Published in final edited form as:

Int J Radiat Oncol Biol Phys. 2012 May 1; 83(1): 8–15. doi:10.1016/j.ijrobp.2011.06.1951.

Variation in Use of Androgen Suppression With External-Beam Radiotherapy for Nonmetastatic Prostate Cancer

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Abstract

Purpose—To describe practice patterns associated with androgen suppression (AS) stratified by disease risk group in patients undergoing external-beam radiotherapy (EBRT) for localized prostate cancer.

Methods and Materials—We identified 2,184 low-risk, 2,339 intermediate-risk, and 2,897 high-risk patients undergoing EBRT for nonmetastatic prostate cancer diagnosed between January 1, 2004, and December 31, 2005, in the linked Surveillance, Epidemiology, and End Results–Medicare database. We examined the association of patient, clinical, and demographic characteristics with AS use by multivariate logistic regression.

Results—The proportions of patients receiving AS for low-risk, intermediate-risk, and high-risk prostate cancer were 32.2%, 56.3%, and 81.5%, respectively. AS use among men in the low-risk disease category varied widely, ranging from 13.6% in Detroit to 47.8% in Kentucky. We observed a significant decline in AS use between 2004 and 2005 within all three disease risk categories. Men aged ≥ 75 years or with elevated comorbidity levels were more likely to receive AS.

Conclusion—Our results identified apparent overuse and underuse of AS among men within the low-risk and high-risk disease categories, respectively. These results highlight the need for clinician and patient education regarding the appropriate use of AS. Practice patterns among

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Presented in part at the 52nd Annual Meeting of the American Society for Radiation Oncology, San Diego, CA, Oct 31 to Nov 4, 2010.

Conflict of interest: none.

intermediate-risk patients reflect the clinical heterogeneity of this population and underscore the need for better evidence to guide the treatment of these patients.

Keywords

Prostate cancer; Androgen suppression; External-beam radiation; Health services research; Quality of care

Introduction

Androgen suppression (AS) has been used to treat prostate cancer since the work of Huggins and Hodges in 1941 (1). While AS use was historically limited to metastatic disease, the results of several randomized trials initially published in the 1990s now support its use in combination with external-beam radiation therapy (EBRT) for men with localized prostate cancer and unfavorable disease risk features (2–5). However, the selection of appropriate patients for combination therapy remains complicated by several factors. Notably, a growing body of data points to potential adverse health effects associated with AS use, including insulin resistance, decreased bone mineral density, risk of cardiovascular disease, and inferior patient-reported quality of life (6, 7).

Since 1996, consensus clinical guidelines from the National Comprehensive Cancer Network (NCCN) have recommended combination therapy with AS and EBRT as a treatment option for men with high-risk prostate cancer, but the guidelines did not support AS use in patients in lower risk categories until 2009, when the use of AS with EBRT was added as a treatment option for men with intermediate-risk prostate cancer (8). Given the potential for adverse effects and the significant economic costs associated with AS use, it is important to analyze patterns of practice at the population level to understand how available scientific evidence and clinical guidelines are being applied by practitioners.

Prior studies analyzing practice patterns of AS use in localized prostate cancer have included men undergoing radical prostatectomy or primary AS and have not stratified patients by prostate cancer disease risk categories as defined by the validated risk stratification models commonly used in clinical practice (9–11). We undertook this study to describe practice patterns associated with AS use that were stratified by risk group in patients undergoing EBRT for localized prostate cancer in a population-based cohort.

Methods and Materials

Study design

We conducted a retrospective, observational cohort study to examine practice patterns associated with AS use in patients undergoing EBRT for localized prostate cancer. This study was approved by the institutional review board of the University of Pennsylvania.

Data source

The study used registry and administrative claims data from the Surveillance, Epidemiology, and End Results (SEER)-Medicare database. The SEER program collects information regarding incident cancer cases in registries that constitute approximately 26% of the United States population. Approximately 94% of patients in SEER aged ≥ 65 years have been successfully linked to their Medicare claims data (12).

