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Preventive care in prostate cancer patients: following diagnosis and for five-year survivors

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Abstract

Introduction—Prostate cancer is the most common male cancer. Survival rates are high, making preventive care maintenance important. Factors associated with prostate-cancer cases' preventive care in the short-term (Year 1) and long-term (Year 5), and how survivors' care compares to non-cancer controls, require study.

Methods—This retrospective, controlled SEER-Medicare study included loco-regional prostate cancer cases age 66 in fee-for-service Medicare diagnosed in 2000 and surviving 12 months, and non-cancer controls matched to cases on socio-demographics and survival. Outcomes included influenza vaccination, cholesterol screening, and colorectal cancer screening. Independent variables were number of physician visits, physician specialties visited, initial prostate cancer treatment, socio-demographic characteristics, and case-control status.

Results—There were 13,507 cases and 13,507 controls in Year 1, and 10,482 cases and 10,482 controls in Year 5. In Years 1 and 5, total number of visits (6/6 outcomes) and primary care

provider (PCP) visits (5/6 outcomes) were most consistently associated with preventive care receipt. In Year 1, prostate cancer cases were more likely than controls to receive influenza vaccination (48% vs. 45%) but less likely to receive colorectal cancer screening (29% vs. 31%) (both $p < 0.0001$). In Year 5, prostate cancer cases remained more likely than controls to receive influenza vaccination (46% vs. 44%; $p < 0.0001$).

Conclusions—Differences in survivors' short-term preventive care did not lead to worse long-term preventive care. The number of physician visits, particularly PCP visits, are important factors associated with appropriate care.

Implications for Cancer Survivors

PCP involvement in prostate cancer patients' care is critical both during treatment and for long-term survivors.

Keywords

Prostate cancer; Preventive care; Survivorship

Introduction

Recently, attention has focused on the importance of quality care for cancer survivors, including not only surveillance for recurrence, but also general primary and preventive care, and care for comorbid conditions [1]. Much of the early research on preventive care in cancer survivors has focused on breast [2–5] and colorectal [6–10] cancers.

Preventive care in prostate cancer survivors has been relatively understudied, yet this is a particularly important population for preventive care. Prostate cancer is the most commonly diagnosed non-skin cancer in men, with an estimated 217,730 cases being diagnosed in the United States in 2010 [11]. While it represents the second most common cause of cancer death in men, the vast majority of men diagnosed with prostate cancer will die of another cause. Specifically, men diagnosed with local or regional disease (over 90% of cases) have 5-year relative survival rates approaching 100% [12]. For all men with prostate cancer, 10-year and 15-year relative survival rates are 93% and 79%, respectively [12]. As a result, there were approximately 2.2 million prostate cancer survivors living in the United States in 2006, representing about half of all male cancer survivors in the country [11]. Prostate cancer is an especially relevant issue for Medicare, with over 60% of cases diagnosed in men older than 65 [13].

To address this lack of research regarding the health maintenance care of prostate cancer survivors, we conducted an analysis of Medicare data to examine the quality of preventive care in prostate cancer survivors.

Methods

Study design and research questions

This was a descriptive, retrospective, controlled study that examined preventive care receipt in prostate cancer cases in the year following diagnosis (Year 1) and for five-year survivors (Year 5). The specific research questions were: (1) how do patterns of physician visits differ for cancer cases vs. non-cancer controls; (2) do cancer cases' rates of preventive care receipt differ from non-cancer controls; and (3) what factors are associated with prostate cancer cases' preventive care receipt?

Data source

We used the Surveillance, Epidemiology and End Results (SEER)-Medicare linked database [14]. SEER-Medicare combines clinical information from the SEER cancer registries with health services utilization data from Medicare claims. Data are also available on non-cancer controls living in SEER regions. In the year 2000, there were 17 SEER registries, providing a representative sample of approximately 26% of the U.S. population [15]. Sixteen of the 17 registries participate in the SEER-Medicare linkage.

