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Physician visits, patient comorbidities, and mammography use among elderly colorectal cancer survivors

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Abstract
Introduction Over a million Americans have survived colorectal cancer. This study examined physician visit patterns, patient comorbidities, and mammography use among colorectal cancer survivors based on the competing demands model.
Methods Using Surveillance, Epidemiology, and End Results (SEER)–Medicare linked data (2003 merge), study cohorts included female colorectal cancer patients who were diagnosed from 1973 through 1994 and had survived five or more years after the cancer diagnosis (n=12,681), and a non-cancer comparison population who had no history of cancer and resided in the SEER areas during the study period.
Results Cancer survivors had a significant 6% higher mammography rate during 2000 to 2001 than matched women with no history of cancer (50 vs 47 per 100 persons, respectively). Among cancer survivors, there was a significant and positive association between the number of physician visits for evaluation and management (E&M) and mammography rates. More physician visits for E&M reduced the differences of mammography rates between those with and without additional comorbidities. Cancer survivors who visited gynecologists for E&M were 45% more likely to receive mammograms than those who visited only primary care physicians (multivariate adjusted rate ratio, 1.45; 95% CI, 1.38–1.53).
Conclusions Elderly female colorectal cancer survivors were more likely to receive mammograms than matched women with no history of cancer.
Implications for cancer survivors Patients with multiple comorbidities might receive more mammograms by increasing the number of office visits for E&M and by visiting gynecologists. Primary care physicians should increase the priority for recommending mammograms among cancer survivors.

Keywords Colorectal cancer survivor · Mammogram · Physician visit · Comorbidity · Competing demand model · Elderly women

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Introduction

Each year, about 148,000 Americans are diagnosed with colorectal cancer [1]. More than 64% of these new cases are expected to survive for five or more years, and for those with localized histological staging, the 5-year survival rate is about 90%. As a result, more than one million Americans have now survived colorectal cancer [2]. In spite of these encouraging statistics, second primary cancers are still among the leading causes of death for cancer survivors [1, 3]. Studies have shown that female colorectal cancer survivors have similar risk of developing breast cancer to women with no history of cancer [4]. While reassuring, it also means we can expect approximately one in eight female colorectal cancer survivors to develop breast cancer [5].

At this point, it remains unclear whether cancer survivors (not specific to a cancer type) use more or less preventive health services than those with no history of cancer [6–11]. For example, using Surveillance, Epidemiology, and End Results (SEER)–Medicare data, one study reported that mammography rate among colorectal cancer survivors was 54%, not different from that of matched non-cancer controls (52%) [9]. Our previous study found that uterine cancer survivors had a

higher mammography rate (56%) than the non-cancer controls (50%) [10]. Mammography rate among cancer survivors in general has not reached the national goal, 80% in two years, as stipulated in Healthy People 2010 [12].

To understand the mechanisms underlying the use of preventive services, Jaen proposed a "competing demands model" arguing that the competing demands faced by physicians during clinical encounters would affect the utilization of recommended preventive services [13]. For elderly cancer survivors, the issue of mammography use is more complex because they often have multiple comorbidities [14]. Determinants of mammography use include patient characteristics such as knowledge, attitudes, and comorbidities, physician characteristics such as skills, attitudes, and performance gap among physician peers, as well as constraints in the practice environment such as regulations and financial incentives. During office visits these factors interact to determine mammography use [15]. Although some patients may request mammograms during office visits [15, 16], studies have shown that the physician's recommendation is the most important factor in determining mammography use [17, 18]. More patient-physician interactions increase the chance of receiving mammograms [19]. In addition, studies have found that gynecologists are more likely to recommend mammograms than primary care physicians [9, 10, 20, 21].

Previous studies have examined mammography use as one of several preventive and/or recommended services use among cancer survivors, and have reported that patient characteristics can affect mammography use among cancer survivors [6, 9–11, 16, 19, 22]. However, no study has explicitly examined how physician visit patterns and patient comorbidities interact to affect mammography use among cancer survivors based on the competing demands model framework. In this study, we used the linked SEER–Medicare data to examine the mammography rates among women who survived colorectal cancer for more than 5 years, and assess how patient characteristics and physician visit patterns impacted the mammography use in this population.