Cohort

Eligible patients included men aged ≥ 65 years who received diagnoses of prostate cancer between January 1, 2004, and December 31, 2005. The figure illustrates the definition of the cohort and reasons for exclusion. We allowed a 9-month interval for therapy assignment to ensure sufficient time for consultation with specialists and initiation of definitive therapy. We identified 8,120 men who received EBRT with or without AS, and we excluded 700 men who could not be classified by disease risk group (the primary risk stratification). Our final cohort included 2,184 low-risk, 2,339 intermediate-risk, and 2,897 high-risk patients with nonmetastatic prostate cancer.

Primary outcome

The primary outcome was the receipt of AS in conjunction with EBRT. Consistently with previous studies, AS was defined as either hormonal therapy (luteinizing hormone–releasing hormone (LHRH) agonist) or surgical castration via orchiectomy administered within 12 months of the initial diagnosis (13). This 12-month period allowed for neoadjuvant, concurrent, or adjuvant therapy. We identified AS use from Medicare claims on the basis of International Classification of Disease, Version 9 procedure codes 99.25 and 62.4; Current Procedural Terminology, version 4 codes 11980, 54520, 54522, 54530, 54535, and 54690; and Health Care Common Procedure Coding System codes J0970, J1000, J1051, J1380, J1950, J3315, J9170, J9202, J9217, J9218, J9219, and C9430 (14).

Other variables

Patient characteristics included age at diagnosis according to Medicare data, and race, ethnicity, and marital status according to SEER registry data. Clinical characteristics included clinical tumor stage (American Joint Committee on Cancer, 6th edition staging system), Gleason sum, prostate-specific antigen (PSA), and estimated comorbidity. Patient comorbidities were identified by classifying all available Medicare claims for the 12-month interval preceding prostate cancer diagnosis into 46 categories, based on the comorbidity measure described by Elixhauser *et al.* (15). For clarity, comorbidity is reported as the number (0, 1, 2) of the possible 46 comorbidity groups identified.

Beginning in 2004, SEER registries recorded individual patient Gleason sum and PSA values as Collaborative Staging Site-Specific Factors 1–6 (SSF). Gleason sum (SSF6) is obtained from the pathology report and includes both primary and secondary patterns of disease. The PSA value (SSF1) reports the highest PSA value (ng/mL) in the medical record before diagnostic biopsy or therapy.

Demographic characteristics included diagnosis year, SEER registry, and county or metropolitan area population. Because individual-level socioeconomic data are not available in either the SEER or the Medicare records, we used census tract median household income as a proxy for individual socioeconomic status. For approximately 6% of cases where the census tract of residence was unavailable, we used zip code–level data.

Disease risk grouping

We examined AS use by disease risk group because the recommendations and evidence for AS vary substantially between low-risk, intermediate-risk, and high-risk patients (Table 1). We classified patients according to 2004/2005 NCCN criteria with minor modifications as follows: low risk (PSA ≤ 10 ng/mL, Gleason sum ≤ 7 , T1–2), intermediate risk (PSA 10.1–20 ng/mL or Gleason sum 7, T1–2), and high risk (PSA > 20 ng/mL, Gleason sum > 7 , T3–4). These disease risk groups were modified from NCCN criteria because T2 substages a, b, and c are not reliably ascertained from SEER staging data. Therefore, T1–T2 was classified as either low or intermediate risk, depending on the appropriate PSA and Gleason sum.

Additionally, we categorized patients with T3b–T4 disease as high risk rather than very high risk as in the NCCN guidelines.

