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Am J Clin Oncol. Author manuscript; available in PMC 2019 October 17.

Published in final edited form as:

Am J Clin Oncol. 2018 November ; 41(11): 1076–1082. doi:10.1097/COC.0000000000000442.

The role of provider characteristics in the selection of surgery or radiation for localized prostate cancer and association with quality of care indicators

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Abstract

Introduction—We sought to identify the role of provider and facility characteristics in receipt of radical prostatectomy (RP) or external beam radiation therapy (EBRT) and adherence to quality of care measures in men with localized prostate cancer (PCa)

Materials and Methods—Subjects included 2861 and 1630 men treated with RP or EBRT respectively for localized PCa whose records were re-abstracted as part of the Centers for Disease Control and Prevention Breast and Prostate Patterns of Care Study. We utilized multivariable generalized estimating equation (GEE) regression analysis to assess patient, clinical, and provider (year of graduation, urologist density) and facility (group vs. solo, academic/teaching status, for-profit status, distance to treatment facility) characteristics that predicted use of RP versus EBRT as well as quality of care outcomes.

Results—Multivariable analysis revealed that Group (vs. solo) practice was associated with a decreased risk of RP (odds ratio [OR]: 0.47, 95% confidence interval [CI]: 0.25-0.91). Among RP patients with low risk disease, receipt of a bone scan that was not recommended was significantly predicted by race and insurance status. Surgical quality of care measures were associated with physician's year of graduation and receiving care at a teaching facility.

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Conclusions—In addition to demographic factors, we found that provider and facility characteristics were associated with treatment choice and specific quality of care measures. Long term follow-up is required to determine if quality of care indicators are related to prostate cancer outcomes.

Keywords

Prostate Cancer; Radical Prostatectomy; External Beam Radiation Therapy; Patterns of Care; Quality of Care

Introduction

Radical Prostatectomy (RP) and External Beam Radiation Therapy (EBRT) are the dominant forms of definitive treatment for localized Prostate Cancer (PCa)[1–4]. Given limitations of randomized controlled trials showing a clear oncological benefit to a particular treatment, there is significant variation in definitive treatment selection which is influenced by socio-demographic, clinical and tumor-risk characteristics as well as geographic location[3,5–7]. This variation in the use of RP or EBRT also reflects preference-sensitive decision making, wherein patient and the provider's preferences strongly influence treatment choice[5,8–10]. Other factors influencing treatment choice are unknown. One study found that unexplained patient and clinician factors accounted for 70% of the unmeasured variation[2,11–13]. Characteristics of the provider such as date of graduation and academic affiliation of the treatment facility have been shown to influence practice patterns[2,14]. There is a need to better understand the contribution of these and other provider/facility level factors such as the practice characteristics (group vs. solo) and ownership of facility (government vs for-profit) on treatment selection[2,3,6,15].

In addition to treatment choice, provider level variables may also affect quality of care received. There has been a nation-wide effort over the past two decades to establish and assess quality of PCa care benchmarks[6–8,10,16]. Application of the Donabedian model[3,7,9,17] to consider structures, processes and outcomes in PCa care has yielded RAND (Research and Development Corporation), National Quality Forum (NQF) endorsed quality indicators, such as avoiding bone scans in staging low-risk PCa[2,8,9,11]. There is significant variation in the adherence to such measures[12,13,18] and it is unclear whether and to what extent provider/facility level factors may impact quality of PCa care.

The primary objective of this study was to assess the association of provider and facility level characteristics (in addition to demographic and clinical determinants) on use of RP versus EBRT for patients with localized PCa. The secondary objective was to assess the influence of provider/facility characteristics on adherence to quality of care metrics for the treatment of PCa.

Materials and Methods

The CDC POC-BP Cohort

This analysis utilized the CDC Breast and Prostate Cancer Patterns of Care Study (CDC-POC-BP) cohort which included re-abstraction (in 2007–2009) of medical records and

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external linkages with provider databases for men with histologically confirmed Prostate Cancer (PCa) diagnosed in 2004 in seven NPCR registries (Georgia, Louisiana, California, Minnesota, Kentucky, North Carolina and Wisconsin). Sampling methodology for random selection of cases by race/ethnicity, registry, and facility characteristics has been previously described[5,14,19,20]. Treatment related variables for these cases were verified and supplemented by re-abstracting hospital records in addition to obtaining treatment information from physicians' offices, ambulatory surgical centers, radiation treatment facilities, and long term care facilities for some cases.

