1.37	<.001	0 (referent)	1.00	–	–
Widowed	1.24	1.18, 1.31	<.001	1	1.02	0.96, 1.08	.52
Unknown	1.23	1.08, 1.39	.001	≥2	1.21	1.13, 1.29	<.001
				Influenza vaccination			
				No (referent)	1.00	–	–
				Yes	0.72	0.69, 0.76	<.001

AJCC = American Joint Commission on Cancer; CL = confidence limits; MSA = metropolitan statistical area; PCP = primary care physician.

Note: Patients with stage 0 carcinoma (in situ) or missing were excluded.

^aOdds ratios indicate odds of late-stage (AJCC stages III, IV) diagnosis of breast cancer relative to early stage (AJCC stages I, II). Logistic models also include indicator variables for cancer registry (data not presented).

which primary care visits could affect overall mortality include promoting preventive services^{75,76} and managing comorbid illnesses, which occur in most cancer patients.⁷⁷ Our study did not have sufficiently detailed data to assess these hypotheses, but our findings are consistent with a growing body of evidence linking primary care to improved cancer outcomes.^{28-31,34-36,38,61,78,79}

Improved breast cancer outcomes were also seen for an increasing number of non–primary care physician visits. There are several possible explanations for the association between non–primary care physician visits and improved breast cancer outcomes. First, primary care and non–primary care physician visits tend to be correlated for such reasons as physician

referrals and sharing common mediators of health care utilization (eg, health care needs of sicker patients). Although it is possible that some non–primary care physicians function in the role of primary care,⁸⁰ we found few mammograms ordered by non–primary care physicians, and we found equally strong associations in non–primary care specialties that traditionally have not functioned in that role (eg, ophthalmology, orthopedics, otolaryngology, data not shown). We also found that the associations for primary care physician visits were equally strong across all levels of utilization, suggesting that these non–primary care physician visits do not substitute for primary care encounters. Regardless of number of non–primary care visits, utilization of primary care physician visits confers independent

Table 4. Adjusted Hazard Ratios for Breast Cancer Mortality (n = 90,537)

Characteristic	Unadjusted Hazard Ratio (95% CI)	Adjusted Excluding Stage and Tumor Size ^a Hazard Ratio (95% CI)	Adjusted Including Stage and Tumor Size ^a Hazard Ratio (95% CI)
Total ambulatory primary care physician visits			
0-1 (referent)	1.00	1.00	1.00
2-4	0.55 (0.52-0.59)	0.68 (0.64-0.73)	0.89 (0.82-0.95)
5-10	0.50 (0.47-0.53)	0.61 (0.58-0.65)	0.83 (0.77-0.89)
≥11	0.50 (0.47-0.53)	0.59 (0.55-0.63)	0.80 (0.74-0.86)
Total ambulatory non-primary care physician visits			
0-1 (referent)	1.00	1.00	1.00
2-4	0.62 (0.58-0.65)	0.72 (0.68-0.76)	0.87 (0.81-0.93)
5-10	0.56 (0.53-0.59)	0.66 (0.62-0.72)	0.83 (0.77-0.89)
≥11	0.55 (0.51-0.58)	0.60 (0.56-0.64)	0.83 (0.76-0.89)
Age at diagnosis			
67-75 y (referent)		1.00	1.00
76-85 y		1.36 (1.30-1.43)	1.28 (1.21-1.35)
≥86 y		2.19 (2.05-2.33)	1.85 (1.71-2.00)
Race/ethnicity			
White, non-Hispanic (referent)		1.00	1.00
Black, non-Hispanic		1.15 (1.06-1.25)	1.03 (0.94-1.14)
Hispanic		1.03 (0.93-1.16)	0.91 (0.80-1.03)
Asian/American Indian/Pacific Islander		0.86 (0.74-1.01)	0.97 (0.81-1.15)
Other		0.52 (0.36-0.77)	1.09 (0.94-1.26)
Marital status			
Married (referent)		1.00	1.00
Never married		1.36 (1.25-1.48)	1.22 (1.11-1.35)
Separated/divorced		1.35 (1.24-1.48)	1.27 (1.14-1.40)
Widowed		1.33 (1.26-1.40)	1.21 (1.14-1.28)
Unknown		1.15 (1.03-1.29)	1.09 (0.94-1.26)
Education level of residence			
Quintile 1 (lowest) (referent)		1.00	1.00
Quintile 2		1.02 (0.95-1.09)	1.08 (0.99-1.16)
Quintile 3		0.94 (0.87-1.01)	0.97 (0.89-1.06)
Quintile 4		0.92 (0.84-1.00)	0.98 (0.89-1.08)
Quintile 5		0.88 (0.80-0.97)	0.92 (0.82-1.03)
Income level of residence			
Quintile 1 (lowest) (referent)		1.00	1.00
Quintile 2		1.00 (0.93-1.07)	0.97 (0.90-1.05)
Quintile 3		1.02 (0.95-1.11)	0.96 (0.88-1.05)
Quintile 4		1.00 (0.92-1.09)	0.98 (0.89-1.08)
Quintile 5		1.03 (0.93-1.14)	1.03 (0.92-1.16)
MSA of residence			
Large metropolitan (referent)		1.00	1.00
Metropolitan		0.99 (0.92-1.06)	0.98 (0.90-1.06)
Urban		0.95 (0.85-1.06)	0.97 (0.86-1.10)
Less urban		0.92 (0.82-1.02)	0.96 (0.84-1.09)
Rural		0.78 (0.65-0.94)	0.81 (0.66-1.00)

continued

and additional benefits, which is consistent with results from our prior study in patients with colorectal cancer.⁷⁹