Study subjects

Prostate cancer cases included in our sample were diagnosed with loco-regional disease in the year 2000 while living in a SEER region, were at least 66 years old at diagnosis, survived at least 12 months from diagnosis, and were enrolled continuously in Medicare fee-for-service (both Part A and B) from 1 year prior to diagnosis through the observation period. Non-cancer controls had to meet the same eligibility criteria as the cancer cases, with the exception of having a cancer diagnosis. Controls were matched to prostate cancer cases one-to-one on age (controls had to have lived for the same number of years as cases), race (White, Black, Other), sex (all male), comorbidity index (0, 1, 2+), SEER region, and survival (controls and cases had to survive for similar lengths of time as measured by 12-month intervals).

Variables

We used three preventive care outcome measures: influenza vaccination, cholesterol screening, and colorectal cancer screening (endoscopy or fecal occult blood testing). These measures are based on quality indicators that are feasible for use with administrative data and have been used in previous research (Appendix 1) [2–4, 6, 7, 9]. We assessed care during two time periods: Year 1 (months –1 through 12 from diagnosis) and Year 5 (months 49 through 60 from diagnosis). Analyses controlled for clinical and socio-demographic variables as described below.

Age was analyzed as a continuous variable. Race, SEER region, and the comorbidity index were analyzed as categorical variables as described above. The comorbidity index was calculated using data from 12 months prior to diagnosis based on the Charlson score [16] as implemented by Deyo et al. [17], and modified by Klabunde et al. [18]. We used the year 2000 census data and categorized socioeconomic status in quintiles based on the age- and race-specific census tract median income for cancer cases and based on ZIP code median income for controls. Finally, we included a categorical variable for urban vs. rural residence.

Health services utilization variables included the number of physician visits (categorical 0–4, 5–7, 8–12, 13+) and physician specialties visited (based on the Medicare physician specialty codes). Primary care providers (PCPs) were defined as family practice, general practice, internal medicine, geriatric medicine, and multispecialty group practice. Oncology specialists included medical oncology, hematology-oncology, radiation oncology, general surgery, and surgical oncology. Due to their important role in caring for prostate cancer patients, urologist visits were categorized separately. Visits to physician specialties not listed above were categorized as “Other Physician” visits. Finally, we classified prostate cancer cases based on the treatment they received in the first 9 months from diagnosis: radiation only, hormonal therapy only, radiation + hormonal therapy, surgery (may have received other therapies), and watchful waiting (if no treatment was received).

Analyses

Study sample characteristics were described using means and percentages. Then, the average number of visits to each physician specialty was calculated for both cases and controls in

Years 1 and 5. Comparisons were made between cases and controls for PCP, urologist, other physician, and total visits with number of visits as the outcome and group (case vs. control) as the independent variable using negative binomial models that accounted for patient-to-patient variation and GEE (generalized estimating equations) to account for the correlation between matched cases and controls. (We did not do a formal statistical comparison of oncology specialist visits because we would expect cases to have a higher number of visits than controls.) These analyses only adjusted for urban/rural residence and socioeconomic status because the other socio-demographic variables were matched.

To compare rates of preventive care receipt between prostate cancer cases and controls, we calculated the proportion of cases and controls who received influenza vaccination, cholesterol screening, and colorectal cancer screening in Years 1 and 5. We used GEE logistic regression models with adjustments for urban/rural residence and socioeconomic status to assess differences between groups. We conducted a sensitivity analysis that repeated the Year 1 comparison, including only the subset of subjects who survived through Year 5, to determine whether differences in patterns from Year 5 to Year 1 were related to survival bias.

To identify the factors associated with preventive care receipt in prostate cancer cases in Years 1 and 5, we again used logistic regression models. Receipt of the preventive care service was modeled as a function of physician specialty visited using four dichotomous variables (oncology specialist, PCP, urologist, other physician), total number of physician visits per year, initial prostate cancer treatment strategy, age, race, comorbidity, urban/rural residence, and socioeconomic status, while adjusting for SEER region.

Due to the large sample size, we focus primarily on the absolute differences between groups. Where p-values are used, a threshold of $p < 0.0001$ was considered statistically significant.

Results

A total of 13,507 prostate cancer cases met our eligibility criteria for inclusion in the Year 1 analyses (Table 1). The average age of the sample was 75 years, 87% were White, and 69% had a comorbidity index of 0. Due to the matching, the characteristics for the non-cancer controls ($n=13,507$) were identical. Our Year 5 analyses included 10,482 prostate cancer cases and, due to matching on survival, an equal number of controls.

