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ORIGINAL REPORT

Quality of Care for Comorbid Conditions During the Transition to Survivorship: Differences Between Cancer Survivors and Noncancer Controls

Claire F. Snyder, Kevin D. Frick, Robert J. Herbert, Amanda L. Blackford, Bridget A. Neville, Antonio C. Wolff, Michael A. Carducci, and Craig C. Earle

Claire F. Snyder, Johns Hopkins School of Medicine; Claire F. Snyder, Kevin D. Frick, and Robert J. Herbert, Johns Hopkins Bloomberg School of Public Health; Claire F. Snyder, Kevin D. Frick, Amanda L. Blackford, Antonio C. Wolff, and Michael A. Carducci, Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins University, Baltimore, MD; Bridget A. Neville, Consultant, Boston, MA; and Craig C. Earle, Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada.

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Corresponding author: Claire Snyder, PhD, Johns Hopkins School of Medicine, 624 N. Broadway, Room 657, Baltimore, MD 21205; e-mail: csnyder@jhsph.edu.

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ABSTRACT

Purpose

Building on previous research documenting differences in preventive care quality between cancer survivors and noncancer controls, this study examines comorbid condition care.

Methods

Using data from the Surveillance, Epidemiology, and End Results (SEER) –Medicare database, we examined comorbid condition quality of care in patients with locoregional breast, prostate, or colorectal cancer diagnosed in 2004 who were age ≥ 66 years at diagnosis, who had survived ≥ 3 years, and who were enrolled in fee-for-service Medicare. Controls were frequency matched to cases on age, sex, race, and region. Quality of care was assessed from day 366 through day 1,095 postdiagnosis using published indicators of chronic (n = 10) and acute (n = 19) condition care. The proportion of eligible cancer survivors and controls who received recommended care was compared by using Fisher's exact tests. The chronic and acute indicators, respectively, were then combined into single logistic regression models for each cancer type to compare survivors' care receipt to that of controls, adjusting for clinical and sociodemographic variables and controlling for within-patient variation.

Results

The sample matched 8,661 cancer survivors to 17,322 controls (mean age, 75 years; 65% male; 85% white). Colorectal cancer survivors were less likely than controls to receive appropriate care on both the chronic (odds ratio [OR], 0.88; 95% CI, 0.81 to 0.95) and acute (OR, 0.72; 95% CI, 0.61 to 0.85) indicators. Prostate cancer survivors were more likely to receive appropriate chronic care (OR, 1.28; 95% CI, 1.19 to 1.38) but less likely to receive quality acute care (OR, 0.75; 95% CI, 0.65 to 0.87). Breast cancer survivors received care equivalent to controls on both the chronic (OR, 1.06; 95% CI, 0.96 to 1.17) and acute (OR, 0.92; 95% CI, 0.76 to 1.13) indicators.

Conclusion

Because we found differences by cancer type, research exploring factors associated with these differences in care quality is needed.

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INTRODUCTION

The 2005 Institute of Medicine report "From Cancer Patient to Cancer Survivor: Lost in Transition" highlights cancer survivors' health care needs, including surveillance for recurrence, treatment for long-term and late effects of cancer and its treatment, general primary and preventive care, and in many cases, care for comorbid conditions.[1] In a population-based national sample, 58% of cancer survivors had at least one comorbid condition compared with 45% of noncancer controls[2]; thus, comorbid condition care is required in a majority of cancer survivors. The need for quality comorbid condition care will continue to increase as improvements in diagnosis and treatment lead to patients with cancer living longer after diagnosis. The 5-year relative survival for breast cancer is 90%, for prostate cancer is 100%, and for colorectal cancer is 65%.[3] For cancers such as early-stage breast cancer, survivors are more likely to die from causes other than cancer.[4] Although quality comorbid condition care is important for all cancer survivors, it is particularly relevant for older cancer survivors because they are more likely to have health problems in addition to their cancer. Sixty percent of survivors are older than age 65,[5] and two thirds of the projected increase in annual cancer incidence between 2010 and 2030, from 1.6 to 2.3 million cases, is related to the aging of the population.[6]

Despite the importance of appropriate comorbid condition care for cancer survivors, few studies have examined this topic. Research has examined either particular comorbid conditions (eg, diabetes)[7,8] or particular cancers.[9-14] Earle and Neville[15] examined comorbid condition care quality in 5-year colorectal cancer survivors diagnosed from 1991 to 1992 and found worse care in cancer survivors compared with noncancer controls, particularly for chronic conditions. Other research comparing the quality of cancer survivors' preventive care to that of controls has produced mixed results, depending on the type of cancer studied.[16-21] In this study, we build on the previous research to investigate the quality of comorbid condition care in three kinds of cancer by using more recent data from patients with cancer who were transitioning from active treatment to survivorship. We examine a broad range of quality indicators for comorbid condition care to assess whether the prior research findings of differences in care by cancer type are further supported.