We restricted our analysis to patients with localized PCa who received definitive initial treatment (RP or EBRT) within 6-months of pathology-confirmed diagnosis, accounting for 57% of the CDC-POC-BP cohort (those receiving RP followed by adjuvant or salvage EBRT [n=108], were excluded). EBRT included either 3D Conformal Radiation Therapy (CRT) or Intensity Modulated Radiation Therapy (IMRT) and external radiation with unspecified modality. RP included both open and minimally invasive surgical approaches (but the specific type of surgery received was not specified in the data abstracted). We focused only on men receiving either of these two most common forms of definitive therapy and excluded those treated with brachytherapy, either alone or in combination with EBRT (due to the different clinical indications for treatment between brachytherapy and RP or EBRT alone in this time period). We also excluded those initially receiving conservative therapy (active surveillance, expectant management, or primary androgen deprivation therapy). Finally, we excluded 33 patients who died within 6 months after diagnosis with no record of treatment, 239 patients that underwent cryo- or non-radical prostate surgery as well as 273 patients with missing information on AJCC Stage, PSA and/or Gleason Score. After these exclusions our analytic sample consisted of 4491 cases (2861 that were treated with RP and 1630 that were treated with EBRT).

Patient Covariates

Categories used for each covariate are shown in Table 1. Demographic covariates included age at diagnosis, Race/ethnicity, marital status and insurance status. Additionally, the 2000 U.S. Census tract-specific data based on the patient's residence location at diagnosis was used to categorize level of urbanization and socio-economic status (based on poverty level and educational ascertainment[15,21,22]). The registry location of the patient was categorized as A to G. Patient comorbidity severity was determined using the Adult Comorbidity Evaluation 27 (ACE-27), a validated chart-based comorbidity instrument[1–4]. Recurrence risk groups were defined according to the National Comprehensive Cancer Network (NCCN) guidelines for PCa (ver. 1.2002), which utilizes a combination of clinical T stage (AJCC, American Joint Committee on Cancer Clinical Staging System, 6th Ed.), Gleason Score from trans-rectal ultrasound guided biopsy and prostate specific antigen (PSA) level. The definitions of the risk groups are: Low (T1–2a AND Gleason Score ≤ 6 AND PSA < 10 ng/mL), Intermediate (T2b-T2c OR Gleason Score 7 OR PSA 10–20 ng/mL) and High (≥ T3a OR Gleason Score 8–10 OR PSA > 20 ng/mL).

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Provider and facility characteristics

Provider (the physician whom diagnosed the malignancy) and facility characteristics were linked to patients using external information sources that were available for 2004. Provider year of graduation from medical school (categorized by decade starting from 1950 to 1990) and type of practice (solo vs. group) was obtained for the treatment year from the Medicare Physician Identification and Eligibility Registry (MPIER) File, maintained by the US Centers for Medicare and Medicaid Services as previously described[3,5–7]. Facility ownership (for profit versus non-profit/government funded) and facility teaching status (based on the presence of post-graduate medical training) corresponding to the treatment year were determined from the American Hospital Directory (AHD), which includes data from the Graduate Medical Education Database (American Medical Association, Chicago, Illinois). The distance (miles) from the primary treatment (surgery or radiation) facility for each patient was determined by the great circle distance and was categorized by quartiles (<5, 5–9, 10–14 and 15+ miles). County level population estimates of males in 2004 from SEER and number of urologists obtained from the Area Resource File were used to calculate urologist density per 100,000 men as previously described[5,8–10]. Based on quintiles of the residential distribution of patients, ratio-cut points were 0, >0–5.6, >5.6–6.8, >6.8–10.6 and >10.6–26.0 urologists/100,000 men.

