Association Between Urologist Characteristics and Radiation Oncologist Consultation for Patients With Locoregional Prostate Cancer

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Abstract

Background: Physicians managing patients with prostate cancer play a critical role in subsequent specialist consultations and initial treatment choice, especially in cases for which no consensus exists regarding optimal treatment strategy. The NCCN Guidelines for Prostate Cancer recommend radiation as a therapy option for patients with locoregional prostate cancer. **Purpose:** The authors examined the association of urologist characteristics with the likelihood that patients would consult radiation oncologists. **Methods:** A retrospective cohort of 39,934 patients aged 66 years or older who were diagnosed with locoregional prostate cancer between 2004 and 2007, and the 2405 urologists who performed the patient diagnostic biopsies were constructed using the SEER-Medicare linked database and the American Medical Association Physician Masterfile. Logistic multilevel regression analysis was used to evaluate the influence of urologists' characteristics on radiation oncologist consultation within 9 months of locoregional prostate cancer diagnosis. **Results:** Overall, 24,549 (61.5%) patients consulted a radiation oncologist. After adjusting for patient and urologist characteristics, patients diagnosed by urologists in noninstitutional settings (eg, physician office) were significantly more likely to consult a radiation oncologist (odds ratio [OR], 1.40; 95% CI, 1.17–1.67; $P=.0002$) compared with those diagnosed by urologists in institutional settings with a major medical school affiliation. In addition, patients diagnosed by urologists older than 57 years were significantly more likely to consult a radiation oncologist (OR, 1.21; 95% CI, 1.07–1.38, $P=.003$). (J Natl Compr Canc Netw 2015;13:303–309)

Background

With insufficient high-quality evidence to identify an optimal prostate cancer treatment modality,¹ preferences of individual physicians can significantly affect management decisions of this disease. The NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Prostate Cancer² include radiation therapy as a treatment option for men with locoregional prostate cancer (to view the most recent version of these guidelines, visit NCCN.org). Many patients seek information and recommendations from urologists and radiation oncologists,³ the 2 most common specialists providing prostate cancer care.⁴ Urologists generally act as both diagnosticians (eg, diagnosing prostate cancer after performing diagnostic core needle biopsy) and proceduralists (eg, performing radical prostatectomy). In contrast, radiation oncologists usually act solely as proceduralists (eg, administering radiation therapy) during prostate cancer treatment. In the United States, urologists perform biopsies for patients with suspected prostate cancer and are generally the first physicians to discuss further diagnostic, treatment, and referral options.

A study comparing recommendations by urologists and radiation oncologists found that physicians overwhelmingly recommended therapy that they themselves deliver.⁵ Likewise, studies have reported a strong correlation between specialty seen and initial treatment received by patients with prostate cancer.^{3,4,6} Physicians play a major role in influencing patients' treatment decisions.^{7,8} Multiple studies have indicated that physician characteristics are important determinants of referral patterns.^{9–13}

This study examined urologists' characteristics as determinants of radiation oncologist consultation for patients with locoregional prostate cancer.

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Methods

Data Sources

Incident locoregional prostate cancer cases for 2004 through 2007 were selected from the SEER-Medicare database that links cancer registry information in selected US geographic areas with claims for covered health care services of Medicare beneficiaries (Figure 1). The SEER program represents 26% of the US population, whereas Medicare covers health services for 97% of people aged 65 years and older.^{14,15} Approximately 94% of SEER patients aged 65 years or older have been successfully linked with their Medicare claims.^{14,15} Geographic areas selected for inclusion in the SEER program are based on their ability to operate and maintain a high-quality, population-based cancer reporting system and for their

epidemiologically significant population subgroups.¹⁶ Louisiana SEER registry data were removed from this study because of missing information after Hurricane Katrina in 2005. Exact prostate-specific antigen (PSA) levels at time of diagnosis were not recorded in SEER until 2004. Until 2007, Medicare files used Unique Physician Identification Numbers that are required to link with the American Medical Association Physician Masterfile (AMAPM).

Characteristics of physicians who treated SEER-Medicare patients were obtained from the AMAPM. This file contains physician information collected from multiple sources, including medical schools, state licensing boards, and the American Board of Medical Specialties (ABMS).¹⁷

Guidelines, published annually by NCCN since 1996 and throughout the study period, have consistently recommended radiation as a possible initial treatment option for locoregional prostate cancer (any T, any N, M0).^{18–24}

An analytical cohort of patients with an index urologist was created using registry-claims linked data. Urologists perform core needle biopsies (Healthcare Common Procedure Coding System code 55700) to diagnose prostate cancer.^{25,26} The urologist who performed the biopsy on the day closest to the patients' diagnosis date in SEER was assigned as the index urologist. Patients diagnosed with prostate cancer without undergoing biopsy, received their biopsy from a non-urologist, or had multiple biopsies performed by different urologists on the day closest to the patients' diagnosis date were removed. These exclusions create a more homogenous population in terms of treatment selection.