The number and patterns of physician visits differed significantly between prostate cancer cases and controls (all $p < 0.0001$) (Table 2). As would be expected, during the first year after diagnosis, prostate cancer cases had significantly more physician visits on average than controls (15 vs. 6). The prostate cancer cases' visits were distributed across physician specialties, with 31% of visits to urologists, 26% of visits to PCPs, 24% to other physicians, and 19% to oncology specialists. In contrast, 90% of controls' visits were to PCPs (43%) or other physicians (47%). The differences between cases and controls in physician visits persisted, though to a lesser degree, during Year 5. On average, cases had 2 more total visits versus controls (9 vs. 7). However, the distribution of visits during Year 5 was much more similar between cases and controls with PCP and other physician visits accounting for 78% of total visits for cases and 89% for controls. Urologist visits remained more common in cases (14% of visits vs. 7%). Of note, there were a small number of oncology specialist visits among controls, which may be due to misclassification or because general surgeons were included in the definition.

There were differences in preventive care receipt between prostate cancer cases and controls, particularly in Year 1 (Table 3). Prostate cancer cases were more likely to receive influenza vaccination (48% vs. 45%; $p < 0.0001$), less likely to receive colorectal cancer

screening (29% vs. 31%; $p<0.0001$), and had no differences in cholesterol testing (38% vs. 39%; $p=0.16$). In Year 5, prostate cancer cases continued to receive influenza vaccination at higher rates than controls (46% vs. 44%; $p<0.0001$), but there were no other differences between groups. In the sensitivity analysis that repeated the Year 1 comparisons but only included the 10,482 cases and controls who survived the full 5 years, similar patterns were found with higher rates of influenza vaccination, lower rates of colorectal cancer screening, and no difference in cholesterol screening.

In logistic regression models investigating the factors associated with preventive care receipt among prostate cancer cases, the number and type of physician visits were consistently associated with care receipt (Tables 4 and 5). In particular, for all three preventive care measures in both Years 1 and 5, having 13+ total visits (vs. 0–4 visits) was associated with higher rates of preventive care (odds ratios [OR] ranging from 1.36 to 2.67). In Year 1, 8–12 total visits was associated with increased rates of influenza vaccination (OR=2.15) and cholesterol screening (OR=2.13). PCP visits, in particular, were associated with higher rates of preventive care receipt on all three measures in both years (ORs ranging from 1.30 to 1.56), except cholesterol screening in Year 5 (OR=1.15). Visits to the other types of specialties had variable impacts. Other physician visits were associated with higher rates of cholesterol and colorectal cancer screening in Years 1 and 5 (ORs ranging from 1.45 to 1.51), and urologist visits were associated with more influenza vaccinations in both years (ORs=1.40 and 1.29). Oncology specialist visits were only associated with increased rates of colorectal cancer screening in Year 5 (OR=1.41). Initial prostate cancer treatment strategy also had inconsistent associations, with higher rates of cholesterol screening for surgery patients (vs. watchful waiting) in Year 1 (OR=1.45), and for influenza vaccination and colorectal cancer screening in Year 5 (OR=1.64 and 1.53). Also in Year 5, radiation only patients (vs. watchful waiting) had higher rates of influenza vaccinations (OR=1.58).

Some associations between socio-demographic variables and preventive care receipt were also identified. In both Years 1 and 5, older patients were more likely to receive influenza vaccination (OR=1.03 in both years) but less likely to receive cholesterol screening (OR=0.98 in both years). Black patients were less likely to receive influenza vaccination in both years compared to White patients (OR=0.41 and 0.43). Finally, the highest socioeconomic status quintile had higher rates of cholesterol and colorectal cancer screening in Year 1 (OR=1.32 and 1.48, respectively) and influenza vaccination in Year 5 (OR=1.47) compared to the lowest quintile. Comorbidity and urban/rural residence did not demonstrate significant associations.

Discussion

Preventive care in prostate cancer survivors is an important issue given the high incidence and low mortality associated with the disease; however, there has been little research in this area. We compared patterns of physician visits and preventive care of prostate cancer cases to non-cancer controls, and identified factors associated with preventive care receipt among prostate cancer cases.