Statistical analysis

We measured the proportion of AS use among patients undergoing EBRT for nonmetastatic prostate cancer stratified by disease risk group. Within each disease risk group, we calculated the proportion of AS use by dividing the number of patients who received EBRT + AS (numerator) by the total number of patients receiving EBRT (denominator). We calculated frequencies and proportions of patient, clinical, and demographic factors stratified by prostate cancer risk group. We performed univariate and multivariate logistic regression to evaluate the association of patient, clinical, and demographic variables with AS use. In sensitivity analysis, we also examined the 700 patients who could not be classified by disease risk group and observed patterns qualitatively consistent with our overall findings (data not shown). Statistical analysis was performed using SAS version 9.2 (Cary, NC). Statistical significance was set at 0.05, and all tests were two-tailed.

Results

AS use in men with low-risk disease

In the low-risk disease group, 32.2% of men received AS combined with EBRT. Age, American Joint Committee on Cancer clinical T stage, and SEER registry were associated with AS use (Table 2). After adjustment for patient, clinical, and demographic factors, men with T2 disease had higher rates of AS than did those with T1 disease (38% vs. 29%; odds ratio [OR] 1.60; 95% confidence interval [CI], 1.31–1.96; $p < 0.001$). Men aged >75 had higher rates of AS than did those aged 65–74 (36% vs. 30%; OR 1.28; 95% CI, 1.05–1.56; $p = 0.014$). We observed substantial variation in AS use for low-risk patients among the 16 SEER registries, ranging from 14% in Detroit to 48% in Kentucky. There was also a significant decline in use of AS among low-risk patients from 2004 to 2005 (35% vs. 29%; OR 0.76; 95% CI, 0.63–0.92; $p = 0.005$).

AS use in men with intermediate-risk disease

Within the intermediate-risk disease group, 56.3% of patients received AS combined with EBRT. Age, Gleason sum, and marital status were associated with AS use (Table 3). After adjustment for patient, clinical, and demographic factors, men with Gleason sum 7 (4 + 3) were more likely to receive AS than were men with Gleason sum 2–6 (65% vs. 51%; OR 1.88; 95% CI, 1.39–2.33; $p < 0.001$). By contrast, men with Gleason sum 7 (3 + 4) were not significantly more likely to receive AS than were those with Gleason sum 2–6 (55% vs. 51%; OR 1.20; 95% CI, 0.96–1.48; $p = 0.105$). Men aged ≥ 75 years were more likely to receive AS than were those aged 65–74 (59% vs. 54%; OR 1.24; 95% CI, 1.04–1.47; $p = 0.017$). AS use among intermediate-risk patients declined between 2004 and 2005 (58% vs. 55%; OR 0.82; 95% CI, 0.69–0.98; $p = 0.025$).

AS use in men with high-risk disease

In men with high-risk disease, 81.5% of patients received AS combined with EBRT. Clinical stage, Gleason sum, and comorbidity were associated with AS use (Table 4). After adjustment for patient, clinical, and demographic factors, men with T3 disease were more likely to receive AS than were those with T1–2 disease (88% vs. 81%; OR 1.86; 95% CI, 1.24–2.79, $p = 0.003$). Men with Gleason sum ≥ 8 histologic characteristics were more likely to receive AS than were those with Gleason sum ≤ 7 . In addition, men with a comorbidity score ≥ 2 were more likely to receive AS than were those with no comorbidity (82% vs. 76%; OR 1.58; 95% CI, 1.18–2.11; $p = 0.002$). PSA elevation (> 20 ng/mL) was not found to

be predictive of AS use. We also observed a significant decline in AS use for high-risk patients from 2004 to 2005 (84% vs. 78%; OR 0.70; 95% CI, 0.57–0.86; $p = 0.001$).

Discussion

We undertook this study to evaluate practice patterns associated with AS use in men undergoing EBRT for localized prostate cancer using a recent population-based cohort. We found that adherence to clinical guidelines with respect to use of AS varied substantially across all disease risk categories. Our results suggest overuse of AS among men within the low-risk disease category, in which approximately one third of men received AS without supporting evidence. Approximately one half of men with intermediate-risk disease received AS, which remains an area of current controversy. Finally, there was underuse of AS within the high-risk disease category, in which nearly one fifth of men did not receive AS despite evidence showing an overall survival benefit when AS is combined with EBRT.