Institutional Review Board approval was obtained from Emory University and Morehouse School of Medicine.

Patient Characteristics

Sociodemographic and clinical characteristics of the analytic cohort were extracted from SEER data (see supplemental eTable 1, available with this article at JNCCN.org). For tumor grade, *low* corresponds to Gleason grade 2 through 4; *intermediate* to Gleason grade 5 through 6, and *high* to Gleason grade 7 through 10.²⁷ Education and income levels were based on US Census tract data from 2000; the categories chosen were prespecified to ensure a reasonable distribution, with cutoffs approximately corresponding to quartiles. The prevalence of comorbid disease in the

Figure 1 Definition of study cohort of 39,934 men with locoregional prostate cancer.

Abbreviations: AMAPM, American Medical Association Physician Masterfile; HMO, health maintenance organization.

*Exact prostate-specific antigen levels at time of diagnosis were recorded in SEER from 2004, and up until 2007, Medicare files used Unique Physician Identification Numbers that are required to link with the AMAPM.

study cohort was calculated using a modified Charlson comorbidity index derived from Medicare Part A and Part B claims.²⁸

Urologist Characteristics

Urologists were identified by using either the Health Care Financing Administration (HCFA) specialty codes in Medicare claims, the physician specialty information from the AMAPM, or the urology board certification identified through the ABMS information within the AMAPM. Other urologist characteristics extracted from the AMAPM can be found in [supplemental eTable 1](#)). Urologists' patient volume was defined as the number of unique patients with prostate cancer that each urologist saw during the study period. Categories used for urologists' patient volume, age, and years after medical school graduation were prespecified to ensure cutoffs approximating quartiles.

Physician Medical School Affiliation

Urologists' medical school affiliation was derived from the SEER-Medicare Hospital (HOSP) file.²⁹ Specifically, if the Medicare biopsy claim recorded in the institutional outpatient standard analytical file (OUTSAF) was submitted from a hospital with a major or without a medical school affiliation (as defined within the HOSP file), the associated index urologist was categorized as having a major or no medical school affiliation, respectively. Index urologists were categorized as having mixed medical school affiliations if the OUTSAF biopsy claims were from hospitals with limited or graduate medical school affiliations.³⁰

Biopsy claims found within the National Claims History (NCH) file (consisting of mostly noninstitutional physician/supplier claims) did not have the associated provider (eg, hospital) identifier required to retrieve medical school affiliation (found within HOSP) for the index urologist. These NCH claims were assigned the provider identifier associated with the institutional inpatient Medicare Provider Analysis and Review (MEDPAR) claims if (1) the patient associated with both types of claims matched, (2) the NCH place of service was institutional,³¹ and (3) the NCH claims dates fell between the MEDPAR admission and discharge dates.

Subsequently, remaining NCH biopsy claims without assigned provider identifiers from MEDPAR claims were assigned provider identifiers from

OUTSAF claims if (1) the patient and urologist associated with both claim types matched, (2) the NCH place of service was institutional,³¹ and (3) the NCH claims dates were between the OUTSAF claims dates. Urologists whose biopsy claims were only found in the NCH file and whose claims could not be assigned provider identifiers from OUTSAF or MEDPAR claims were categorized as having a noninstitutional affiliation.

Measurement of Outcomes

Whether the patient had a radiation oncologist consultation after being diagnosed with locoregional prostate cancer was the primary dichotomous outcome. Radiation oncologists were identified using either HCFA specialty codes, AMAPM's physician specialty information, or ABMS radiation oncology board certification information. Patients were categorized as having radiation oncologist consultations if at least one radiation oncologist-associated Medicare claim was identified within 9 months after locoregional prostate cancer was diagnosed. A 9-month interval was selected to ensure sufficient time for multidisciplinary consultations with specialists before treatment selection⁴ and to minimize the possibility of significant cancer progression. A total of 568 patients who underwent prostatectomy before radiation oncologist consultation were excluded in the outcome measurement. As part of a sensitivity analysis to examine the impact of these consultations as potentially part of adjuvant radiation therapy, these patients were included in the outcome measurement but the results were not substantially changed (unpublished data, 2014).