The nation's primary care workforce has been in decline during the past few decades, potentially threatening health conditions, such as cancer, that are sensitive to primary care services.^{24,81} Although primary care physician supply may be an important predictor of health outcomes, effective primary care may well require more than just a sufficient number of primary care physicians. The best evidence for improved quality appears to come from a more fundamental primary care orientation of the health care system.⁸²

This study has a number of limitations that should be considered when interpreting our results. First, this study was limited to patients aged 67 years and older having Medicare fee-for-service insurance, and findings may be different for other populations. Selection bias might have affected our results if persons with unknown disease staging were more likely to have late-stage disease. Given that unknown stage was more common for persons with low primary care utilization, excluding patients with an unknown stage from the analysis would bias our findings toward the null (our findings would be conservative). Selection bias could also affect our results of survival (overestimating associations) if healthy persons are more likely to see primary care physicians. We included influenza vaccination in our models as a proxy for this healthy user effect.

The association between visits to a primary care physician and breast cancer mortal-

ity could also be, in part, the result of lead time bias in which persons receive an earlier disease diagnosis but

do not have improved survival. Our study attempted to address this issue by exploring the hypothesized causal

pathway linking greater use of mammography (proven to lower breast cancer mortality) to earlier stage diagnosis and in turn lower breast cancer mortality. Future studies should explore the association between primary care services and population-based measures of breast cancer mortality.

Our study was limited to administrative data contained within the SEER-Medicare database, which may omit important confounders. For example, we did not have information on severity of comorbid illness, which may be associated with mortality. Our measure of primary care utilization was limited, and we did not have detailed information on the content of the primary care relationship. As such, it is uncertain what specific aspects of the primary care relationship are most important to improve breast cancer outcomes. For example, it is uncertain whether the quantity of visits is more important than the type of visits (health maintenance visits for example).

In conclusion, for Medicare beneficiaries with breast cancer, increasing the number of visits to a primary care physician was associated with an increased likelihood of recent mammography, lower odds of late-stage diagnosis, and lower breast cancer and overall mortality. These findings suggest adequate primary medical care may be an important factor in achieving optimal outcomes for patients with a diagnosis of breast cancer.

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Table 4. Adjusted Hazard Ratios for Breast Cancer Mortality (n = 90,537)
(continued)

Characteristic	Unadjusted Hazard Ratio (95% CI)	Adjusted Excluding Stage and Tumor Size ^a Hazard Ratio (95% CI)	Adjusted Including Stage and Tumor Size ^a Hazard Ratio (95% CI)
Year of diagnosis			
1994-1997 (referent)		1.00	1.00
1998-2000		1.05 (0.99-1.11)	0.97 (0.91-1.04)
2001-2005		1.06 (1.00-1.13)	0.93 (0.87-1.00)
Histology type			
Ductal (referent)		1.00	1.00
Lobular		0.79 (0.74-0.84)	0.88 (0.82-0.94)
Ductal/lobular		1.09 (0.78-1.51)	1.18 (0.83-1.68)
Favorable		0.29 (0.24-0.34)	0.45 (0.38-0.54)
Unfavorable		1.98 (1.78-2.21)	1.10 (0.89-1.35)
Undefined		0.88 (0.78-1.00)	1.09 (0.95-1.25)
Tumor grade			
Well differentiated (referent)		1.00	1.00
Moderately differentiated		2.16 (1.96-2.39)	1.66 (1.49-1.85)
Poorly differentiated		4.62 (4.19-5.10)	2.78 (2.50-3.10)
Undifferentiated		4.73 (4.04-5.53)	2.71 (2.28-3.23)
Unknown		5.07 (4.58-5.62)	2.23 (1.98-2.51)
Estrogen receptor status			
Positive/borderline (referent)		1.00	1.00
Negative		1.52 (1.41-1.64)	1.62 (1.49-1.75)
Unknown		1.36 (1.13-1.64)	1.37 (1.09-1.71)
Progesterone receptor status			
Positive/borderline (referent)		1.00	1.00
Negative		1.40 (1.31-1.50)	1.37 (1.27-1.47)
Unknown		1.21 (1.00-1.46)	1.01 (0.81-1.27)
Tumor size (continuous, mm)			1.006 (1.006-1.006)
Stage at diagnosis			
I (referent)		–	1.00
II		–	3.38 (3.13-3.64)
III		–	8.90 (8.12-9.75)
IV		–	32.34 (29.51-35.43)
Unknown		–	3.60 (3.25-4.00)
Charlson comorbidity index			
0 (referent)		1.00	1.00
1		1.15 (1.08-1.21)	1.20 (1.13-1.28)
≥2		1.51 (1.42-1.60)	1.53 (1.43-1.64)
Influenza vaccination			
No (referent)		1.00	1.00
Yes		0.79 (0.76-0.83)	0.92 (0.87-0.97)

MSA = metropolitan statistical area; SEER = Surveillance Epidemiology and End Results.

Note: Patients with stage 0 carcinoma (in situ) were excluded in the multivariable analysis.

^a Multivariable Cox proportional models also included indicator variables for SEER Registry location (data not presented).

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