Methods

The study used linked SEER–Medicare data files from the 2003 linkage [23]. About 97% of the SEER cases age≥ 65 years were linked to Medicare data through 2002. Women with colorectal cancer were identified using the first SEER cancer site recode variable (15–23, 25, 26, colon or rectal cancer; n=112,737). We included only cases with in situ, local, or regional disease at the time of diagnosis (n=86,060). The colorectal cancer survivors were defined as those who were diagnosed between 1973 and 1994 (n=59,354) and had lived for at least five years after the diagnosis (n=24,609). Since comorbidities and covariables were identified from 1998 and 1999 Medicare claims, our study cohort included only women age 67 or older at January 1, 2000 (n=22,281). Similar to other studies using the linked SEER–Medicare database, we further limited the cohort to people likely to have complete claims by excluding those who did not have both Medicare part A and part B (n=770), were enrolled in managed care (n=5,593), had end-stage renal disease (n=14), enrolled in a hospice program (n=1,086), or died in 2000 or 2001 (n=1,896), resulting in 12,922 women in the final cancer survivor cohort.

SEER–Medicare data also include a 5% sample from non-cancer Medicare beneficiaries residing in the same SEER areas (108,236 women). We applied similar exclusion criteria to them, resulting in 53,789 women for the comparison group who had no history of a cancer diagnosis before 2000 and were alive at December 31, 2001.

Using Medicare National Claims History (NCH) and outpatient files, mammography use during the years 2000 and 2001 was identified using Common Procedure Coding System (CPT) or Healthcare Common Procedure Coding System (HCPCS) code 76090–76092, G0202–G0207, G0236, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code V76.12. Only the first mammogram in the 2-year period was counted.

Patient socio-economic variables such as age, race, ethnicity, zip code median household income from 2000 census, and rural/urban residence were obtained from SEER Patient Entitlement and Diagnosis Summary File.

ICD-9 diagnosis codes in the Medicare NCH, inpatient and outpatient claims were used to calculate a Charlson Index using Deyo's modifications [24, 25], as suggested by Klabunde, et al. [26] We also used Elixhauser's algorithm to classify cormobidities [27]. Both Charlson score and Elixhauser's comorbidity groups were grouped as zero, 1, and 2+. We did not include cancer diagnosis as a comorbidity when calculating the above scores. Findings were consistent between the analyses using these two comorbidity measures (data available upon request). We present only the results based on the Charlson score.

We classified people who had a hospital claim during the year 1998 and 1999 as being hospitalized. Teaching hospital status was determined by the non-zero amount of medical education fee in the hospital claims.

Physician visits for Evaluation and Management (E&M) refer to new or established office visits. Non-E&M visits include hospital visits and visits for procedures and tests. Physician visits for E&M and non-E&M, and the associated physician specialties during 24 months prior to the mammography use were determined using NCH files. The physician visit patterns were coded as: visited only primary

care physicians; visited gynecologists (specialty code, 16) or gynecologic oncologist (98) but not other oncologists; visited other oncologists; and the "other" group which included women who never visited a physician (<1%) or visited other specialists. The primary care physicians included those in general practice (01), family practice (08), internal medicine (11), geriatric medicine (38), and multi-specialty group practice (70). The "other" oncologists included hematology/oncology (83), medical oncology (90), surgical oncology (91), and radiation oncology (92).

The propensity score matching method was used to balance the distributions of personal characteristics between cancer survivors and women without a history of cancer [28]. The dependent variable in the logistic regression for calculating propensity score was cancer status (yes/no), and the predictors included age, race, ethnicity, zip code median household income, rural/urban residence, comorbidities, and physician visit patterns. Each cancer survivor was matched with a woman who had no history of cancer, lived in the same SEER area, and whose propensity score was nearest to that of the cancer survivor and within half of the standard deviation of the propensity score distribution (one-to-one nearest neighbor method). The psmatch2 module in Stata 9.2 was used for this procedure [29]. After matching, there were 12,681 cancer survivors and matched controls available for the final analysis.