METHODS

Research Design

This retrospective cross-sectional study examined the quality of comorbid condition care in survivors of locoregional breast, prostate, or colorectal cancer and compared survivors' care to that of matched noncancer controls. These three cancer types represent approximately half of incident cancers[3] and survivors.[5] We focused on the period during which patients would be completing active cancer treatment and transitioning to survivorship. Specifically, we assumed that cancer treatment would occur in the first year following diagnosis; thus, our study period started on day 366 postdiagnosis and continued for 2 years through day 1,095. We identified cancer survivors with each comorbid condition and evaluated whether they received appropriate care by using published quality indicators.[15,22] Survivors' care receipt was compared with that of noncancer controls in analyses for each cancer type separately.

Data Source

We used the Surveillance, Epidemiology, and End Results (SEER)–Medicare linked database, which combines the clinical information from the SEER registries with Medicare claims. During our study period, there were 17 SEER registries covering a population-based sample of 26% of the US population,[23] with 16 of the 17 registries participating in the Medicare linkage. Data on noncancer controls from a 5% random sample of Medicare beneficiaries living in SEER regions were used for comparison.

Study Subjects

We identified patients diagnosed with locoregional breast, prostate, or colorectal cancer in the year 2004 who survived for at least 3 years. Patients had to be continuously enrolled in fee-for-service Medicare from 1 year before diagnosis through 3 years after diagnosis, which means they had to be at least 66 years old at diagnosis. Patients enrolled in managed care at any point during the observation period were excluded. Thus, all patients were insured through the fee-for-service Medicare program. We used the claims data from before the cancer diagnosis to calculate the prediagnosis comorbidity score. Because we wanted to study patients who had completed acute treatment and had no evidence of disease, we excluded patients who had a subsequent malignant diagnosis or had received chemotherapy, radiation, or hospice care from day 366 through day 1,095.

Noncancer controls had to meet similar eligibility criteria, with the exception of a cancer diagnosis. We frequency matched controls 2:1 by using age (65-74, 75+ years), race (white, black, other), sex, and SEER region (combining Atlanta and rural Georgia, and combining all California registries). Controls were matched separately for each of the three tumor types to retain the frequency matching for analyses by tumor type. A dummy diagnosis date of January 1, 2004, was used for all controls.

Outcome Measures

We used nine chronic condition and 19 acute condition quality indicators (Table 1). There were also seven avoidable outcome indicators that were summarized in one chronic condition indicator: "no avoidable outcome." Approximately half the chronic condition indicators related to ongoing visits, and approximately half the acute event indicators related to visits following a hospitalization. Other quality indicators included monitoring procedures such as eye examinations for patients with diabetes and tests such as ECGs. We used indicators based on those developed by RAND[22] and later applied by Earle and Neville.[15] Using these indicators allowed us to compare our findings