Statistical Analyses

Differences in the proportion of patients consulting radiation oncologists across index urologists and patient characteristics were evaluated using chi-square tests. The effect of patient and urologist characteristics on the likelihood of a subsequent radiation oncologist consultation was assessed with logistic hierarchical generalized linear mixed models³² (GLMM) and estimated using restricted pseudo-likelihood methodology.^{32–34} The use of hierarchical GLMM accounted for possible clustering of subsequent radiation oncologist consultation among patients who had the same index urologist for diagnostic biopsy.^{29,35–37} The unit of analysis was the patient. The clustering variable was the index urologist associated with each

patient. Univariate and adjusted multivariate odds ratios (ORs) and 95% CIs for the radiation oncologist consultation were calculated for each patient and urologist characteristic ([supplemental eTable 2](#)). Variables used in the adjusted model were selected a priori and based on previous studies that investigated the influence of patient and physician characteristics on clinical referral patterns.^{12,38}

All statistical testing was 2-sided, performed at 5% significance level, and used SAS version 9.3 (SAS Institute, Cary, NC).

Results

The SEER-Medicare database contained 39,934 men diagnosed with incident locoregional prostate cancer from 2004 to 2007 who met study eligibility criteria. A total of 2405 urologists performed diagnostic biopsies on these patients, and were predominantly male (96.8%), board certified (93.4%), had patient volumes across the study period of fewer than 37 (60.5%), were trained in the United States (84.4%), and had an MD (97.6%) as opposed to a DO degree ([supplemental eTable 3](#)).

Overall, 24,549 (61.5%) patients consulted a radiation oncologist within 9 months after diagnosis ([supplemental eTable 1](#)). Radiation oncologist consultations were less common among patients who were aged 80 years or older; of Hispanic ethnicity; unmarried; residing in SEER areas covering Iowa, New Mexico, or Utah; and residing in census tracts with lower educational and median incomes levels. Consultations were also less common among patients with higher levels of comorbidities, tumor stages higher than T1, PSA levels greater than 20 ng/mL, low tumor grade, and/or positive regional lymph nodes. Index urologists treating patients who consulted radiation oncologists were more likely to be older than 57 years, have a patient volume of fewer than 37, be trained in the United States, and/or have a mixed medical school affiliation.

Using hierarchical GLMM, factors associated with patients' subsequent radiation oncologist consultation after diagnosis were investigated, while controlling for multiple patients being diagnosed by the same urologist ([supplemental eTable 2](#)). Unadjusted univariate ORs showed that lower propensities to consult radiation oncologists are associated with patients who were aged 80 years or older; of Hispanic

ethnicity compared with white; were unmarried; residing in California, Detroit, Iowa, Kentucky, New Mexico, Seattle, or Utah as opposed to Georgia; and residing in census tracts with lower educational and/or median income levels. A significantly smaller association with radiation oncologist consultation was also observed for patients with higher levels of comorbidities (ie, comorbidity index ≥ 3 vs 0), clinical stage T2–T4 versus T1, regional lymph node metastasis stage N1 versus N0, low versus high tumor grade, and higher PSA levels. The index urologists for patients who subsequently consulted radiation oncologists were significantly more likely to have noninstitutional affiliations (OR, 1.21; 95% CI, 1.02–1.43; $P=.03$).

After the multivariate adjustment for patient and urologist characteristics, patients whose index urologists had noninstitutional affiliations (OR, 1.40; 95% CI, 1.17–1.67; $P=.0002$) as opposed to major medical school affiliations were significantly more likely to have a subsequent radiation oncologist consultation. In addition, patients who subsequently consulted radiation oncologists were also significantly more likely to be diagnosed by index urologists older than 57 years (OR, 1.21; 95% CI, 1.07–1.38; $P=.003$) and/or significantly less likely to be diagnosed by index urologists with patient volumes between 37 and 54 (OR, 0.88; 95% CI, 0.78–1.00; $P=.049$) as opposed to fewer than 37. Patient characteristics that remained significantly associated with lower odds of radiation oncologists consultation included age of 80 years or older; Hispanic ethnicity versus white; SEER region of residence in California, Iowa, or Utah as opposed to Georgia; residence in census tracts with lower educational levels; clinical stage T2–T4 versus T1; lower tumor grade; and PSA levels greater than 20.0 ng/mL compared with 0.1 to 9.9 ng/mL.

Discussion

To our knowledge, this is the first study to investigate the association of urologists' characteristics on the likelihood of subsequent radiation oncologist consultation by men diagnosed with locoregional prostate cancer. The index urologists' age, patient volume, and noninstitutional practice affiliation exerted a significant influence on patients' subsequent radiation oncologist consultations. Similar radiation

oncologist consultation patterns were found among patients diagnosed by institutional-affiliated urologists regardless of medical school affiliation level (major/mixed). Other significant associations found between patient-related sociodemographic and clinical factors and radiation oncologist consultations complement prior research.⁴

Significant associations with urologist age may be a result of younger urologists being keener to act as proceduralists and not actively referring their patients to radiation oncologists. In addition, older urologists may not feel the need to perform multiple procedures, and prefer the added value of a radiation oncologist consultation.