Comparisons of mammography use between cancer survivors and women with no history of cancer were performed on the matched cohorts. Bivariate associations were tested using a Z test. In addition, we used a modified multivariate Poisson regression to further examine how patient characteristics and physician visit patterns affected mammography use among cancer survivors [30]. Unadjusted and multivariate adjusted rates are presented. All statistical analyses used the Statistical Analysis Software (SAS Genmod, version 9.1 for Windows, SAS Institute Inc., Cary, NC, 2006).

Results

Prior to matching, colorectal cancer survivors were significantly different from the entire sample of women with no history of cancer in most characteristics (Table 1). The propensity matching method successfully created a comparable non-cancer control (c statistic, 0.67) and achieved balance for all covariables except medical specialty.

The overall unadjusted mammography rate was 49.8 per 100 persons among cancer survivors, 6% more than that of the control group (47.4 per 100 persons; $p<0.0001$; Table 2). Among those under age 75, the mammography rate was 72 per 100 persons among cancer survivors, also 6% higher, compared with 68 per 100 persons among the control group. Further adjustment for race, comorbidities, socioeconomic variables, and physician visit patterns yielded similar results (50 vs 47 per 100 persons for cancer survivors and controls, respectively), reflecting effective propensity score matching.

The mammography rate decreased significantly among cancer survivors with age (p for trend <0.0001; Table 3). Women aged 75–84 were about half as likely to receive mammograms than those in the 67–74 age group. In addition, mammography use was not different between blacks and whites after adjustment for other factors. Cancer survivors who had state subsidy for Medicare premium, lived in poor areas or in urban areas, were hospitalized, or had a non-zero Charlson score, were also less likely to receive mammograms.

After adjustment for personal characteristics, cancer survivors who visited gynecologists or gynecologic oncologists for E&M during the study period were 45% more likely to receive mammograms than those who visited only primary care physicians (rate ratio, 1.45; 95% CI, 1.38–1.53; Table 3). Those who visited other oncologists also had higher mammography rates than those who visited only primary care physicians. In addition, more physician visits for E&M were associated with higher mammography rates ($p<0.001$ for trend). Those having 1–4 visits per year were three times more likely to receive mammograms than those having no E&M visit. From the 1–4 visits per year to ≥15 visits per year, mammography rates increased 18, 12, and 13% for every increase of five visits per year. However, there was a decreased trend of mammography use with non-E&M visits ($p<0.0001$).

Among cancer survivors who had a Charlson score of zero and visited only primary care physicians, a moderate increase of E&M visits from 1–4 to 5–9 visits per year raised the mammography rate from 45 per 100 persons to 50 per 100 persons, a 9% change (Fig. 1). Among those who had a non-zero Charlson score, the effects of E&M visits on the mammography use were more evident: a 29% increase in mammography use from the one to four visits group (38 per 100 persons) through the five to nine visits group (50 per 100 persons). After physician visits reached the five to nine visits group, the mammography rates were similar between these two comorbidity groups. There was no significant increase of mammography use with additional E&M visits.

Findings were similar in the analyses on E&M visits to gynecologists (Fig. 2). From zero to one visit category, those with zero Charlson score had a 35% increase in mammography rates, and those with a non-zero Charlson score had a 51% increase. Both groups had smaller increases from one visit to two or more visits category. However, comparing Fig. 1 with Fig. 2, the highest mammography rate among those who visited only primary

Table 1 Characteristics of colorectal cancer survivors and women with no history of cancer