Table 1. Quality Indicators

Indicator
Chronic care
Visit every 6 months for patients with chronic stable angina
Visit every 6 months for patients with congestive heart failure
Visit every 6 months for patients with COPD
Visit every year for patients with diagnosis of transient ischemic attack
Cholesterol test every 6 months for patients hospitalized for acute myocardial infarction and who have hypercholesterolemia
Lipid profile ≤ 1 year after initial diagnosis of angina
Visit every 6 months for patients with diabetes
Eye examination every year for patients with diabetes
Glycosylated hemoglobin or fructosamine every 6 months for patients with diabetes
No avoidable outcome
Acute care
Visit ≤ 4 weeks after discharge for patients hospitalized with acute myocardial infarction
Electrocardiogram during emergency department visit for unstable angina
Follow-up visit or hospitalization ≤ 1 week after initial diagnosis of unstable angina
Visit ≤ 4 weeks after discharge for patients hospitalized with unstable angina
Visit ≤ 4 weeks after discharge for patients hospitalized with congestive heart failure
Electrocardiogram ≤ 3 months after initial diagnosis of congestive heart failure
Chest radiograph ≤ 3 months after initial diagnosis of congestive heart failure
Visit ≤ 4 weeks after discharge for patients hospitalized with cerebrovascular accident
For patients hospitalized with carotid artery stroke, carotid imaging ≤ 2 weeks of initial diagnosis
For cerebrovascular accident patients with eventual carotid endarterectomy, interval between carotid imaging and carotid endarterectomy < 2 months
Electrocardiogram within 2 days of initial diagnosis of transient ischemic attack
Visit ≤ 4 weeks after discharge for patients hospitalized with transient ischemic attack
For transient ischemic attack patients with eventual carotid endarterectomy, interval between carotid imaging and carotid endarterectomy < 2 months
Visit ≤ 4 weeks after discharge for patients hospitalized with diabetes
Visit ≤ 2 weeks after discharge for patients hospitalized with depression
Visit ≤ 4 weeks after discharge for patients hospitalized with malignant or otherwise severe hypertension
Visit ≤ 4 weeks after discharge for patients hospitalized with GI bleeding
Cholecystectomy (open or laparoscopic) for patients with cholelithiasis and ≥ one of the following: cholecystitis, cholangitis, gallstone pancreatitis
Arthroplasty or internal fixation of hip during hospital stay for hip fracture

NOTE. Based on Asch et al[22] as used by Earle and Neville.[15]
Abbreviation: COPD, chronic obstructive pulmonary disease.

in patients with one of three cancer types who were transitioning to survivorship with the previous findings in 5-year colorectal cancer survivors.[15] Where necessary, we revised the quality indicators to reflect updated diagnosis and billing codes for our study period (see Appendix Table A1, online only, for the indicator specifications we used).

Analyses

First, survivors' and controls' clinical and sociodemographic data were described by using mean (standard deviation) for age and proportions for race, sex, SEER registry site, urban/rural residence, participation in state buy-in (an indicator of lower socioeconomic status), and the Charlson comorbidity score as modified by Deyo and implemented by Klabunde.[24-26] This comorbidity score was measured by using precancer diagnosis claims for the purpose of developing a summary measure to include as a covariate. To identify cases and controls eligible for each quality indicator on the basis of the presence of a particular comorbid condition, we applied the algorithms in the technical document associated with the published quality indicators.[22]

Specifically, for the chronic condition indicators, we identified cases and controls with the chronic conditions by using claims from day 1 through day 365 from diagnosis (the denominator). We then examined whether appropriate care was provided during the observation period from day 366 through day 1,095 (the numerator). For the acute care indicators, we examined incident events from day 366 through day 1,095. For both the chronic and acute condition indicators, we calculated the percentage of cases and controls who received appropriate care and compared the two groups using Fisher's exact tests with a $P < .05$ threshold for statistical significance. Given the large number of indicators and comparisons, we then combined all chronic and acute condition indicators, respectively, into single generalized estimating equation logistic regression models for each cancer type, adjusting for age, race, sex (colorectal analysis only), SEER region, comorbidity score, state buy-in, and urban/rural residence. Generalized estimating equation models were used to account for clustering because patients who were eligible for more than one indicator were included in the model multiple times. Six models (acute and chronic for the three tumor types) were analyzed, and a Bonferonni correction was used such that $P < .008$ was considered statistically significant. Although the unadjusted tests comparing the individual indicators were performed to evaluate patterns in the data, the statistical tests of the models combining all indicators were considered the definitive tests of differences in care between cancer cases and controls by cancer type. Finally, we examined the interaction between each covariate and case-control group in the regression models. The Johns Hopkins School of Medicine Institutional Review Board deemed this project exempt.

RESULTS

The final sample included 8,661 cancer cases and 17,322 controls. The sample included 4,559 prostate cancer survivors (53%), 2,231 colorectal cancer survivors (26%), and 1,871 breast cancer survivors (22%). Across the three cancer types, the mean age was 75 years; approximately two thirds of the sample was male, and 85% were white (Table 2). One third of the population was from one of the California registries. These characteristics were identical between cases and controls as a result of matching. For the nonmatched variables, we see approximately the same proportion of controls and cases with comorbidity scores of 0 (72% of controls *v* 71% of cases) and level of urban