Our results are consistent with the findings of other investigators that suggest overuse of AS, particularly with LHRH agonists, among men with low-grade nonmetastatic prostate cancer (9–11). Our study extends these findings by examining patterns of AS use specifically in combination with EBRT and by disease risk category. A prior analysis using SEER-Medicare data found that the overall use of LHRH agonists among patients diagnosed with prostate cancer increased nearly fourfold between 1991 and 1999, whereas the use of LHRH agonists among patients over the age of 80 with localized, low-grade prostate cancer increased by a factor of eight (9).

Several studies have suggested that financial incentives may have a significant influence on patterns of AS use (10, 11). Medicare expenditures for the use of LHRH agonists peaked in 2003 at nearly \$1 billion, making it one of the most commonly prescribed physician-administered medications. In some cases, the administration of LHRH agonists constituted up to 40% of total urologic practice revenue. However, reimbursement policy for injectable drugs underwent a significant change after the passage of the Medicare Prescription Drug, Improvement and Modernization Act in 2003, which was associated with a reduction in Medicare reimbursement for LHRH agonists by approximately 50% (16). A recent study reported a significant decline in the inappropriate use of AS between 2003 and 2005, which the authors defined as primary AS therapy for men with localized prostate cancer of low to moderate grade (10). Consistent with those findings, we observed a small decline in the use of AS with EBRT between 2004 and 2005 in men within the low-risk disease category, although the absolute rate of AS in this group remained substantial.

Appropriate use of AS for men with intermediate risk disease undergoing EBRT remains controversial. We found that 56.3% of men with intermediate-risk disease received combination therapy with AS, indicating that there may be insufficient evidence to guide treatment decisions for these patients. A randomized trial by D'Amico and colleagues demonstrated an improvement in 5-year overall survival (88% vs. 78%, $p = 0.04$) with the addition of 6 months of AS to EBRT for men with unfavorable disease risk features (4). Approximately 57% of the patients enrolled in this trial had intermediate-risk disease by NCCN criteria (17). The results from this trial were first published in August 2004, which may help explain the frequent use of AS in men within the intermediate-risk disease category. However, the NCCN guidelines did not recommend AS for men with intermediate-risk disease until 2009 (8). Our results showed lower rates of AS use with EBRT for intermediate-risk patients in 2005 than in 2004. This may indicate that the results of the trial by D'Amico *et al.* (4) had not yet been incorporated into widespread clinical practice. Alternatively, any increased use of AS resulting from this publication may have been counterbalanced by deterrents to AS use including lower Medicare reimbursement

during the same time period. To our knowledge, currently there are no prospective randomized data that examine the use of AS exclusively in men with intermediate-risk disease, and the selection criteria for patients most likely to benefit from AS remain to be defined. This clinical question is being further investigated in the currently accruing Radiation Therapy Oncology Group Trial 0815, and our findings underscore the importance of this trial.

Among men with high-risk disease undergoing EBRT, the great majority of patients received AS, which is consistent with Level I evidence and consensus guidelines supporting its use. Published results from the European Organisation for Research and Treatment of Cancer Trial 22863 demonstrated an improvement in 5-year overall survival (78% vs. 62%, $p = 0.0002$) associated with the addition of 3 years of AS combined with EBRT in comparison with EBRT alone for men with locally advanced or high-grade prostate cancer (2). The most recent results from the Radiation Therapy Oncology Group Trial 85-31 reported an overall survival benefit at 10 years (49% vs. 39%, $p = 0.002$) associated with the addition of AS continued indefinitely after EBRT for men with extraprostatic disease or lymph node involvement (5). Although 18.5% of men with high-risk disease did not receive AS with EBRT, individual physician or patient preferences, perhaps related to the desire to avoid the potential side effects of AS, may have contributed to the decision to withhold AS. A more troubling finding is the significant decline in use of AS among high-risk patients between 2004 and 2005. This change is consistent with declines in the overall use of AS observed during the time period after changes in Medicare reimbursement policy (11). However, these findings suggest that reductions in reimbursement may have discouraged the use of AS in patients for whom there was Level I evidence supporting its use.