Physician practice settings are known to be associated with variation in primary treatment of prostate cancer³⁹; inherent differences may exist between physicians practicing within major medical schools and those in noninstitutional settings that may explain observed variations. One possible reason major medical school-affiliated urologists refer less often may be related to the teaching nature of their institutions. Urologists affiliated with major medical schools may potentially want to reserve patients for their residents and fellows to perform surgery.

Given the rising prevalence of expectant management approaches during this study period,³⁹ many of the patients who did not consult a radiation oncologist may have opted for active surveillance or watchful waiting. Current NCCN Guidelines^{2,40,41} recommend active surveillance for low-risk patients with an expected survival of less than 10 years and very-low-risk patients with an expected survival of less than 20 years (to view the most recent version of these guidelines, visit NCCN.org). However, during this study period, NCCN Guidelines^{18–24} allowed for expectant management or radiation therapy as possible treatment options for low-risk patients with an expected survival of less than 10 years. A significant proportion (27%–69%) of the study's patients aged 75 years or older (with an expected survival $\approx$ <10 years)⁴² had a radiation oncologist consultation. Based on current NCCN Guidelines,² future research should investigate whether radiation oncologists should discuss treatment options with all of these patients. In addition, uncertainty surrounds the threshold for reclassifying prostate cancer from low risk to higher risk, which would trigger a physician recommendation for active treatment.⁴⁰ Ongo-

ing randomized clinical trials⁴³ will further inform this important management decision and the need for multiple specialty consultations.

Physicians working for academic health providers are more commonly remunerated through a salary-only payment mechanism rather than a fee-for-service (FFS) model.⁴⁴ Previous research has shown that different payment mechanisms influence clinical decision-making⁴⁵ and physician behavior is significantly different under salaried versus FFS reimbursement models. A previous study concluded that, regarding inappropriate androgen deprivation therapy use, financial incentives might have played a lesser role for major medical school-affiliated urologists, because they were more likely to be salaried.³⁶ In another recent study, urologists employed by NCCN Member Institutions (generally major medical school-affiliated institutions) were unlikely to derive financial benefits from recommending specific treatments such as intensity-modulated radiation therapy (IMRT).²⁶

SEER-Medicare data limitations preclude direct ascertainment of individual physicians' payment mechanisms (ie, salaried vs nonsalaried) and self-referral confirmation (ie, that the radiation oncologist and index urologist worked within the same practice; and that the urologist had a financial interest in the referral). Nonetheless, a 2012 report by the US Government Accountability Office (GAO) that investigated advanced imaging self-referral concerns noted that "financial incentive for providers to self-refer is most direct when the service is performed in a physician office."⁴⁶ In our study, as expected, greater than 90% of patients diagnosed by noninstitutional-affiliated urologists received biopsies in physician office settings. The GAO report also found that between 2004 and 2010, the greatest increase in CT self-referral rates occurred among urology and radiation oncology providers.⁴⁶ Our findings may shed further light on the determinants of radiation oncologist consultations before IMRT self-referrals that were reported in another 2013 GAO report.⁴⁷

We acknowledge other important study limitations when using the SEER-Medicare database.^{14,15,17} Multiple physician characteristics (eg, intrinsic motivation, professionalism, altruism) not measured in this study may influence practice patterns or response to financial incentives.^{48–52} Medicare claims-based categorization of medical school affiliation may be influenced by other patients seen (eg, younger pa-

tients, those with private insurance, and/or receiving care in health maintenance organizations). Therefore, our study observations may not be representative of the physicians' entire practice. Nonetheless, 79% of men with incident prostate cancer are aged 65 years or older,⁵³ and in 2010, 76% of Medicare beneficiaries were covered under traditional FFS.⁵⁴ Medicare claims–based categorization of physicians' medical school affiliation has also been used in previous literature.^{29,30,36,37}

Whether a patient sees a radiation oncologist is likely influenced by many other factors. Individual patient selection biases not assessed may have led to variability in observations. Whether the present observations reflect urologists' referral decisions or patients' individual choices is unclear. Nonetheless, previous studies^{55,56} suggest that patient preference is unlikely to entirely explain the observed radiation oncologist consultation patterns. Further research is necessary to confirm whether subsequent radiation oncologist consultations reflect index urologist referral behavior, patient response, or urologist-patient interactions. Future studies should also examine subsequent urologist consultation after diagnosis and the association of physicians' (both urologist and radiation oncologist) characteristics on the eventual treatment received by patients with prostate cancer.