Table 2. Characteristics of Cancer Cases and Matched Controls

Characteristic	Controls Overall (n = 17,322)		Cases: Overall (n = 8,661)		Cases: Colorectal (n = 2,231)		Cases: Breast (n = 1,871)		Cases: Prostate (n = 4,559)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Age, years										
Mean	75.0		74.8		77.2		76.9		72.8	
SD	6.81		6.55		7.02		7.16		5.25	
Male sex	11,228	64.8	5,614	64.8	1,055	47.3	0	0.0	4,559	100.0
Race										
White	14,660	84.6	7,330	84.6	1,926	86.3	1,656	88.5	3,748	82.2
Black	1,442	8.3	721	8.3	149	6.7	113	6.0	459	10.1
Other	1,220	7.0	610	7.0	156	7.0	102	5.5	352	7.7
Comorbidity score										
0	12,474	72.0	6,114	70.6	1,376	61.7	1,306	69.8	3,432	75.3
1+	4,848	28.0	2,547	29.4	855	38.3	565	30.2	1,127	24.7
Ever in state buy-in	2,388	13.8	883	10.2	280	12.6	245	13.1	358	7.9
Urban residence	15,272	88.4	7,824	90.3	1,963	88.0	1,679	89.7	4,182	91.7
SEER region										
Connecticut	1,242	7.2	621	7.2	179	8.0	171	9.1	271	5.9
Detroit	1,172	6.8	586	6.8	156	7.0	112	6.0	318	7.0
Hawaii	262	1.5	131	1.5	37	1.7	19	1.0	75	1.7
Iowa	1,240	7.2	620	7.2	229	10.3	163	8.7	228	5.0
New Mexico	430	2.5	215	2.5	54	2.4	41	2.2	120	2.6
Seattle	1,266	7.3	633	7.3	119	5.3	130	7.0	384	8.4
Utah	712	4.1	356	4.1	62	2.8	56	3.0	238	5.2
Atlanta and rural Georgia	466	2.7	233	2.7	43	1.9	50	2.7	140	3.1
California*	5,810	33.5	2,905	33.5	662	29.7	581	31.1	1,662	36.5
Kentucky	1,158	6.7	579	6.7	177	7.9	138	7.4	264	5.8
Louisiana	1,144	6.6	572	6.6	118	5.3	137	7.3	317	7.0
New Jersey	2,420	14.0	1,210	14.0	395	17.7	273	14.6	542	11.9

*Including greater California, San Francisco, San Jose, and Los Angeles registries.

residence (88% of controls *v* 90% of cases). Slightly more controls than cases were in state buy-in (14% *v* 10%), indicating lower socioeconomic status.

Table 3 presents the performance on the 10 chronic condition indicators for the cases and controls overall and by tumor type. In the analysis combining all three tumor types, the differences tend to be small, with only differences on visits for chronic obstructive pulmonary disease (COPD) and diabetes being statistically significant ($P < .05$), with cases more likely to receive appropriate care than controls (82% *v* 79% for COPD visits and 86% *v* 81% for diabetes visits). The analyses by tumor type suggest differences depending on the type of cancer. For breast and prostate cancer, cases were more likely to receive appropriate care for the same two indicators as the overall analysis. For COPD visits, 90% of breast cancer survivors versus 83% of controls and 85% of prostate cancer survivors versus 75% of controls received appropriate care. For diabetes visits, 92% of breast cancer survivors versus 84% of controls and 84% of prostate cancer survivors versus 76% of controls received appropriate care. In addition, breast cancer cases with hypercholesterolemia who were hospitalized for acute myocardial infarction were more likely than controls to have a cholesterol test every 6 months (60% *v* 5%), and prostate cancer survivors were less likely than controls to experience an avoidable outcome (88% *v* 80%). The patterns in the results for the colorectal cancer survivors are quite different. Compared with controls, survivors were less likely to receive appropriate care for five of the 10 indicators: COPD visits (75% *v* 83%), lipid profile within 1 year of angina diagnosis (61% *v* 73%), eye examinations for diabetics (42% *v* 49%), diabetes monitoring (26% *v* 31%), and not having an avoidable outcome (71% *v* 77%).

Table 4 presents the results for each of the 19 acute care indicators. Although some of the denominators are small (particularly in the analyses by tumor type) and some of the indicators did not show variation, differences in the patterns of care quality emerge across cancer types. In the overall analyses, two indicators were statistically significantly different favoring the control group: ECG after initial diagnosis of congestive heart failure (CHF; 46% *v* 50%) and cholecystectomy (16% *v* 24%). In the prostate cancer subgroup, the control group received better care on one of these same indicators (ECG after CHF diagnosis, 44% *v* 52%), as well as chest radiograph after CHF diagnosis (39% *v* 46%). Among the colorectal cancer subgroup, there were two indicators that statistically significantly favored the control group: visits following hospitalization for acute myocardial infarction (72% *v* 89%) and for CHF (68% *v* 81%). There were no statistically significant differences in the breast cancer subgroup.