During the first year following diagnosis, prostate cancer cases averaged more than double the number of physician visits vs. non-cancer controls (15 vs. 6). Prostate cancer cases also had higher rates of influenza vaccinations. There are several potential explanations for this finding. First, cancer cases may be more likely to receive influenza vaccination simply because they had more visits during which they had the opportunity to be vaccinated. That total number of visits was related to vaccination receipt supports this explanation. It is also possible that the higher rates of influenza vaccination are related to concerns about compromised immunity in patients undergoing treatment. As vaccination rates were higher

for patients with PCP or urologist visits, those physicians may be particularly attuned to the need for vigilance in this patient population. At the same time, prostate cancer cases were less likely to receive colorectal cancer screening during Year 1. Again, this is likely appropriate, given the focus on prostate cancer in the near term. However, we once again found that cancer cases with visits to a PCP (and, in this case, Other Physician) were more likely to receive colorectal cancer screening. This may result from the PCP being more focused on the patient's overall health, rather than focusing exclusively on the prostate cancer diagnosis.

By Year 5, prostate cancer cases had only two more visits on average than controls and had similar rates of cholesterol screening and colorectal cancer screening, suggesting that their cancer history was not unduly influencing their care in the long-term. The persistently higher rates of influenza vaccination may indicate increased vigilance in cancer survivors. Again, for the prostate cancer cases, we saw an association with visits to PCPs or urologists, suggesting their continued focus on preventive care, even after the prostate cancer treatment had ended.

Previous studies investigating preventive care in breast and colorectal cancer survivors have had mixed results. Some studies have found lower rates in survivors vs. controls [3, 9], while others have found increased rates on at least some measures [5, 10]. The preventive care history of the controls used in the analyses has an important impact on these comparisons [2, 4]. In this study, we matched controls to cases based on a number of factors, but we did not require any evidence of previous screening among controls.

In previous studies, we categorized the mix of physician specialties seen by survivors as follows: both an oncology specialist and PCP, oncology specialist only, PCP only, or neither [2, 3, 6, 7]. These previous studies showed survivors with visits to both an oncology specialist and PCP are generally more likely to receive appropriate preventive care. In the current study, the physician specialties visited were more complex, due to the importance of urologists in prostate cancer care. We therefore used an analytic approach of including four dichotomous variables to represent presence or absence of visits to PCPs, oncology specialists, urologists, and other physicians. Of all physician specialties, PCPs were most consistently associated with preventive care receipt in both Years 1 and 5. This finding is particularly important given that PCP visits were significant, even when adjusting for visits to the other physician specialties. These results support the importance of PCP involvement in cancer survivors' care both during treatment and for long-term survivors.

Other health service utilization variables were also associated with preventive care receipt. Specifically, prostate cancer cases with the greatest number of physician visits (13+), and on some measures 8–12 visits, were most likely to receive preventive care. Socio-demographic variables had consistent relationships with certain preventive measures (e.g., younger age and Black race associated with lower rates of influenza vaccination and older age associated with lower rates of cholesterol screening). However, the comorbidity index did not have statistically significant associations with any of the preventive care measures, in contrast to our previous research [2, 3, 6, 7]. This finding may result from collinearity of the comorbidity index with age and initial prostate cancer treatment strategy, which were also included in the models. In other research, we found strong associations between age and comorbidity with prostate cancer treatment receipt [19].

Several other analytic limitations are noteworthy. Like all SEER-Medicare analyses, our population was limited to the population older than 65 years enrolled continuously in the fee-for-service program. Therefore, generalizability to younger populations and those in managed care is uncertain. The analyses were restricted to covered health services, and we

had only three preventive measures as outcomes. Notably, we examined colorectal cancer screening in one-year intervals (Years 1 and 5), though endoscopy is recommended every 5 years. As the focus of this paper is on the comparison of cancer cases to non-cancer controls, examining 1 year of data should not bias the conclusions since the indicators are being applied equally to both cases and controls.