		Cancer survivors	Non-cancer controls	Total non-cancer
Total		12,681	12,681	53,789
Age, in years	67–74	26.6%	26.8%	43.9%*
	75–84	46.8%	47.1%	42.2%
	≥85	26.7%	26.1%	14.0%
Race/ethnicity	White	88.3%	89.0%	82.1%*
	Black	6.1%	5.8%	7.1%
	Other	5.6%	5.2%	10.8%
State buy-in status	No state buy-in	88.7%	89.5%	83.5%*
	State buy-in	11.3%	10.5%	16.5%
Rural residence	No	86.7%	86.9%	88.2%*
	Yes	13.3%	13.1%	11.8%
Hospitalization	Not hospitalized	70.7%	71.9%	75.8%*
	Non-teaching hospital	12.8%	12.5%	11.4%
	Teaching hospital	16.5%	15.6%	12.8%
Zip code median household income	<40,000	32.1%	31.1%	30.9%*
	40,000–53,000	34.7%	35.0%	36.3%
	≥53,000	33.2%	33.9%	32.7%
Charlson score	0	54.0%	56.3%	57.7%*
	1	26.0%	24.7%	23.9%
	≥2	20.0%	19.0%	18.4%
Medical specialty	Primary care physician only	66.6%	69.1%*	64.7%*
	Gynecologist or gynecologic oncologist	13.4%	17.8%	2.1%
	Other oncologists	6.6%	1.3%	14.2%
	Other specialists	13.3%	11.8%	19.0%
Physician E&M visits (per year)	0	5.4%	4.9%	11.2%*
	1–4	34.7%	35.8%	34.7%
	5–9	34.8%	35.3%	30.8%
	10–14	15.6%	14.9%	14.0%
	≥15	9.5%	9.1%	9.3%
Physician non-E&M visits (per year)	0	15.6%	16.4%	25.2%*
	1–4	61.7%	61.6%	58.4%
	5–9	12.1%	11.8%	9.0%
	10–14	5.0%	5.1%	14.0%
	≥15	5.7%	5.2%	9.3%

Note:
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*$P<0.001$ from chi-square tests between cancer survivors and women with no history of cancer

Table 2 Mammography rates (per 100 persons) by age group

		Cancer survivors	Non-cancer controls
Total		49.8	47.4*
Age-group	67–74	71.8	68.0*
	75–84	52.4	50.9*
	≥85	23.6	20.0*
Multivariate adjusted		50.3	47.1*
Multivariate adjusted rate ratio and 95% confidence interval		1.07 (1.04–1.09)	

The multivariate model included age, race, ethnicity, zip code median household income, rural/urban residence, comorbidities, and physician visit patterns.
*$P<0.001$ for the Z test between cancer survivors and non-cancer controls

care physicians was still lower than among those who ever visited gynecologists.

Discussion

We found that female colorectal cancer survivors had higher mammography rates than women with no history of cancer, after matching on personal characteristics and physician visit patterns, though both were well below the target established in Healthy People 2010. This is consistent with findings from studies using the same SEER data [9, 10] and the study from National Health Interview Survey [6]. In addition, among those aged 67–74, the mammography rate was about 70 per 100 persons, closer to the

Table 3 Determinants of mammography use among colorectal cancer survivors

		Rate ratios	*P* for trend
Age	67–74	Reference	<0.0001
	75–84	0.79 (0.76–0.83)	
	≥85	0.44 (0.39–0.49)	
Race/ethnicity	White	Reference	
	Black	1.04 (0.92–1.18)	
	Other	0.87 (0.81–0.93)	
State buy-in status	No state buy-in	Reference	
	State buy-in	0.76 (0.70–0.83)	
Rural residence	No	Reference	
	Yes	1.08 (1.04–1.12)	
Hospitalization	Not hospitalized	Reference	
	Non-teaching hospital	0.94 (0.93–0.96)	
	Teaching hospital	0.94 (0.90–0.98)	
Zip code median household income	<40,000	Reference	0.08
	40,000–53,000	1.02 (1.00–1.04)	
	≥53,000	1.06 (0.99–1.13)	
Charlson score	0	Reference	<0.0001
	1	0.91 (0.87–0.95)	
	≥2	0.89 (0.84–0.94)	
Medical specialty	Primary care physician only	Reference	
	Gynecologist or gynecologic oncologist	1.45 (1.38–1.53)	
	Other oncologists	1.30 (1.25–1.36)	
	Other specialists	0.81 (0.71–0.92)	
Physician E&M visits (per year)	0	Reference	<0.0001
	1–4	3.14 (2.28–4.34)	
	5–9	3.70 (2.66–5.13)	
	10–14	4.16 (3.03–5.73)	
	≥15	4.69 (3.35–6.56)	
Physician non-E&M visits (per year)	0	Reference	<0.0001
	1–4	1.11 (1.07–1.16)	
	5–9	0.77 (0.71–0.85)	
	10–14	0.57 (0.47–0.68)	
	≥15	0.44 (0.39–0.49)	