Quality of Care Measures

We utilized two quality of care indicators from the RAND consensus method and the Physician Consortium for Performance Improvement (PCPI) that are endorsed by the American Urological Association (AUA) and could be assessed from variables available from the CDC-POC-BP cohort[2,11–13]. These included 1) receiving a staging bone scan that is not recommended for patients with NCCN low-risk PCa and 2) receipt of concomitant androgen deprivation therapy (ADT) in those undergoing EBRT for NCCN high-risk PCa[2,14]. Additionally, we also considered surgical quality of care in those treated by RP, including 1) receipt of pelvic lymph node dissection (PLND) in patients with NCCN intermediate or high risk PCa at the time of RP[2,3,6,15] and 2) achieving negative surgical margins in patients with pathologic T2 disease.

Statistical Analysis

The data were analyzed using SAS software (Proc Genmod). Weights were calculated by the inverse of the sampling fractions used by each registry for each sampling stratum to represent the source population. Unadjusted associations between initial treatment (RP or EBRT) and socio-demographic, location, patient comorbidity, NCCN risk group, provider characteristics and patient distance to provider variables were assessed by chi-square tests. We utilized multivariable generalized estimating equation (GEE) models with a logit link to account for correlation in outcomes based on treatment facility. This analysis was performed on a subset of patients (n=3875) in whom facility level information was available. Physician identifiers were not available in our cohort to adjust for correlation at this level. We included variables that showed associations in unadjusted analyses ($p < 0.1$) and/or those deemed *a priori* to be clinically important. The final model to determine predictors of RP (versus EBRT) included age, race/ethnicity, SES, insurance, registry, ACE-27 comorbidity severity,

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NCCN risk group, provider's medical school graduation date, practice type (solo vs. group), facility ownership, teaching status of facility, distance to treatment facility and regional urologist density. One registry (labeled as 'E') did not contribute data on provider characteristics and was excluded from the final model.

Additionally, 4 separate GEE models with each of the quality of care measures as the outcome variable were constructed to determine the association between patient and provider/facility characteristics with these outcome measures. Variable selection for each of these models was based on the same technique for assessing predictors of definitive treatment modality. Race/ethnicity was retained in all models as there is potential evidence that race impacts multiple measures of quality of surgical care, and specifically the utilization of pelvic lymph node dissection (PLND)[6–8,10,16]. As we were specifically interested in the association of provider and facility level variables on quality of care measures, all these variables were included in all models.

Results

Treatment received

A total of 2861 (66.2% based on weighed percentages) men underwent RP while 1630 (33.8%)were treated by EBRT. The breakdown of EBRT by treatment modality included IMRT, 3D-CRT and unspecified external beam treatment in 548 (33.6%), 102 (6.3%) and 980 (60.1%) patients, respectively. The characteristics of patients receiving RP or EBRT as initial treatment are summarized in Table 1. In comparison to those receiving EBRT, younger patients were more likely to receive RP than older patients (e.g. 88.9% of those <60 had a RP compared to 11.3% of those 75+). Black patients and those with lower SES were less likely to receive RP compared to those in other racial/ethnic groups or in higher SES groups. There was evidence of significant variation in the utilization of RP between registries, ranging from 56.3% to 76.0%. Patients with no medical comorbidities were more likely to receiving RP compared to those with comorbidities of any severity (e.g. 76.0% of those with no comorbidities had a RP compared to 53.5% of those with severe comorbidities). Likewise, men with in the low NCCN risk group were more likely to receive RP compared to those in the high risk group (71.8% vs. 47.5%). There were statistically significant differences in provider and facility characteristics for patients receiving RP vs. EBRT (Table 2). Specifically, those who received care from a for-profit facility (vs. non-profit) as well as those seen at a hospital that had a teaching designation (vs. non-teaching) were more likely to receive a RP.