Also, use of administrative data can lead to misclassification of certain variables. For example, our non-cancer controls had evidence of visits to oncology specialists, albeit at very low rates. Possible explanations include inaccurate data regarding physician specialty in the Medicare files, actual visits to oncology specialists even in the absence of a cancer diagnosis, or a cancer diagnosis not captured by SEER. Of note, we included general surgeons in our definition of oncology specialists due to their importance in cancer care, but certainly not all visits to general surgeons are cancer-related. The definitions of PCPs and oncology specialists used in this study were in line with previous research [2–4, 6, 7, 9]. We also did not limit identification of the preventive services to screening codes specifically. If someone has a test for a diagnostic purpose, it would not be necessary to repeat the test for screening. We were more interested in whether the test was done than the reason for it. It can also be difficult to determine reliably from claims data the purpose for procedures. As the codes were applied equally to both cases and controls, this approach should not bias our results.

In addition, due to the large sample size, differences in preventive care receipt of as low as 2% points were significant, even using a very low p -value (<0.0001) threshold for statistical significance. At the population level, differences in rates of preventive care as small as 2% may be clinically relevant. Finally, this study used cross-sectional data so we cannot make definitive causal conclusions regarding the relationships between the variables studied and outcomes observed.

In summary, this study shows that prostate cancer survivors may have different preventive care immediately following diagnosis, but their care in the long-term is not worse than controls. The variables most consistently associated with preventive care receipt were total number of visits and presence of a PCP visit. It was the patients with the greatest number of visits who were most likely to receive appropriate care. This raises the question of whether there are opportunities to improve efficiency by providing appropriate care with fewer visits. Our previous research has indicated that patients with visits to both oncology specialists and PCPs were most likely to receive preventive care. The consistent association between PCP visits with preventive care in this study, even adjusting for visits with other physician specialties, supports the notion of the ‘medical home’ in ensuring high quality health care. Involvement of primary care is essential to optimize service delivery models for cancer survivors.

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Appendix

Appendix 1:

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Table 1

Characteristics of prostate cancer cases and matched controls

Characteristic	Total (<i>n</i> =13507) ^a
Age	
Mean (standard deviation)	74.6 (5.51)
Race <i>n</i> (%)	
White	11791 (87.3)
Black	1018 (7.5)
Other	698 (5.2)
Comorbidity index <i>n</i> (%)	
0	9374 (69.4)
1	2570 (19.0)
2+	1563 (11.6)
Survived through year 5 <i>n</i> (%)	10482 (77.6)
SEER region	
San Francisco	391 (2.9)
Connecticut	863 (6.4)
Detroit	1393 (10.3)
Hawaii	183 (1.4)
Iowa	1000 (7.4)
New Mexico	295 (2.2)
Seattle	721 (5.3)
Utah	474 (3.5)
Atlanta & Rural Georgia	352 (2.6)
San Jose	262 (1.9)
Los Angeles	929 (6.9)
Greater California	2321 (17.2)
Kentucky	1046 (7.7)
Louisiana	914 (6.8)
New Jersey	2363 (17.5)

^a Sample sizes are equal for prostate cancer cases and control cohorts. Because of matching, descriptive statistics are the same for cases and controls.

Table 2

Mean (SD) number of physician visits for prostate cancer cases and controls: years 1 and 5

	Year 1 (month “-1” –12) (n=13,507)	P-value for cases vs. controls in year 1 ^a	Year 5 (month 49–60) (n=10,482)	P-value for cases vs. controls in year 5 ^a
Primary care providers				
Prostate cancer cases	3.84 (4.62)	<0.0001	3.41 (4.25)	<0.0001
Controls	2.77 (4.15)		2.99 (4.18)	
Oncology specialists				
Prostate cancer cases	2.89 (4.42)	NA	0.67 (2.45)	NA
Controls	0.20 (1.12)		0.34 (1.86)	
Urologists				
Prostate cancer cases	4.64 (3.23)	<0.0001	1.30 (1.71)	<0.0001
Controls	0.43 (1.14)		0.47 (1.15)	
Other physicians				
Prostate cancer cases	3.59 (4.70)	<0.0001	3.80 (5.07)	<0.0001
Controls	3.02 (4.56)		3.39 (5.29)	
Total visits				
Prostate cancer cases	14.96 (9.41)	<0.0001	9.19 (8.15)	<0.0001
Controls	6.41 (7.10)		7.20 (8.03)	