Within all three disease risk categories, men aged ≥ 75 years or with elevated comorbidity were more likely to receive AS with EBRT. The reasons underlying these associations are uncertain, although it is possible that among men with comorbid disease, our findings reflect in part the propensity for patients with more comorbidities to have more frequent health care visits and associated procedures (18). These findings are particularly concerning, given the potential for adverse health effects associated with AS use. A retrospective analysis of the randomized trial conducted by D'Amico *et al.* indicates that patient comorbidity significantly attenuates the potential survival benefit associated with AS for patients with unfavorable disease risk features undergoing EBRT (19). In contrast, long-term follow-up data from randomized trials combining AS with EBRT have not demonstrated an increased risk of death due to cardiovascular disease among men receiving AS (20). Although the subject remains controversial, our results suggest that more attention to the potential adverse features of AS among older patients and those with comorbid disease may be required in making decisions about appropriate AS.

Our study has several limitations. First, our study included only patients diagnosed between January 1, 2004, and December 31, 2005 (the latest SEER-Medicare data available) to allow for stratification by disease risk category using SEER variables. The time period of our study overlaps with the enactment of the Medicare Prescription Drug, Improvement and Modernization Act between 2003 and 2005, and we do not have information about how practice patterns may have changed since 2005. In addition, we did not assess the duration of AS. The optimal duration of AS remains controversial, and the practice patterns of AS duration have not been well described. Third, although our results identify important examples of overuse and underuse of medical therapy, limited conclusions may be drawn with respect to the reasons for the existence of observed practice patterns. For example, some individuals with low-risk disease may receive a short course of AS for cytoreduction before undergoing EBRT. However, this seems unlikely to account for the majority of AS use in this patient group.

In conclusion, our study describes recent practice patterns of AS use with EBRT for patients stratified by prostate cancer disease risk category. We found that a significant proportion of men received AS with EBRT despite a lack of evidence or clinical guidelines supporting its use. Conversely, almost one fifth of men with high-risk disease did not receive AS. Our findings highlight the need for clinician and patient education regarding the appropriate use of AS. There is wide variance in the frequency of AS administration for men within the intermediate-risk disease category, which suggests a lack of sufficient evidence to guide clinical decision making. Temporal analyses regarding the patterns of AS use will remain important to enable an understanding of how available evidence and clinical guidelines are being applied by the majority of practitioners. These data may help identify important areas for intervention with the goal of improving health care quality and outcomes.

Acknowledgments

This study used the linked Surveillance, Epidemiology, and End Results (SEER)–Medicare database. The authors acknowledge the efforts of the Applied Research Program, National Cancer Institute (NCI), the Office of Research, Development and Information, Centers for Medicare & Medicaid Services (CMS), Information Management Services (IMS), Inc., and the SEER Program tumor registries in the creation of the SEER–Medicare database.

Supported in part by Grant #IRG-78-002-29 from the American Cancer Society.

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Fig. 1.
Definition of the study cohort. AJCC = American Joint Committee on Cancer; HMO = health maintenance organization.