GEE regression analysis (used to account for the effect of multiple patients linked to a facility) was utilized to assess the association of patient and provider/facility characteristics with the receipt of RP versus EBRT (Table 3, n=2953 used in model, after exclusion of cases with missing values). Demographic factors were related to treatment choice. Older age (adjusted OR: 0.07, 95% CI: 0.05–0.11 for 70–74 vs < 60), as well as Black race versus White (OR: 0.47, 95% CI: 0.30–0.73), and being single vs. married (0.72, 95% CI 0.54–0.98) were associated with a decreased risk of receiving RP. Clinical factors including greater severity of comorbidities (vs. none) and high NCCN risk group (vs. low) were also associated with lower risk of having a RP. High versus low SES was associated with an

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increased risk of receiving RP as was residing in an urban setting vs rural. Among the provider/facility variables, group versus solo practice (OR: 0.47, 95% CI: 0.25–0.91) was associated with a decreased risk of RP. Although not statistically significant after accounting for clustering by facility, there was a decreased risk for receiving a RP at a teaching facility (vs. non-teaching), and an increased risk of RP if seen at a for profit facility (vs. non-profit/government facility).

Quality of Care measures

A total of 1455 (of 1575) NCCN low-risk prostate cancer patients had information available on receipt of bone scan. There were 444 patients (30.5%) who received a bone scan that was not recommended and the GEE regression model that identified predictors of this are shown in Table 4. Compared to Whites, Blacks (OR: 1.80, 95% CI: 1.00–3.25) and API/AI/AN's (OR: 2.76, 95% CI: 1.16–6.56) had an increased risk of receiving a bone scan that was not recommended. Medicaid insured patients (OR: 2.78, 95% CI: 1.24–6.26) also had an increased risk of a bone scan that was not recommended. While none of the facility variables were significantly associated with the use of bone scans, there was an increased risk of receiving an bone scan that was not recommended in areas with a higher density of urologists.

Surgical quality of care was assessed by identifying NCCN intermediate and high risk patients who appropriately received pelvic lymph node dissection at the time of RP (Supplementary Table 1, n = 1289 used in model). A total of 77.3% of patients underwent appropriate PLND at the time of RP. Men aged 65–59 (vs. <60) and those in the highest NCCN risk group (vs. intermediate) were more likely to receive PLND. Contrary to expectations, more recent year of graduation of the Urologist was associated with a decreased risk receiving appropriate PLND (Adj. OR: 0.36, 95% CI: 0.15–0.88 for 1990+ vs. 1950–1969) and RP performed at a teaching facility was associated with a decreased risk of receiving PLND (OR: 0.55, 95% CI: 0.34–0.90).

Surgical quality of care was also assessed by determining predictors of achieving a negative surgical margin in patients with organ confined (pathological T2) PCa (Supplementary Table 2, n=620 used in model). High versus low pre-operative NCCN risk was associated with a decreased risk of achieving a negative margin (OR: 0.32, 95% CI: 0.13–0.75). Further, higher urologist density was associated with increased risk of achieving a negative margin (OR: 3.30, 95% CI: 1.58–6.90 for 10.6–26 Urologist/100,000 Men vs. none).

Quality of care for radiation therapy (EBRT) was assessed by the concomitant prescription of ADT during treatment of NCCN-defined high risk PCa. The regression model was limited to 224 patients (after including those for whom outpatient records had been reviewed) and but did not converge.

Discussion

We found that that provider and facility characteristics influenced both the selection of initial treatment as well as measures of quality of care for the treatment of localized PCa after taking into account socio-demographic and clinical factors. Treatment choice for localized

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PCa is highly related to preferences of both patients and physicians. In addition, geographic location (including factors related to reimbursement and medico-legal climate), hospital factors (volume, expertise), access to care (both distance as well as information), tumor related risk, and patient factors (including comorbidities, baseline urinary and erectile function) will remain relevant in treatment selection[3,7,9,17]. While it is clear these factors are potentially important in treatment selection, we sought to additionally assess whether they may impact quality of care as well, which is also multi-factorial[2,8,9,11] Specifically, we found that the nature of the practice organization (group vs. solo) was related to the treatment selection, while higher regional urologist density was related to increased risk of receiving an inappropriate bone scan. Urological density, on the other hand was related to higher likelihood of achieving a negative surgical margin. Unexpectedly more recent year of graduation and being seen at a teaching facility were associated with lower receipt of PLND.