^aControlling for socioeconomic status and urban/rural residence

NA not applicable

Table 3

Number (%) of prostate cancer cases and controls receiving preventive care: years 1 and 5

	Year 1 (month “-1” –12) (n=13,507)	P-value for cases vs. controls in year 1 ^a	Year 5 (month 49–60) (n=10,482)	P-value for cases vs. controls in year 5 ^a
Influenza vaccination				
Prostate cancer cases	6483 (48.0)	<0.0001	4852 (46.3)	<0.0001
Controls	6131 (45.4)		4605 (43.9)	
Cholesterol screening				
Prostate cancer cases	5184 (38.4)	0.16	4509 (43.0)	0.59
Controls	5244 (38.8)		4487 (42.8)	
Colorectal cancer screening				
Prostate cancer cases	3866 (28.6)	<0.0001	2393 (22.8)	0.20
Controls	4133 (30.6)		2453 (23.4)	

^aControlling for socioeconomic status and urban/rural residence

Table 4Factors associated with preventive care receipt: prostate cancer cases only - year 1 ($n=13,507$)

Characteristic ^a	Odds Ratio (95% Confidence Interval)		
	Influenza vaccination	Cholesterol screening	Colorectal cancer screening
Physician specialty visited			
Primary care provider	1.30 (1.19–1.42)	1.36 (1.25–1.49)	1.50 (1.36–1.65)
Oncology specialist	0.94 (0.86–1.03)	0.90 (0.82–0.98)	1.06 (0.96–1.16)
Urologist	1.40 (1.22–1.61)	1.11 (0.96–1.29)	1.29 (1.10–1.52)
Other physician	1.10 (1.00–1.20)	1.51 (1.37–1.65)	1.46 (1.33–1.62)
Treatment group			
Active surveillance	<i>b</i>	<i>b</i>	<i>b</i>
Radiation only	1.35 (1.18–1.53)	1.28 (1.12–1.46)	1.31 (1.13–1.50)
Hormonal only	1.06 (0.94–1.21)	1.07 (0.94–1.23)	1.05 (0.91–1.21)
Hormonal + Radiation	1.18 (1.05–1.34)	1.28 (1.13–1.46)	1.14 (0.99–1.30)
Surgery	1.25 (1.10–1.43)	1.45 (1.26–1.66)	1.32 (1.14–1.53)
Total number of visits			
0–4	<i>b</i>	<i>b</i>	<i>b</i>
5–7	1.72 (1.43–2.07)	1.82 (1.48–2.24)	1.59 (1.27–1.98)
8–12	2.15 (1.80–2.57)	2.13 (1.75–2.59)	1.54 (1.25–1.90)
13+	2.62 (2.18–3.16)	2.67 (2.18–3.27)	1.92 (1.54–2.39)
Age	1.03 (1.03–1.04)	0.98 (0.98–0.99)	0.99 (0.98–1.00)
Race			
White	<i>b</i>	<i>b</i>	<i>b</i>
Black	0.41 (0.35–0.48)	0.73 (0.62–0.85)	0.78 (0.65–0.93)
Other	0.82 (0.68–0.99)	1.03 (0.86–1.23)	0.86 (0.71–1.05)
Comorbidity index			
0	<i>b</i>	<i>b</i>	<i>b</i>
1	1.21 (1.11–1.33)	1.36 (1.24–1.49)	0.92 (0.83–1.01)
2+	1.17 (1.04–1.31)	1.42 (1.26–1.59)	0.92 (0.81–1.03)
Urban/Rural residence			
Rural	<i>b</i>	<i>b</i>	<i>b</i>
Urban	1.06 (0.91–1.22)	1.05 (0.90–1.23)	1.11 (0.94–1.31)
Socioeconomic status			
1st quintile	<i>b</i>	<i>b</i>	<i>b</i>
2nd quintile	1.10 (0.98–1.23)	0.95 (0.84–1.07)	1.08 (0.95–1.22)
3rd quintile	1.27 (1.13–1.42)	1.08 (0.96–1.22)	1.17 (1.03–1.33)
4th quintile	1.37 (1.22–1.54)	1.10 (0.98–1.24)	1.09 (0.96–1.24)
5th quintile	1.37 (1.22–1.55)	1.32 (1.17–1.49)	1.48 (1.30–1.68)