The results of the multivariate models combining all of the chronic and acute indicators, respectively, largely confirmed the patterns seen in the individual indicators (Fig 1). Colorectal cancer survivors were less likely than controls to receive appropriate care on both the chronic (OR, 0.88; 95% CI, 0.81 to 0.95) and acute (OR, 0.72; 95% CI, 0.61 to 0.85) indicators. Prostate cancer survivors were more likely to receive appropriate chronic condition care (OR, 1.28; 95% CI, 1.19 to 1.38) but less likely to receive quality acute condition care (OR, 0.75; 95% CI, 0.65 to 0.87). Breast cancer survivors received care equivalent to controls on both the chronic (OR, 1.06; 95% CI, 0.96 to 1.17) and acute (OR, 0.92; 95% CI, 0.76 to 1.13) condition indicators. All covariates except SEER region were statistically significant in the prostate cancer chronic model, but in general, the covariates were not statistically significant in the other five models. SEER region and comorbidity score were significant in the breast cancer chronic and acute models, respectively. Sex and comorbidity score were significant in the colorectal chronic model. The only statistically significant interaction we found was with case control status and comorbidity score in the prostate and breast cancer chronic models ($P = .004$ and .001, respectively). In the prostate cancer model, patient cases with fewer comorbidities were more likely to receive chronic care indicators than controls (OR, 1.39; 95% CI, 1.27 to 1.52). For those with more comorbidities, the association was the same, though not as strong in magnitude (OR, 1.11; 95% CI, 1.00 to 1.25). In the breast cancer model, the same pattern emerged. Patient cases with fewer comorbidities were more likely to receive chronic care indicators than controls (OR, 1.39; 95% CI, 1.26 to 1.52), with a lesser magnitude in those with more comorbidites (OR, 1.12; 95% CI, 0.98 to 1.27).

DISCUSSION

The issue of comorbid condition care in cancer survivors has been understudied. As treatments improve and survivors live longer after a cancer diagnosis, appropriate care for comorbid conditions takes on greater importance. This study examines this important issue and benefits from several strengths: examining care quality for a range of chronic and acute comorbid conditions, including survivors of three different tumor types, comparing cancer survivors' care with that of noncancer controls, and focusing on the transition period when active cancer treatment is ending.

Thus, our findings are informative on several different levels. First, we found that patterns of care receipt depend on the type of cancer survived. Breast cancer survivors tend to do as well as controls; prostate cancer survivors do better on chronic care but worse on acute care; and colorectal cancer survivors are consistently less likely to receive recommended care than controls. Finally, focusing on day 366 through day 1,095 from diagnosis addresses a period that may be particularly important for ensuring that patients do not get "lost in transition."

The study most similar to this one[15] examined preventive and comorbid condition care quality in 5-year colorectal cancer survivors. It also found that colorectal cancer survivors were less likely to receive appropriate chronic condition care than controls, with no clear pattern in acute care quality. Other studies comparing survivors' care with that of controls have focused on preventive care. Yu et al[16] found higher rates of mammography in female colorectal cancer survivors compared with controls. In prostate cancer, survivors were more likely to receive certain services and less likely to receive others.[17] Studies examining preventive care in breast cancer survivors have also been mixed, with some studies finding better care on at least some measures[18] and others finding worse care,[19] with the eligibility criteria for the control group having important implications for the results.[20,21] Thus, these prior studies also suggest differences in care quality by type of cancer survived, similar to the findings presented here.