Our analysis identified that, while not significant based on our sample size, patients receiving care at for profit facilities had 80% increased likelihood of receiving RP over EBRT. The introduction of robotic assisted laparoscopic RP around this period, which is associated with increased costs may be correlated with this finding, although the cost-structure of some facilities does not make this procedure more expensive than traditional RP[12,13,18]. However, we were not able to determine the proportion of RPs that were robotic from our dataset. Importantly, the cost related to EBRT has significantly changed since 2004, particularly with the greater than 10-fold increased use of IMRT over CRT from 2001 to 2007[5,14,19,20]. IMRT is significantly more expensive[21] and therefore, the implications for patterns of care in the context of greater IMRT adoption over RP are unclear.

The implication that provider characteristics may influence quality of care, while of growing economic interest, requires ongoing follow-up to demonstrate possible influence on oncological outcome, given the paucity of evidence to support the tenet that improving quality of care always equates with improved outcomes[15,21,22]. We have previously assessed the CDC-POC-BP cohort with respect to NCCN guideline-concordance, which occurred for 80% of initial treatment[16,23]. However the guidelines for initial therapy are quite broad, and the literature would suggest that PCa quality of care is, however, not as homogenous and adherence is variable[2,13,24]. The use of bone scans in 30.5% of patients with low risk PCa confirms previously observed discordance with published guidelines[13,25]. Our analysis showed that a bone scan that was not recommended was more likely in Blacks treated for PCa, which is in contrast to other studies where Black race did not impact guideline-discordant bone scans[5,20,25,26].

The finding that lymph node dissection for intermediate and high NCCN risk PCa was performed less frequently by newly trained urologists and at teaching institutions is surprising. These results may in part be related to the start of robotic RP adoption in 2004 wherein PLND may have not been performed early in the learning curve and omitted due to technical complexity[21,27]. However we were unable to perform a sensitivity analysis in patients that received only robotic RP. These findings are in contrast to a recent study utilizing the National Cancer Data Base registry with a more contemporary cohort (2010–2011) which showed pelvic lymph node dissection was higher in academic and high-volume

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hospitals[1,6]. Interestingly, we did not identify any racial disparity in the receipt of PLND as previously reported[5,8].

This study has several limitations. The patterns of care captured in 2004 for localized PCa has changed over the past decade, with specifically increased utilization of active surveillance for those men with low risk disease[28]. More granular metrics would have been helpful to assess provider training and experience including, urologists' post graduate fellowship training, experience and volume. Further, although we utilized contemporary, nationally endorsed metrics of quality of care, these standards were not as widely accepted in 2004. Nonetheless, other studies have applied these quality of care metrics to SEER-Medicare linked cohorts diagnosed between 2001–2007[5,13]. Additionally, we were not able to measure the full spectrum of contemporary quality of care metrics in PCa[2,11,13,16].

Conclusions

Among those receiving definitive therapy, we found black race associated with a lower likelihood of receiving a RP while those in higher income areas were more likely to receive RP, possibly indicating issues with access to care or preference for EBRT. In addition to demographic and clinical factors, we identified provider and facility-level characteristics that were associated with the selection of RP over EBRT. These factors also appear to influence quality of care; however, follow-up is required to determine if quality of care indicators are related to prostate cancer outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Source of Funding: The Breast and Prostate Cancer Data Quality and Patterns of Care Study was supported by the Centers for Disease Control and Prevention through cooperative agreements with the California Cancer Registry (Public Health Institute) (1-U01-DP000260), Emory University (1-U01-DP000258), Louisiana State University Health Sciences Center (1-U01-DP000253), Minnesota Cancer Surveillance System (Minnesota Department of Health) (1-U01-DP000259), Medical College of Wisconsin (1-U01-DP000261), University of Kentucky (1-U01-DP000251), and Wake Forest University (1-U01-DP000264). The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Am J Clin Oncol. Author manuscript; available in PMC 2019 October 17.

Table 1

Socio-demographic, clinical and primary tumor characteristics of patients undergoing initial therapy by radical prostatectomy (RP) versus external beam radiation therapy (EBRT) for localized prostate cancer.