^aalso controlling for SEER Region^bReference Group**BOLD** = $p < 0.0001$

Table 5Factors associated with preventive care receipt: prostate cancer cases only - year 5 ($n=10,482$)

Characteristic ^a	Odds Ratio (95% Confidence Interval)		
	Influenza vaccination	Cholesterol screening	Colorectal cancer screening
Physician specialty visited			
Primary care provider	1.42 (1.28–1.56)	1.15 (1.04–1.27)	1.56 (1.38–1.76)
Oncology specialist	1.02 (0.92–1.13)	0.97 (0.88–1.07)	1.41 (1.26–1.58)
Urologist	1.29 (1.18–1.41)	1.04 (0.95–1.13)	1.12 (1.01–1.24)
Other physician	1.22 (1.10–1.36)	1.46 (1.31–1.63)	1.45 (1.27–1.66)
Treatment group			
Active surveillance	<i>b</i>	<i>b</i>	<i>b</i>
Radiation only	1.58 (1.38–1.82)	1.52 (1.32–1.74)	1.45 (1.23–1.70)
Hormonal only	1.17 (1.00–1.36)	1.22 (1.04–1.43)	0.97 (0.80–1.18)
Hormonal + Radiation	1.39 (1.23–1.58)	1.49 (1.31–1.69)	1.28 (1.10–1.49)
Surgery	1.64 (1.42–1.90)	1.55 (1.34–1.79)	1.53 (1.29–1.81)
Total number of visits			
0–4	<i>b</i>	<i>b</i>	<i>b</i>
5–7	1.22 (1.07–1.40)	1.40 (1.23–1.60)	1.09 (0.93–1.28)
8–12	1.48 (1.28–1.70)	1.72 (1.50–1.98)	1.13 (0.96–1.34)
13+	1.58 (1.36–1.83)	2.04 (1.76–2.37)	1.36 (1.15–1.62)
Age	1.03 (1.02–1.04)	0.98 (0.97–0.99)	0.99 (0.98–1.01)
Race			
White	<i>b</i>	<i>b</i>	<i>b</i>
Black	0.43 (0.35–0.51)	0.77 (0.65–0.92)	0.88 (0.71–1.08)
Other	0.79 (0.64–0.97)	1.10 (0.91–1.34)	1.03 (0.82–1.30)
Comorbidity index			
0	<i>b</i>	<i>b</i>	<i>b</i>
1	1.08 (0.97–1.20)	1.22 (1.09–1.35)	0.90 (0.79–1.02)
2+	1.13 (0.98–1.31)	1.27 (1.10–1.47)	0.91 (0.77–1.08)
Urban/Rural residence			
Rural	<i>b</i>	<i>b</i>	<i>b</i>
Urban	0.90 (0.77–1.07)	1.12 (0.94–1.33)	0.98 (0.80–1.21)
Socioeconomic status			
1st quintile	<i>b</i>	<i>b</i>	<i>b</i>
2nd quintile	1.04 (0.90–1.19)	0.96 (0.84–1.10)	1.06 (0.90–1.25)
3rd quintile	1.29 (1.12–1.47)	1.06 (0.93–1.21)	1.15 (0.98–1.35)
4th quintile	1.31 (1.14–1.50)	1.03 (0.90–1.18)	1.20 (1.02–1.41)
5th quintile	1.47 (1.28–1.69)	1.07 (0.93–1.23)	1.35 (1.15–1.59)

^aalso controlling for SEER Region^bReference Group**BOLD** = $p < 0.0001$

Table 6

Codes used to identify prevention services

Variable	ICD-9 Diagnostic codes	ICD-9 Procedure codes	CPT	HCPSCS
Influenza vaccination		99.52	90657, 90658, 90659, 90724	G0008
Cholesterol screening	272.0–272.3		82465, 83715, 83717, 83718, 83719, 83721	G0054
Colorectal cancer screening	V76.41	45.23–45.25,	44388–44394, 44397,	G0104, G0105, G0106, G0107,
	V76.51	48.21–48.24, 89.34	45300–45327, 45330–45345, 45355–45377, 45378–45392, 82270	G0120, G0121, G0122, G0328