Without a gold standard for prostate cancer treatment, urologists' recommendations and referrals can be crucial in determining eventual treatment. Inherent differences in specialty-related treatment recommendations^{5,6} underscore the importance of obtaining second opinions from different types of specialists before selecting a specific treatment modality. Nevertheless, variation observed in this study should ideally be from the collective preferences and consents of well-informed patients and patient-centered clinical judgment of their physicians.

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- **eTable 1:** Patients Consulting a Radiation Oncologist Within 9 Months After Prostate Cancer Diagnosis by an Index Urologist
- **eTable 2:** Unadjusted Univariate and Adjusted Multivariate Multilevel Regression Models Predicting Odds Of Consulting a Radiation Oncologist Among Patients With Locoregional Prostate Cancer
- **eTable 3:** Characteristics of Index Urologists Who Diagnosed Patients From 2004 to 2007 With Locoregional Prostate Cancer

eTable 1 Patients Consulting a Radiation Oncologist Within 9 Months After Prostate Cancer Diagnosis by an Index Urologist

	n (%)	Percentage of Patients Consulting a Radiation Oncologist	P Value ^a
All patients	39,934 (100.0)	61.5	
Patient sociodemographic characteristics			
Age at diagnosis			<.0001
66–69 y	10,837 (27.1)	57.5	
70–74 y	12,784 (32.0)	68.8	
75–79 y	9553 (23.9)	68.6	
80–84 y	4891 (12.2)	50.4	
≥85 y	1869 (4.7)	26.9	
Race/ethnicity			<.0001
Non-Hispanic white	31,073 (77.8)	63.0	
Non-Hispanic black	2916 (7.3)	62.3	
Hispanic	2649 (6.6)	54.9	
Non-Hispanic Asian/Pacific Islander	1758 (4.4)	64.3	
Other/unknown	1538 (3.9)	37.6	
Marital status			<.0001
Married	27,344 (68.5)	64.4	
Not married	7393 (18.5)	62.8	
Unknown	5197 (13.0)	43.9	
SEER region of residence			<.0001
Georgia	1608 (4.0)	65.5	
California	13,452 (33.7)	58.1	
Connecticut	2659 (6.7)	72.6	
Detroit	3421 (8.6)	61.8	
Hawaii	721 (1.8)	70.7	
Iowa	2377 (6.0)	52.7	
Kentucky	2919 (7.3)	59.9	
New Jersey	7070 (17.7)	70.6	
New Mexico	961 (2.4)	48.8	
Seattle	3085 (7.7)	59.2	
Utah	1661 (4.2)	50.6	
Rural status			.089
Nonrural	39,265 (98.3)	61.5	
Rural	669 (1.7)	58.3	
Census tract: percentage of adults with less than a high school education			<.0001
<7.5	10,031 (25.1)	63.0	
7.5 to <13.3	10,010 (25.1)	63.0	
13.3 to <21.6	9923 (24.8)	61.1	
≥22.6	9970 (25.0)	58.7	
Census tract: median income (\$USD)			<.0001
<37,400	9961 (24.9)	58.2	
37,400 to <50,500	10,007 (25.1)	59.5	
50,500 to <67,700	9972 (25.0)	63.1	
≥67,700	9994 (25.0)	65.2	

(continued on next page)

Abbreviations: \$USD, US dollars; PSA, prostate-specific antigen.

^aP values calculated from 2-sided chi-squared tests for heterogeneity in proportion of patients consulting a radiation oncologist across different patient and urologists' characteristics.

^bComorbidity index based on a modification of the Charlson comorbidity index.

^cDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 1 Patients Consulting a Radiation Oncologist Within 9 Months After Prostate Cancer Diagnosis by an Index Urologist (cont.)			
	n (%)	Percentage of Patients Consulting a Radiation Oncologist	P Value ^a
Patient clinical characteristics			
Comorbidity index ^b			.028
0	24,856 (62.2)	61.8	
1	9711 (24.3)	61.7	
2	3197 (8.0)	60.3	
≥3	2170 (5.4)	58.8	
Clinical tumor stage			<.0001
T1	17,153 (43.0)	74.8	
T2	20,074 (50.3)	52.8	
T3	2310 (5.8)	40.6	
T4	184 (0.5)	45.1	
Unknown	213 (0.5)	40.4	
Regional lymph node metastasis stage			<.0001
N0	38,937 (97.5)	61.6	
N1	306 (0.8)	45.1	
NX/unknown	691 (1.7)	59.2	
Tumor grade			<.0001
Low	235 (0.6)	52.8	
Intermediate	17,230 (43.1)	64.0	
High	21,753 (54.5)	60.1	
Unknown	716 (1.8)	46.6	
PSA level at diagnosis (ng/mL)			<.0001
0.1–9.9	24,332 (60.9)	66.7	
10.0–20.0	6395 (16.0)	63.7	
>20.0	3501 (8.8)	55.8	
Unknown	5706 (14.3)	40.0	
Year of diagnosis			.120
2004	10,268 (25.7)	61.2	
2005	9606 (24.1)	61.3	
2006	10,160 (25.4)	62.5	
2007	9900 (24.8)	60.9	