Variable		Total (%)[a]	Patients (n)[b]	RP (%)[c]	EBRT (%)[c]
Total		**100**	**13762 (4491)**	**66.2**	**33.8**
Registry (p < 0.0001 *)	**A**	25.3	3476 (859)	62.8	37.2
	B	14.2	1948 (834)	56.3	43.7
	C	8.2	1123 (309)	69.1	30.9
	D	8.7	1192 (786)	65.5	34.5
	E	11.9	1637 (505)	75.5	24.5
	F	19.8	2720 (610)	65.0	35.0
	G	12.1	1667 (588)	76.0	24.0
Age at Diagnosis (p < 0.0001 *)	**<60**	33.5	4609 (1520)	88.9	11.1
	60–64	20.3	2796 (927)	78.5	21.5
	65–69	20.9	2871 (952)	64.8	35.2
	70–74	15.2	2094 (661)	37.9	62.1
	75+	10.1	1392 (431)	11.3	88.7
Race/Ethnicity (p < 0.0001 *)	**White**	74.3	10220 (2654)	68.8	31.2
	Black	16.6	2285 (1279)	55.9	44.1
	Hispanic	6.4	882 (315)	63.6	36.4
	API/AI/AN[e]	2.7	375 (243)	61.7	38.3
Marital Status (p< 0.0001 *)	**Married**	77.0	10603 (3410)	68.2	31.8
	Single/Divorced/Separated/Widowed	18.3	2522 (893)	57.6	42.4
	Unknown	4.6	638 (188)	65.9	34.1
Socio-economic Status (p< 0.0001 *)	**Low**	13.6	1863 (895)	52.6	47.4
	Mid	18.3	2515 (875)	59.0	41.0
	High	68.1	9347 (2707)	70.9	29.1
Insurance (p< 0.0001 *)	**None**	1.6	217 (85)	66.5	33.5
	Medicaid	4.7	648 (283)	57.0	43.0

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Variable		Total (%)[a]	Patients (n)[b]	RP (%)[c]	EBRT (%)[c]
Total		**100**	**13762 (4491)**	**66.2**	**33.8**
	Medicare or Other Public	23.4	3221 (1101)	44.2	55.8
	Private	65.0	8942 (2835)	75.1	24.9
	Unknown	5.3	733 (187)	61.6	38.4
Urbanization (p=0.001 *)	**Rural**	13.6	1870 (666)	58.4	41.6
	Urban	50.3	6918 (2204)	67.4	32.6
	Rural-Urban Mix	35.9	4938 (1607)	67.4	32.6
	Unknown	0.3	37 (14)	45.2	54.8
ACE-27 Comorbidity Score (p < 0.0001 *)	**None**	37.0	5092 (1566)	76.0	24.0
	Mild	47.9	6592 (2239)	62.7	37.3
	Moderate	10.1	1392 (464)	54.6	45.5
	Severe	2.7	378 (129)	53.5	46.5
	Unknown	2.2	308 (93)	45.6	54.4
NCCN Risk Group[d] (p < 0.0001 *)	**Low**	36.9	5082 (1575)	71.8	28.2
	Intermediate	48.2	6633 (2203)	67.6	32.4
	High	14.9	2047 (713)	47.5	52.5
Receipt of ADT (p < 0.0001 *)	**No**	77.3	10637 (3373)	79.8	20.2
	Yes	22.7	3125 (1118)	19.8	80.2

*Chi-square

[a]Column percentages based on weighted number of patients

[b]Weighted number of patients (unweighted number in parenthesis)

[c]Row percentages based on weighted number of patients

[d]Low (T1–2a AND Gleason Score ≤ 6 AND PSA < 10 ng/mL), Intermediate (T2b-T2c OR Gleason Score 7 OR PSA 10–20 ng/mL) and High (≥ T3a OR Gleason Score 8–10 OR PSA > 20 ng/mL)

[e]Asian Pacific Islander (API)/American Indian (AI)/Alaska Native (AN)

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Table 2

Provider and facility characteristics for treatment by radical prostatectomy (RP) and external beam radiation therapy (EBRT).