The multivariate model included age, race, ethnicity, zip code median household income, rural/urban residence, comorbidities, and physician visit patterns simultaneously.
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Healthy People 2010 target. The lower mammography rate among those aged 75 or above may reflect the belief that mammography is less cost-effective for those aged 75 or above [31]. Because of this concern, we also performed the same multivariate analyses among cancer survivors aged 67–74 and obtained the same conclusions (data available upon request). Furthermore, the absolute risk of developing breast cancer is not lower in older people than in younger people [31]. With improved medical care, women at the age of 75 may still have a life expectancy of 12 years [32]. Thus, the National Cancer Institute recommends usual mammography use for all elderly people [33], and Centers for Medicare and Medicaid Services reimburse annual screening mammograms regardless of age.

During office visits, both patient and physician will evaluate the need of mammography. We specifically examined the interactions between comorbidities and physician E&M visits, separately for primary care physicians and for gynecologists. For both physician groups, there was a positive relationship between E&M visits and mammography rates (Figs. 1 and 2). However, the relationship was not linear. When the number of physician visits increased, the increase in mammography use became smaller. This is in accordance with the competing demands model [13]. Women who had most physician visits might have other health issues, causing attending physicians to consider mammograms as a lower priority [34–36]. This is also consistent with the finding that more non-E&M visits were associated with lower mammography rates, because during non-E&M visits physicians were more likely to focus on acute problems and unlikely to recommend mammograms.

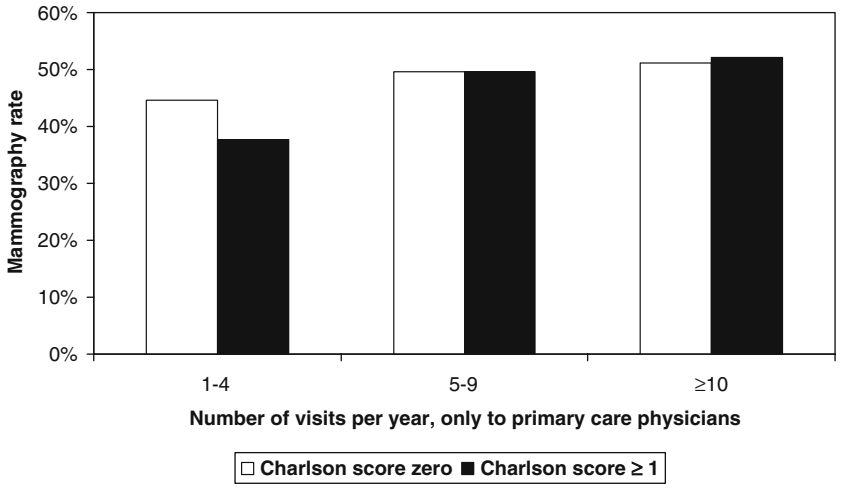

Figure 1 Mammography rates by primary care physician visits among colorectal cancer survivors.

As also shown in Figs. 1 and 2, increasing physician E&M visits helped reduce the difference in mammography use between those who had a non-zero Charlson score and those who had a zero Charlson score. After physician visits reached a moderate level, there was no significant difference in mammography use between these two comorbidity groups. Therefore, elderly cancer survivors may increase the chance of receiving mammograms by increasing E&M visits.