Table 1

NCCN guidelines for initial treatment of prostate cancer

Disease category	Risk group definition	2004 guidelines*
Low risk	T1–T2a Gleason sum 2–6 PSA <10 ng/mL	Expectant management or radiation therapy (EBRT or brachytherapy) or radical prostatectomy
Intermediate risk	T2b–T2c Gleason sum 7 PSA 10–20 ng/mL	Expectant management or radiation therapy (EBRT +/- brachytherapy) or radical prostatectomy +/- pelvic lymph node dissection
High risk *Patients with multiple adverse factors may be shifted into the next higher risk group	T3a Gleason sum 8–10 PSA >20 ng/mL	EBRT + androgen ablation (2–3 years) or EBRT + concurrent short-term androgen ablation (selected patient with single adverse risk feature) or radical prostatectomy + pelvic lymph node dissection
Very high risk	T3b–T4	Androgen ablation or EBRT + androgen ablation

Abbreviations: NCCN = National Comprehensive Cancer Network; EBRT = external-beam radiation therapy; PSA = prostate-specific antigen.

* NCCN guidelines for initial therapy remained stable between 2004 and 2005 except for a note in the 2005 guidelines that pelvic lymph node dissection should be performed for men with intermediate-risk disease undergoing radical prostatectomy unless the predicted risk of lymph node metastases was <3%.

Table 2

Adjusted odds ratio of a patient's receiving AS with EBRT for low-risk disease

Characteristic	n	% receiving AS + EBRT	Adjusted OR ^a (95% CI)
Men with low-risk disease	2,184	32.2%	
Clinical characteristics			
Clinical stage			
T1	1,416	29.0%	Reference
T2	762	38.4%	1.60 (1.31–1.96) [‡]
PSA			
0.1–5.0 ng/mL	778	30.7%	Reference
5.1–10.0 ng/mL	1,406	33.0%	1.22 (0.99–1.49)
Gleason sum			
2–5	106	45.2%	Reference
6	2,078	31.5%	0.69 (0.45–1.04)
Comorbidity			
0	289	28.4%	Reference
1	518	32.2%	1.16 (0.83–1.62)
2	1,377	32.9%	1.15 (0.86–1.55)
Patient characteristics			
Age at diagnosis (y)			
65–74	1,398	29.8%	Reference
75	786	36.3%	1.28 (1.05–1.56) [‡]
Race			
White	1,852	32.8%	Reference
Black	213	28.1%	0.88 (0.61–1.25)
Other	83	32.5%	1.20 (0.68–2.12)
Unknown	36	§	1.85 (0.53–6.43)
Marital status			
Married	1,616	32.4%	Reference
Not married	394	31.2%	0.91 (0.71–1.17)
Unknown	174	32.2%	1.27 (0.87–1.86)
Demographic characteristics			
Year of diagnosis			
2004	390	35.0%	Reference
2005	313	29.0%	0.76 (0.63–0.92) [‡]
Median income (\$, thousands)			
34	476	39.1%	Reference
35–44	425	29.4%	0.75 (0.55–1.02)
45–59	568	28.9%	0.80 (0.59–1.08)
60	715	31.9%	0.91 (0.66–1.26)
Size of county (thousands)			

Characteristic	<i>n</i>	% receiving AS + EBRT	Adjusted OR* (95% CI)
>1 Million	1,261	31.8%	Reference
250K–1 million	416	26.2%	0.67 (0.50–0.91) [†]
<250 K	500	38.6%	1.21 (0.87–1.66)
SEER registry			
San Francisco–Oakland	46	§	Reference
Connecticut	150	28.0%	3.83 (1.53–9.59) [†]
Utah	18	§	0.45 (0.05–4.12)
Seattle	83	22.9%	1.84 (0.69–4.93)
Los Angeles	189	36.0%	3.51 (1.46–8.41) [†]
Atlanta	29	§	2.74 (0.85–8.84)
San Jose–Monterey	34	35.3%	4.42 (1.46–13.42) [†]
New Mexico	60	§	0.69 (0.21–2.25)
Detroit	198	13.6%	1.12 (0.44–2.84)
Iowa	130	33.1%	3.15 (1.22–8.11) [†]
Hawaii	31	§	2.99 (0.86–10.43)
Kentucky	157	47.8%	5.97 (2.40–14.86) [†]
Louisiana	130	46.9%	5.62 (2.22–14.27) [†]
New Jersey	470	41.7%	5.40 (2.32–12.53)

Abbreviations: OR = odds ratio; CI = confidence interval; AS = androgen suppression; EBRT = external-beam radiotherapy; PSA = prostate-specific antigen.