Variable		Total (%)[a]	Patients (n)[b]	RP (%)[c]	EBRT (%)[c]
Total		**100**	**13762 (4491)**	**66.2**	**33.8**
Graduation Year of Provider (p = 0.20 *)	**1950–1969**	9.7	945 (330)	69.2	30.8
	1970–1979	21.9	2127 (709)	65.4	34.6
	1980–1989	39.1	3803 (1284)	62.7	37.3
	1990+	29.4	2858 (976)	66.9	33.1
Practice Type of Provider (p = 0.10 *)	**Solo Practice**	9.2	892 (368)	70.6	29.4
	Group Practice	90.8	8842 (2931)	64.6	35.4
Ownership of Facility (p < 0.003 *)	**Non-Profit/Government**	91.1	10081 (3228)	68.5	31.5
	For Profit	8.9	985 (364)	78.2	21.8
Teaching Status of Facility (p = 0.019 *)	**Non-Teaching**	43.9	4855 (1609)	66.8	33.2
	Teaching	56.1	6211 (1983)	71.3	28.7
Distance to Treatment Facility (p = 0.66 *)	**<5**	29.0	3338 (1106)	64.7	35.3
	5–9	23.0	2646 (857)	66.6	33.4
	10–14	13.0	1493 (469)	65.2	34.8
	15+	35.0	4034 (1334)	67.5	32.5
Number of Urologists per 100,000 Men (p = 0.002 *)	**0**	14.3	1733 (705)	60.6	39.4
	0–5.6	19.9	2412 (776)	63.2	36.8
	5.6–6.8	28.3	3423 (819)	65.6	34.4
	6.8–10.6	22.1	2675 (899)	71.0	29.0
	10.6–26	15.4	1868 (781)	61.1	38.9

*Chi-square

[a]Column percentages based on weighted number of patients

[b]Weighted number of patients (unweighted number in parenthesis)

[c]Row percentages based on weighted number of patients

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Table 3

Adjusted Odds Ratios and 95% CI for receiving a radical prostatectomy (RP) vs. External Beam Radiation Therapy (EBRT) for socio-demographic, clinical, and provider/facility variables.*

Variable		Adj. OR	95% CI
Age	**<60**	1.0 (Ref)	
	60–64	0.42	0.29–0.61
	65–69	0.26	0.17–0.38
	70–74	0.07	0.05–0.11
	75+	0.01	0.01–0.03
Race/Ethnicity	**White**	1.0 (Ref)	
	Black	0.47	0.30–0.73
	Hispanic	1.17	0.51–2.67
	API/AI/AN[a]	0.70	0.31–1.60
Marital Status	**Married**	1.0 (Ref)	
	Single/Divorced/Separated/Widowed	0.72	0.54–0.98
	Unknown	1.05	0.44–2.50
Urbanization	**Rural**	1.0 (Ref)	
	Urban	1.86	1.11–3.11
	Rural-Urban Mix	1.54	1.05–2.26
Socio-economic Status	**Low**	1.0 (Ref)	
	Mid	1.36	0.92–2.01
	High	1.86	1.26–2.75
Insurance	**Private**	1.0 (Ref)	
	Medicaid	0.85	0.49–1.49
	Medicare or Other Public	0.71	0.50–0.99
	None	0.70	0.32–1.55
	Unknown	0.15	0.06–0.38
Registry	**A**	1.0 (Ref)	
	B	0.91	0.38–2.14
	C	2.04	0.77–5.38
	D	1.69	0.69–4.16
	F	1.82	0.80–4.12
	G	1.84	0.75–4.53
ACE-27 Comorbidity Score	**None**	1.0 (Ref)	
	Mild	0.72	0.54–0.96
	Moderate	0.51	0.32–0.83
	Severe	0.66	0.34–1.30
	Unknown	0.48	0.20–1.17
NCCN Risk Group[b]	**Low**	1.0 (Ref)	