The most important determinant for mammography use is a physician's recommendation [17]. Different medical specialties may also have different preferences in recommending mammograms [20, 21, 37]. Studies have reported that obstetrician-gynecologists are more likely to recommend mammograms than primary care physicians [9, 10, 38, 39]. In the National Ambulatory Medical Care Survey [7], women who had preventive health visits to obstetrician-gynecologists were more likely to receive a prescription for a mammogram (87%) than those who visited either internists (23%) or family/general practitioners (22%). In our previous study [10], uterine cancer survivors who visited obstetrician-gynecologists or gynecologic oncologists also had higher mammography rates than those who visited only primary care physicians. The current study showed that the highest mammography rate among primary care physician visit groups was still lower than the lowest rate in the gynecologist groups.

Higher mammography use among patients who visited gynecologists is not surprising. Gynecologists are trained to be more vigilant in screening for breast cancer. However, the mammography rates (72 per 100 persons) among those who visited gynecologists were still lower than the national recommendation. On the other hand, according to the competing demands model, primary care physicians may neglect mammography when facing more patient care demands among elderly women with multiple comorbidities [34–36]. It is also possible that primary care physicians might perceive less need for mammograms among elderly cancer survivors.

A strength of this study is the large national representative sample. The carefully validated SEER-Medicare data

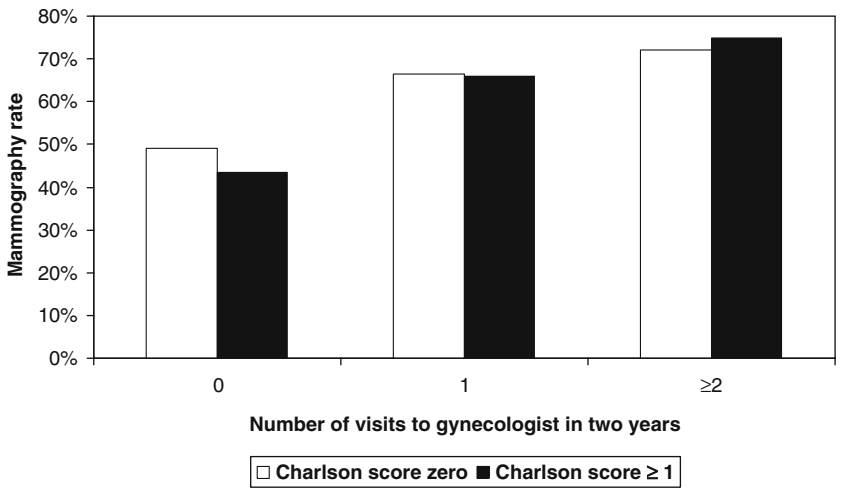

Figure 2 Mammography rates by gynecologist or gynecologic oncologist visits among colorectal cancer survivors.

represent 17% of national cancer patients. Results from this data can be directly generalized to the US population and have significant health policy implications. Because women with no history of cancer may be different in their health behaviors and health utilization patterns, another strength of this study is the use of propensity score matching method to reduce selection bias by identifying an appropriately matched control group. Finally, detailed interaction analyses between physician visits, medical specialties and patient cormorbidity was conducted. No previous study has specifically examined this issue among cancer survivors.

This study has several limitations. The measure of comorbidity was based on claims and not on detailed clinical information [26]. The study could not determine which physician actually prescribed the mammogram or whether the mammogram was recommended but not required. Thus, this study is unable to delineate the reasons why some physicians did not recommend mammograms during regular office visits. It could be that people who had more physician visits and those who visited gynecologists or oncologists might be more knowledgeable and more health conscious than those who had fewer physician visits and those who visited only primary care physicians. However, the differences in mammography use among them can also reflect physician behavior indirectly because the most important factor in determining mammography use is a physician's recommendation [17]. It is also well recognized that patient needs for health services are relatively constant within a population, while physicians play a decisive role in determining health services utilization [40].

In summary, female colorectal cancer survivors were more likely to receive mammograms than women with no history of cancer. More physician visits for E&M and visiting a gynecologist or oncologist increased the chance of receiving mammograms. More importantly, increasing physician E&M visits can reduce the difference in mammography use between those with and without additional comorbidities. Therefore, given that about 70% women were only seen by primary care physicians, primary care physicians should be more aggressive in recommending mammograms to elderly female cancer survivors.

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