* Odds ratio adjusted for all clinical, patient, and demographic characteristics.

[†] $p < 0.05$.

[‡] $p < 0.001$.

[§] Number suppressed because of SEER-Medicare confidentiality restrictions (cell size less than 11).

Table 3

Adjusted odds ratio of a patient's receiving AS + EBRT for intermediate-risk disease

Characteristic	n	% receiving AS + EBRT	Adjusted OR* (95% CI)
Men with intermediate-risk disease	2,339	56.3%	
Clinical characteristics			
Clinical stage			
T1	1,287	53.7%	Reference
T2	1,052	59.4%	1.24 (1.04–1.48) [†]
Gleason sum			
2–6	534	50.7%	Reference
7 (3 + 4)	1,222	54.5%	1.20 (0.96–1.48)
7 (4 + 3)	534	64.6%	1.80 (1.39–2.33) [‡]
7 (5 + 2)	49	69.4%	2.22 (1.16–4.26) [†]
Comorbidity			
0	293	53.6%	Reference
1	544	56.4%	1.15 (0.85–1.54)
2	1,502	56.7%	1.12 (0.86–1.46)
Patient characteristics			
Age at diagnosis (y)			
65–74	1,242	54.2%	Reference
75	1,097	58.6%	1.24 (1.04–1.47) [†]
Race			
White	1,940	56.8%	Reference
Black	229	54.2%	0.96 (0.70–1.32)
Other	134	57.5%	1.01 (0.66–1.56)
Unknown	36	38.9%	0.27 (0.10–0.75) [†]
Marital status			
Married	1,691	56.3%	Reference
Not married	457	60.8%	1.32 (1.06–1.65) [†]
Unknown	191	45.0%	0.74 (0.53–1.04)
Demographic characteristics			
Year of diagnosis			
2004	691	58.0%	Reference
2005	625	55%	0.82 (0.69–0.98) [†]
Median income (\$, thousands)			
34	569	59.2%	Reference
35–44	457	58.4%	0.97 (0.74–1.28)
45–59	552	56.5%	1.03 (0.78–1.36)
60	761	52.6%	0.80 (0.60–1.06)
Size of county (thousands)			

Characteristic	<i>n</i>	% receiving AS + EBRT	Adjusted OR* (95% CI)
>1 million	1,314	53.7%	Reference
250 K–1 million	474	54.9%	0.82 (0.62–1.07)
<250 K	551	63.5%	1.32 (0.98–1.78)
SEER registry			
San Francisco–Oakland	73	52.1%	Reference
Connecticut	214	63.1%	1.98 (1.11–3.52) [†]
Utah	18	[§]	0.81 (0.27–2.44)
Seattle	107	41.1%	0.56 (0.30–1.04)
Los Angeles	216	62.0%	1.67 (0.97–2.88)
Atlanta	42	31.0%	0.44 (0.19–0.99) [†]
San Jose–Monterey	42	61.9%	1.86 (0.84–4.13)
New Mexico	55	54.5%	1.03 (0.48–2.22)
Detroit	229	39.3%	0.64 (0.37–1.10)
Iowa	156	66.0%	1.51 (0.79–2.86)
Hawaii	52	59.6%	1.48 (0.65–3.35)
Kentucky	154	63.0%	1.36 (0.73–2.52)
Louisiana	157	69.4%	1.88 (1.01–3.52) [†]
New Jersey	355	63.4%	1.77 (1.05–2.99) [†]

Abbreviations: OR = odds ratio; CI = confidence interval; AS = androgen suppression; EBRT = external-beam radiotherapy; PSA = prostate-specific antigen.

* Odds ratio adjusted for all clinical, patient, and demographic characteristics.