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Variable		Adj. OR	95% CI
	Intermediate	1.08	0.81–1.45
	High	0.56	0.37–0.84
Graduation Year of Provider	**1950–1969**	1.0 (Ref)	
	1970–1979	1.13	0.56–2.28
	1980–1989	0.64	0.34–1.20
	1990+	0.68	0.34–1.37
Practice Type of Provider	**Solo Practice**	1.0 (Ref)	
	Group Practice	0.47	0.25–0.91
Ownership of Facility	**Non-Profit/Government**	1.0 (Ref)	
	For Profit	1.80	0.91–3.58
Teaching Status of Facility	**Non-Teaching**	1.0 (Ref)	
	Teaching	0.80	0.56–1.16
Distance to Treatment Facility	**<5**	1.0 (Ref)	
	5–9	0.92	0.64–1.34
	10–14	0.94	0.57–1.55
	15+	1.11	0.73–1.69
Number of Urologists per 100,000 Men	**0**	1.0 (Ref)	
	>0–5.6	0.84	0.55–1.28
	>5.6–6.8	0.99	0.53–1.83
	>6.8–10.6	1.17	0.72–1.89
	>10.6–26.0	0.87	0.55–1.36

[*] After exclusion of missing values, 2953 patients were used for this model, which included all variables in the table.

[a] Asian Pacific Islander (API)/American Indian (AI)/Alaska Native (AN)

[b] Low (T1–2a AND Gleason Score ≤ 6 AND PSA < 10 ng/mL), Intermediate (T2b-T2c OR Gleason Score 7 OR PSA 10–20 ng/mL) and High (≥ T3a OR Gleason Score 8–10 OR PSA > 20 ng/mL)

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Table 4

Adjusted Odds Ratios and 95% CI for receiving a non-recommended bone scan for selected socio-demographic, clinical, and provider/facility variables among patients with NCCN Low Risk prostate cancer.*

Variable		Adj. OR	95% CI
Type of Treatment	**EBRT**	1.0 (Ref)	
	RP	0.71	0.40–1.24
Age	**<60**	1.0 (Ref)	
	60–64	1.17	0.76–1.82
	65–69	1.53	0.86–2.75
	70–74	1.71	0.81–3.58
	75+	1.61	0.59–4.39
Race/Ethnicity	**White**	1.0 (Ref)	
	Black	1.80	1.00–3.25
	Hispanic	1.13	0.53–2.42
	API/AI/AN[a]	2.76	1.16–6.56
Socio-economic Status	**Low**	1.0 (Ref)	
	Mid	0.67	0.37–1.21
	High	0.57	0.32–0.99
Insurance	**Private**	1.0 (Ref)	
	Medicaid	2.78	1.24–6.26
	Medicare or Other Public	1.58	0.95–2.65
	None	1.38	0.31–6.24
	Unknown	3.86	1.16–12.80
Registry	**A**	1.0 (Ref)	
	B	0.71	0.32–1.54
	C	2.63	0.60–11.61
	D	1.18	0.54–2.56
	F	0.62	0.28–1.40
	G	0.89	0.37–2.12
ACE-27 Comorbidity Score	**None**	1.0 (Ref)	
	Mild	0.88	0.59–1.32
	Moderate	0.78	0.41–1.50
	Severe	0.43	0.11–1.65
	Unknown	0.65	0.13–3.33
Graduation Year of Provider	**1950–1969**	1.0 (Ref)	
	1970–1979	1.23	0.58–2.60
	1980–1989	1.38	0.66–2.87
	1990+	0.88	0.41–1.87
Practice Type of Provider	**Solo Practice**	1.0 (Ref)	

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Variable		Adj. OR	95% CI
	Group Practice	0.76	0.39–1.49
Ownership of Facility	**Non-Profit/Government**	1.0 (Ref)	
	For Profit	1.39	0.76–2.55
Teaching Status of Facility	**Non-Teaching**	1.0 (Ref)	
	Teaching	0.75	0.43–1.31
Distance to Treatment Facility	**<5**	1.0 (Ref)	
	5–9	0.69	0.44–1.10
	10–14	0.87	0.46–1.65
	15+	0.98	0.57–1.70
Number of Urologists per 100,000 Men	**0**	1.0 (Ref)	
	0–5.6	2.06	0.96–4.39
	5.6–6.8	1.52	0.64–3.61
	6.8–10.6	2.10	1.01–4.42
	10.6–26	2.05	1.07–3.93

[*] Based on 940 patients in NCCN low risk group, with exclusion of those with missing values.

[a] Asian Pacific Islander (API)/American Indian (AI)/Alaska Native (AN)