Although the findings are informative, several limitations of our analysis warrant discussion. First, although this analysis suggests differences in comorbid condition care quality across cancer types, it does not provide evidence on why; ongoing research is exploring the factors associated with quality comorbid condition care. In addition, sample sizes were small for several indicators, particularly in the subgroup analyses, and the comparison of cancer cases and controls on 29 quality indicators both overall and by cancer type resulted in a large number of comparisons. To address both of these issues, we combined

Table 3. Performance on Chronic Care Quality Indicators: Overall and by Tumor Type

Chronic Care Indicators	Overall: No. Receiving Appropriate Care/No. Eligible for Indicator	Overall: %	Breast: No. Receiving Appropriate Care/No. Eligible for Indicator	Breast: %	Prostate: No. Receiving Appropriate Care/No. Eligible for Indicator	Prostate: %	Colorectal: No. Receiving Appropriate Care/No. Eligible for Indicator	Colorectal: %
Visit every 6 months for patients with chronic stable angina								
Cases	389/449	87	80/86	93	174/200	87	135/163	83
Controls	886/1,038	85	178/191	93	450/552	82	258/295	88
Visit every 6 months for patients with congestive heart failure								
Cases	884/1,031	86	193/213	91	269/309	87	422/509	83
Controls	1,471/1,734	85	365/415	88	662/800	83	444/519	86
Visit every 6 months for patients with chronic obstructive pulmonary disease								
Cases	**1,054/1,281**	**82**	**236/263**	**90**	**449/528**	**85**	369/490	75
Controls	1,499/1,909	79	335/406	83	721/968	75	**443/535**	**83**
Visit every year for patients with diagnosis of transient ischemic attack								
Cases	259/266	97	53/53	100	101/105	96	105/108	97
Controls	507/534	95	137/141	97	220/238	92	150/155	97
Cholesterol test every 6 months for patients hospitalized for acute myocardial infarction and who have hypercholesterolemia								
Cases	—	16	—	**60**	—	10	—	10
Controls	22/105	21	—	5	—	21	10/32	31
Lipid profile ≤ 1 year after initial diagnosis of angina								
Cases	308/449	69	58/86	67	151/200	76	99/163	61
Controls	755/1,038	73	143/191	75	396/552	72	**216/295**	**73**
Visit every 6 months for patients with diabetes								
Cases	**1,696/1,984**	**86**	**367/398**	**92**	**817/971**	**84**	512/615	83
Controls	3,037/3,769	81	645/767	84	1,461/1,919	76	931/1,083	86
Eye examination every year for patients with diabetes								
Cases	884/1,984	45	193/398	49	433/971	45	258/615	42
Controls	1,739/3,769	46	395/767	52	815/1,919	43	**529/1,083**	**49**
Glycosylated hemoglobin or fructosamine every 6 months for patients with diabetes								
Cases	536/1,984	27	103/398	26	271/971	28	162/615	26
Controls	1,070/3,769	28	223/767	29	509/1,919	27	**338/1,083**	**31**
No avoidable outcome								
Cases	2,996/3,740	80	597/751	79	**1,468/1,676**	**88**	931/1,313	71
Controls	5,075/6,459	79	1,086/1,402	77	2,563/3,205	80	**1,426/1,852**	**77**

NOTE. **BOLD** indicates statistically significantly ($P < .05$) better in comparison between cases and controls based on Fisher's exact test.
(—) Numerator and denominator suppressed to protect confidentiality because of small cell sizes.

Table 4. Performance on Acute Care Quality Indicators: Overall and by Tumor Type

Acute Care Indicators	Overall: No. Receiving Appropriate Care/No. Eligible for Indicator	Overall: %	Breast: No. Receiving Appropriate Care/No. Eligible for Indicator	Breast: %	Prostate: No. Receiving Appropriate Care/No. Eligible for Indicator	Prostate: %	Colorectal: No. Receiving Appropriate Care/No. Eligible for Indicator	Colorectal: %
Visit ≤ 4 weeks after discharge for patients hospitalized with acute myocardial infarction								
Cases	64/84	76	14/18	78	24/30	80	26/36	72
Controls	259/308	84	48/59	81	135/164	82	**76/85**	**89**
Electrocardiogram during emergency department visit for unstable angina								
Cases	20/20	100	—	100	—	100	—	100
Controls	127/127	100	32/32	100	67/67	100	28/28	100
Follow-up visit or hospitalization ≤ 1 week after initial diagnosis of unstable angina								
Cases	62/152	41	15/33	46	33/77	43	14/42	33
Controls	232/663	35	49/132	37	125/356	35	58/175	33
Visit ≤ 4 weeks after discharge for patients hospitalized with unstable angina								
Cases	39/49	80	—	67	—	83	—	81
Controls	179/208	86	29/37	78	103/118	87	47/53	89
Visit ≤ 4 weeks after discharge for patients hospitalized with congestive heart failure								
Cases	265/352	75	76/97	78	83/99	84	106/156	68
Controls	795/1,006	79	172/241	71	364/447	81	**259/318**	**81**
Electrocardiogram ≤ 3 months after initial diagnosis of congestive heart failure								
Cases	469/1,025	46	122/272	45	163/369	44	184/384	48
Controls	**1,325/2,672**	**50**	307/643	48	**639/1,230**	**52**	379/799	47
Chest radiograph ≤ 3 months after initial diagnosis of congestive heart failure								
Cases	438/1,025	43	123/272	45	145/369	39	170/384	44
Controls	121/2,672	46	277/643	43	**571/1,230**	**46**	383/799	48
Visit ≤ 4 weeks after discharge for patients hospitalized with cerebrovascular accident								
Cases	124/175	71	39/57	68	51/64	80	34/54	63
Controls	345/463	75	82/112	73	160/209	77	103/142	73
Carotid imaging ≤ 2 weeks from initial diagnosis for patients hospitalized with carotid artery stroke								
Cases	21/41	51	—	27	—	53	—	69
Controls	83/164	51	10/27	37	40/79	51	33/58	57
For patients with cerebrovascular accident with eventual carotid endarterectomy, interval between carotid imaging and carotid endarterectomy < 2 months								
Cases	17/20	85	—	80	—	90	—	80
Controls	63/70	90	11/12	92	31/35	89	21/23	91