(continued on next page)

Abbreviations: \$USD, US dollars; PSA, prostate-specific antigen.
^aP values calculated from 2-sided chi-squared tests for heterogeneity in proportion of patients consulting a radiation oncologist across different patient and urologists' characteristics.
^bComorbidity index based on a modification of the Charlson comorbidity index.
^cDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 1 Patients Consulting a Radiation Oncologist Within 9 Months After Prostate Cancer Diagnosis by an Index Urologist (cont.)

	n (%)	Percentage of Patients Consulting a Radiation Oncologist	P Value ^a
Urologist characteristics			
Age			<.0001
<43 y	9983 (25.0)	60.9	
43–50 y	10,763 (27.0)	62.2	
51–57 y	9259 (23.2)	59.4	
>57 y	9929 (24.9)	63.1	
Sex			.315
Male	39,535 (99.0)	61.4	
Female	399 (1.0)	63.9	
Board certification			.096
Yes	37,608 (94.2)	61.6	
No	2326 (5.8)	59.8	
US-trained			.002
Yes	34,155 (85.5)	61.8	
No	5779 (14.5)	59.6	
Degree type			.182
MD	38,870 (97.3)	61.4	
DO	1064 (2.7)	63.4	
Years after medical school graduation			.023
<16	9856 (24.7)	61.6	
16–23	9729 (24.4)	60.3	
24–31	10,384 (26.0)	61.5	
>31	9965 (25.0)	62.5	
Patient volume ^c			.0002
<37	9657 (24.2)	63.2	
37–54	9951 (24.9)	61.6	
55–77	10,257 (25.7)	60.7	
>77	10,069 (25.2)	60.5	
Medical school affiliation			<.0001
Major	1251 (3.1)	60.4	
Mixed	1137 (2.8)	66.8	
None	1692 (4.2)	56.1	
Noninstitutional	35,854 (89.8)	61.6	

Abbreviations: \$USD, US dollars; PSA, prostate-specific antigen.

^aP values calculated from 2-sided chi-squared tests for heterogeneity in proportion of patients consulting a radiation oncologist across different patient and urologists' characteristics.

^bComorbidity index based on a modification of the Charlson comorbidity index.

^cDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 2 Unadjusted Univariate and Adjusted Multivariate Multilevel Regression Models Predicting Odds Of Consulting a Radiation Oncologist Among Patients With Locoregional Prostate Cancer				
	Unadjusted		Adjusted	
	OR (95% CI)	P Value ^a	OR ^b (95% CI)	P Value ^a
Patient sociodemographic characteristics				
Age at diagnosis				
66–69 y	1.00 (Referent)		1.00 (Referent)	
70–74 y	1.68 (1.58–1.79)	<.0001	1.62 (1.52–1.72)	<.0001
75–79 y	1.62 (1.50–1.75)	<.0001	1.57 (1.45–1.70)	<.0001
80–84 y	0.68 (0.62–0.75)	<.0001	0.69 (0.62–0.76)	<.0001
≥85 y	0.22 (0.19–0.25)	<.0001	0.23 (0.20–0.27)	<.0001
Race/ethnicity				
Non-Hispanic white	1.00 (Referent)		1.00 (Referent)	
Non-Hispanic black	0.99 (0.90–1.10)	.880	0.90 (0.80–1.00)	.050
Hispanic	0.74 (0.68–0.82)	<.0001	0.75 (0.68–0.83)	<.0001
Non-Hispanic Asian/ Pacific Islander	0.90 (0.78–1.04)	.139	0.88 (0.76–1.03)	.106
Other/unknown	0.37 (0.32–0.42)	<.0001	0.52 (0.45–0.61)	<.0001
Marital status				
Married	1.00 (Referent)		1.00 (Referent)	
Not married	0.92 (0.87–0.98)	.006	0.99 (0.93–1.06)	.793
Unknown	0.38 (0.35–0.42)	<.0001	0.53 (0.48–0.59)	<.0001
SEER region of residence				
Georgia	1.00 (Referent)		1.00 (Referent)	
California	0.66 (0.53–0.82)	.0002	0.78 (0.62–0.99)	.039
Connecticut	1.38 (1.07–1.77)	.012	1.43 (1.11–1.86)	.007
Detroit	0.76 (0.58–0.99)	.043	1.31 (0.98–1.77)	.071
Hawaii	1.22 (0.81–1.82)	.345	1.95 (1.30–2.93)	.001
Iowa	0.52 (0.39–0.67)	<.0001	0.65 (0.49–0.86)	.003
Kentucky	0.72 (0.55–0.93)	.013	0.89 (0.67–1.17)	.392
New Jersey	1.19 (0.94–1.50)	.152	1.44 (1.13–1.85)	.004
New Mexico	0.49 (0.34–0.70)	.0001	0.74 (0.51–1.06)	.102
Seattle	0.75 (0.57–1.00)	.049	1.06 (0.79–1.44)	.695
Utah	0.47 (0.35–0.64)	<.0001	0.59 (0.43–0.81)	.001
Rural status				
Nonrural	1.00 (Referent)		1.00 (Referent)	
Rural	0.91 (0.77–1.09)	.300	1.04 (0.87–1.26)	.652
Census tract: percentage of adults with less than a high school education				
<7.5	1.00 (Referent)		1.00 (Referent)	
7.5 to <13.3	0.97 (0.91–1.03)	.267	0.95 (0.88–1.02)	.175
13.3 to <21.6	0.89 (0.84–0.95)	.001	0.89 (0.81–0.97)	.008
≥22.6	0.83 (0.77–0.89)	<.0001	0.85 (0.77–0.95)	.003
Census tract: median income (\$USD)				
<37,400	1.00 (Referent)		1.00 (Referent)	
37,400 to <50,500	1.09 (1.02–1.16)	.009	1.01 (0.94–1.09)	.739
50,500 to <67,700	1.17 (1.09–1.25)	<.0001	0.99 (0.91–1.09)	.891
≥67,700	1.27 (1.17–1.36)	<.0001	0.98 (0.87–1.09)	.663

Abbreviations: \$USD, US dollars; OR, odds ratio; PSA, prostate-specific antigen.

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^aP values calculated from hierarchical generalized linear mixed models.^bA single multivariate model, that included all the patient sociodemographic, clinical, and urologist characteristics listed in Table 2, was used to obtain the adjusted ORs.^cComorbidity index based on a modification of the Charlson comorbidity index.^dDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 2 Unadjusted Univariate and Adjusted Multivariate Multilevel Regression Models Predicting Odds Of Consulting a Radiation Oncologist Among Patients With Locoregional Prostate Cancer (cont.)

	Unadjusted		Adjusted	
	OR (95% CI)	P Value ^a	OR ^b (95% CI)	P Value ^a
Patient clinical characteristics				
Comorbidity index ^c				
0	1.00 (Referent)		1.00 (Referent)	
1	0.99 (0.94–1.04)	.693	1.01 (0.95–1.06)	.868
2	0.94 (0.86–1.02)	.138	0.97 (0.89–1.06)	.477
≥3	0.89 (0.80–0.98)	.019	0.97 (0.87–1.08)	.584
Clinical tumor stage				
T1	1.00 (Referent)		1.00 (Referent)	
T2	0.39 (0.37–0.42)	<.0001	0.40 (0.38–0.43)	<.0001
T3	0.24 (0.22–0.27)	<.0001	0.19 (0.17–0.22)	<.0001
T4	0.32 (0.23–0.44)	<.0001	0.32 (0.22–0.46)	<.0001
Unknown	0.23 (0.17–0.30)	<.0001	0.41 (0.29–0.58)	<.0001
Regional lymph node metastasis stage				
N0	1.00 (Referent)		1.00 (Referent)	
N1	0.51 (0.41–0.64)	<.0001	0.91 (0.69–1.20)	.495
NX/unknown	0.95 (0.88–1.03)	.189	1.09 (0.98–1.21)	.105
Tumor grade				
Low	0.64 (0.48–0.85)	.0020	0.52 (0.38–0.71)	<.0001
Intermediate	1.14 (1.09–1.20)	<.0001	0.88 (0.83–0.93)	<.0001
High	1.00 (Referent)		1.00 (Referent)	
Unknown	0.53 (0.43–0.64)	<.0001	0.62 (0.49–0.78)	<.0001
PSA level at diagnosis (ng/mL)				
0.1–9.9	1.00 (Referent)		1.00 (Referent)	
10.0–20.0	0.87 (0.81–0.92)	<.0001	0.97 (0.91–1.04)	.360
>20.0	0.60 (0.55–0.66)	<.0001	0.78 (0.71–0.85)	<.0001
Unknown	0.26 (0.24–0.29)	<.0001	0.34 (0.31–0.38)	<.0001
Year of diagnosis				
2004	1.00 (Referent)		1.00 (Referent)	
2005	1.01 (0.94–1.07)	.885	0.98 (0.91–1.05)	.521
2006	1.07 (1.00–1.14)	.049	1.05 (0.98–1.12)	.195
2007	0.99 (0.92–1.06)	.785	0.96 (0.89–1.03)	.240