[†] $p < 0.05$.

[‡] $p < 0.001$.

[§] Number suppressed because of SEER-Medicare confidentiality restrictions (cell size less than 11).

Table 4

Adjusted odds ratio of a patient's receiving AS with EBRT for high-risk disease

Characteristic	<i>n</i>	% receiving AS + EBRT	Adjusted OR [‡] (95% CI)
Men with high-risk disease	2,897	81.5%	
Clinical characteristics			
Clinical stage			
T1 or T2	2,556	80.6%	Reference
T3	289	88.2%	1.86 (1.24–2.79) [‡]
T4	52	88.5%	1.43 (0.54–3.81)
PSA			
10 ng/mL	818	86.3%	Reference
10–20 ng/mL	1,033	78.1%	1.08 (0.78–1.48)
>20 ng/mL	878	79.5%	1.21 (0.87–1.68)
Gleason sum			
2–7	1,290	73.5%	Reference
8	936	85.5%	2.30 (1.73–3.06) [‡]
9	584	91.3%	3.93 (2.73–5.66) [‡]
10	71	91.5%	4.05 (1.56–10.51) [‡]
Comorbidity			
0	368	76.4%	Reference
1	615	82.0%	1.55 (1.11–2.17) [‡]
2	1,914	82.3%	1.58 (1.18–2.11) [‡]
Patient characteristics			
Age at diagnosis (y)			
65–74	1,390	80.3%	Reference
75	1,507	82.6%	1.11 (0.90–1.36)
Race			
White	2,382	81.9%	Reference
Black	308	78.6%	1.14 (0.80–1.63)
Other	165	81.2%	0.94 (0.57–1.53)
Unknown	57	84.2%	0.35 (0.08–1.57)
Marital status			
Married	2,043	81.4%	Reference
Not married	647	81.8%	1.02 (0.80–1.31)
Unknown	207	81.6%	1.06 (0.69–1.62)
Demographic characteristics			
Year of diagnosis			
2004	1,304	84.0%	Reference
2005	1,057	78.0%	0.69 (0.57–0.83) [‡]
Median income (\$, thousands)			

Characteristic	<i>n</i>	% receiving AS + EBRT	Adjusted OR* (95% CI)
34	785	79.2%	Reference
35–44	566	81.6%	1.16 (0.85–1.57)
45–59	685	83.5%	1.42 (1.03–1.96) [†]
60	861	81.9%	1.18 (0.92–1.76)
Size of county (thousands)			
>1 million	1,559	80.4%	Reference
250 K–1 million	561	81.5%	0.89 (0.64–1.23)
<250 K	777	83.7%	1.30 (0.92–1.83)
SEER registry			
San Francisco–Oakland	92	78.3%	Reference
Connecticut	298	84.2%	1.51 (0.79–2.91)
Utah	42	83.3%	1.38 (0.46–4.14)
Seattle	147	83.6%	1.23 (0.60–2.53)
Los Angeles	220	82.2%	1.30 (0.69–2.47)
Atlanta	48	66.6%	0.53 (0.23–1.22)
San Jose–Monterey	54	90.7%	2.50 (0.84–7.42)
New Mexico	71	63.4%	0.53 (0.24–1.18)
Detroit	269	73.9%	0.73 (0.40–1.36)
Iowa	88	68.2%	1.78 (0.84–3.77)
Hawaii	70	85.7%	2.04 (0.79–5.24)
Kentucky	221	81.9%	1.45 (0.73–2.88)
Louisiana	199	87.4%	2.11 (1.01–4.41) [†]
New Jersey	431	82.8%	1.37 (0.76–2.48)

Abbreviations: OR = odds ratio; CI = confidence interval; AS = androgen suppression; EBRT = external-beam radiotherapy; PSA = prostate-specific antigen.

* Odds ratio adjusted for all clinical, patient, and demographic characteristics.

[†] $p < 0.05$.

[‡] $p < 0.001$.