(continued on following page)

Table 4. Performance on Acute Care Quality Indicators: Overall and by Tumor Type (continued)

Acute Care Indicators	Overall		Breast		Prostate		Colorectal	
	No. Receiving Appropriate Care/ No. Eligible for Indicator	%	No. Receiving Appropriate Care/ No. Eligible for Indicator	%	No. Receiving Appropriate Care/ No. Eligible for Indicator	%	No. Receiving Appropriate Care/ No. Eligible for Indicator	%
Electrocardiogram within 2 days of initial diagnosis of transient ischemic attack								
Cases	121/373	32	37/106	35	56/158	35	28/109	26
Controls	318/965	33	88/250	35	138/442	31	92/273	34
Visit ≤ 4 weeks after discharge for patients hospitalized with transient ischemic attack								
Cases	34/42	81	—	79	—	88	—	73
Controls	125/150	83	41/47	87	49/56	88	35/47	75
For patients with transient ischemic attack with eventual carotid endarterectomy, interval between carotid imaging and carotid endarterectomy < 2 months								
Cases	—	100	—	100	—	100	—	100
Controls	20/21	95	—	100	—	90	—	100
Visit ≤ 4 weeks after discharge for patients hospitalized with diabetes								
Cases	333/461	72	85/116	73	136/188	72	112/157	71
Controls	898/1,173	77	179/233	77	462/609	76	257/331	78
Visit ≤ 2 weeks after discharge for patients hospitalized with depression								
Cases	82/160	51	27/50	54	27/50	54	28/60	47
Controls	212/362	59	49/92	53	85/140	61	78/130	60
Visit ≤ 4 weeks after discharge for patients hospitalized with malignant or otherwise severe hypertension								
Cases	16/19	84	—	88	—	80	—	83
Controls	39/57	68	13/20	65	11/13	85	15/24	63
Visit ≤ 4 weeks after discharge for patients hospitalized with GI bleeding								
Cases	72/98	74	17/25	68	24/30	80	31/43	72
Controls	149/195	76	42/62	68	60/77	78	47/56	84
Cholecystectomy (open or laparoscopic) for patients with cholelithiasis and one or more of the following: cholecystitis, cholangitis, gallstone pancreatitis								
Cases	43/271	16	12/64	19	17/98	17	14/109	13
Controls	**107/447**	**24**	25/117	21	53/196	27	29/134	22
Arthroplasty or internal fixation of hip during hospital stay for hip fracture								
Cases	50/117	43	17/41	42	11/24	46	22/52	42
Controls	81/201	40	28/64	44	28/60	47	25/77	33

NOTE. **BOLD** indicates statistically significantly ($P < .05$) better in comparison between cases and controls based on Fisher's exact test.
(—) Numerator and denominator suppressed to protect confidentiality because of small cell sizes.