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Abbreviations: \$USD, US dollars; OR, odds ratio; PSA, prostate-specific antigen.

^aP values calculated from hierarchical generalized linear mixed models.^bA single multivariate model, that included all the patient sociodemographic, clinical, and urologist characteristics listed in Table 2, was used to obtain the adjusted ORs.^cComorbidity index based on a modification of the Charlson comorbidity index.^dDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 2 Unadjusted Univariate and Adjusted Multivariate Multilevel Regression Models Predicting Odds Of Consulting a Radiation Oncologist Among Patients With Locoregional Prostate Cancer (cont.)

	Unadjusted		Adjusted	
	OR (95% CI)	P Value ^a	OR ^b (95% CI)	P Value ^a
Urologist characteristics				
Sex				
Male	1.00 (Referent)		1.00 (Referent)	
Female	1.14 (0.90–1.46)	.190	1.22 (0.92–1.62)	.159
Board certification				
Yes	1.00 (Referent)		1.00 (Referent)	
No	0.87 (0.72–1.06)	.168	0.86 (0.66–1.11)	.242
US-trained				
Yes	1.00 (Referent)		1.00 (Referent)	
No	0.88 (0.77–1.01)	.061	0.91 (0.79–1.06)	.235
Degree type				
MD	1.00 (Referent)		1.00 (Referent)	
DO	1.05 (0.82–1.36)	.698	1.27 (0.87–1.87)	.213
Age				
<43 y	1.00 (Referent)		1.00 (Referent)	
43–50 y	1.10 (0.97–1.25)	.140	1.10 (0.97–1.26)	.129
51–57 y	0.93 (0.82–1.06)	.292	1.04 (0.90–1.19)	.615
>57 y	1.08 (0.96–1.22)	.224	1.21 (1.07–1.38)	.003
Patient volume ^d				
<37	1.00 (Referent)		1.00 (Referent)	
37–54	0.92 (0.82–1.04)	.171	0.88 (0.78–1.00)	.049
55–77	0.90 (0.79–1.03)	.116	0.89 (0.77–1.01)	.079
>77	0.91 (0.79–1.04)	.177	0.95 (0.82–1.09)	.444
Medical School Affiliation				
Major	1.00 (Referent)		1.00 (Referent)	
Mixed	1.12 (0.86–1.46)	.417	1.08 (0.82–1.42)	.579
None	0.93 (0.75–1.16)	.532	1.06 (0.84–1.33)	.651
Noninstitutional	1.21 (1.02–1.43)	.030	1.40 (1.17–1.67)	.0002

Abbreviations: \$USD, US dollars; OR, odds ratio; PSA, prostate-specific antigen.

^aP values calculated from hierarchical generalized linear mixed models.

^bA single multivariate model, that included all the patient sociodemographic, clinical, and urologist characteristics listed in Table 2, was used to obtain the adjusted ORs.

^cComorbidity index based on a modification of the Charlson comorbidity index.

^dDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.

eTable 3 Characteristics of Index Urologists Who Diagnosed Patients From 2004 to 2007 With Locoregional Prostate Cancer		
	n	%
All urologists	2405	
Age		
<43 y	728	30.3
43–50 y	561	23.3
51–57 y	488	20.3
>57 y	628	26.1
Sex		
Male	2329	96.8
Female	76	3.2
Board certification		
Yes	2247	93.4
No	158	6.6
US-trained		
Yes	2030	84.4
No	375	15.6
Degree type		
MD	2346	97.6
DO	59	2.5
Years after medical school graduation		
<16	722	30.0
16–23	523	21.8
24–31	525	21.8
>31	635	26.4
Patient volume ^a		
<37	1455	60.5
37–54	423	17.6
55–77	312	13.0
>77	215	8.9
Medical school affiliation		
Major	153	6.4
Mixed	76	3.2
None	136	5.7
Noninstitutional	2040	84.8

^aDefined as the number of unique patients with prostate cancer that each urologist saw during the study period.