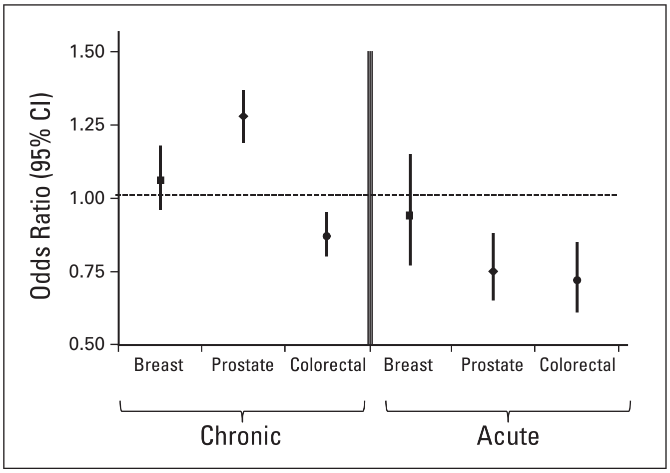

Fig 1. Odds ratios (squares, breast cancer; diamonds, prostate cancer; circles, colorectal cancer) and 95% CIs from models combining the chronic and acute care indicators for cases versus controls (reference group), adjusting for age (65-74, 75+ years), race (white, black, other), sex (colorectal analyses only), comorbidity score, state buy-in, urban/rural residence, and SEER region (combining Atlanta and rural Georgia, and combining all California registries).

the chronic and acute care indicators, respectively, in logistic regression models and used these models in our definitive tests of differences between groups. Notably, even in the unadjusted analyses both overall and for each subgroup, the statistically significant differences were all in the same direction, either favoring the cancer survivors or favoring the controls. If the associations found were spurious, one might expect some differences to favor the cases and some to favor the controls.

There is also the possibility of misclassification bias as a result of the reliance on diagnosis and billing codes to define patients' eligibility and care receipt. For example, we required only one claim for a condition in the year following diagnosis using the same approach as Earle and Neville.[15] Although this approach may be less specific, we would not expect to see differential misclassification between cancer cases and controls. Thus, we would not expect bias in our primary analyses comparing cancer survivors' care to that of controls. There are, however, some differences that may be occurring in the coding between survivors and controls. Given that we matched controls to cases 2:1, we might expect the denominators for the controls to be about double those for cases. We found higher rates of chronic conditions in our cancer survivors, which is consistent with prior research.[2] For the acute indicators, the control denominators are more than double those for cases. It is possible that this results from symptoms of and hospitalizations for noncancer problems being attributed to cancer. Another difference that may occur between cancer cases and noncancer controls relates to counting visits. In general, the indicators require specific diagnosis and procedure codes to determine the nature of the visit, but given that cancer cases tend to have more visits overall than controls,[17,19] cases may be more likely to meet the quality standards simply by having more visits. This would only strengthen our findings related to less care receipt in colorectal cancer.

Other limitations of this analysis relate to the nature of all analyses that use the SEER-Medicare database: the data are restricted to older adults living in the SEER regions and enrolled continuously in the fee-for-service Medicare program, and no information is available on why care was or was not provided. We used the most recent SEER-Medicare data available at the time of our study's initiation; however, newer data are now available, and future research could investigate whether the patterns found here persist.

Despite these limitations, these results have several important implications. First, in terms of survivorship research, these findings indicate that analyses combining multiple cancer types may not be appropriate. In fact, our overall analyses masked important differences in the patterns of care in the individual tumor groups. In terms of clinical implications, these results suggest that there may be certain groups (eg, colorectal cancer survivors) that are less likely to receive appropriate care. Additional research is needed to explore the patient and provider factors associated with the differences found in care quality. Further, interventions designed to improve care may need to be focused on these vulnerable groups, and evaluations of these interventions may be more likely to demonstrate benefits when implemented in cancer populations for which there is evidence of worse care quality.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Although all authors completed the disclosure declaration, the following author(s) and/or an author's immediate family member(s) indicated a financial or other interest that is relevant to the subject matter under consideration in this article. Certain relationships marked with a "U" are those for which no compensation was received; those relationships marked with a "C" were compensated. For a detailed description of the disclosure categories, or for more information about ASCO's conflict of interest policy, please refer to the Author Disclosure Declaration and the Disclosures of Potential Conflicts of Interest section in Information for Contributors.

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AUTHOR CONTRIBUTIONS

Conception and design: Claire F. Snyder, Kevin D. Frick, Craig C. Earle
Collection and assembly of data: Claire F. Snyder, Kevin D. Frick, Robert J. Herbert
Data analysis and interpretation: All authors
Manuscript writing: All authors
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