Original Article

Travel Distance and Stereotactic Body Radiotherapy for Localized Prostate Cancer

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BACKGROUND: Definitive stereotactic body radiotherapy (SBRT) represents an emerging and debated treatment option for patients with prostate cancer, with potential economic savings and reports of short-term efficacy since 2006. The current study sought to define national trends in definitive prostate SBRT use and determine whether patterns vary by travel distance for treatment. **METHODS:** The National Cancer Data Base identified 181,544 men with localized prostate cancer who were treated with definitive external beam radiotherapy from 2004 through 2012. Joinpoint regression analyzed definitive prostate SBRT trends over time, whereas multivariable logistic regression defined the odds for its receipt by travel distance for treatment. **RESULTS:** Definitive prostate SBRT use increased from 1.8% in 2004 to 5.9% in 2012 (P for trend $<.0001$), with a joinpoint for increased use noted in 2006 ($P<.0001$). Higher SBRT use was found to be associated with longer travel distance for treatment, younger age, white race, more affluent zip code of residence, academic treatment center, favorable disease characteristics, and fewer comorbidities (all $P<.0001$). Compared with travel distances <25 miles for treatment, travel distances of 25 to 50 miles and >50 miles were associated with increasing adjusted odds of receipt of definitive prostate SBRT (1.63 [95% confidence interval, 1.51-1.76] and 2.35 [95% confidence interval, 2.14-2.57], respectively; both $P<.0001$). **CONCLUSIONS:** Definitive prostate SBRT use increased more than 3-fold since 2004, with a significant increase in use coinciding with early reports of short-term efficacy. Long-distance travel for treatment was associated with greater than twice the odds of receipt of definitive prostate SBRT compared with short-distance travel, suggesting that treatment decisions with unknown long-term clinical implications may be strongly driven by sociodemographic factors. ***Cancer* 2018;124:1141-9.** © *2017 American Cancer Society.*

KEYWORDS: financial toxicity, prostate cancer, radiation, stereotactic body radiotherapy (SBRT), travel distance.

INTRODUCTION

Prostate cancer is the most common noncutaneous malignancy in men, with 161,360 new cases of prostate cancer and 26,730 deaths due to prostate cancer in the United States alone expected in 2017.[1] Long-course external beam radiotherapy (EBRT) is an established form of definitive therapy used for localized prostate cancer,[2] whereas short-course stereotactic body radiotherapy (SBRT) is a new and emerging high-dose-per-fraction form of EBRT that was cautiously listed as a definitive therapy option by the National Comprehensive Cancer Network (NCCN) in 2014.[3]

SBRT can be conveniently delivered in ≤5 treatments compared with up to 45 fractions (9 weeks) in standard-fractionated EBRT.[4] Before being listed as a potential definitive therapy option by the NCCN, definitive prostate SBRT largely was considered experimental.[4-6] An early short-term report of safety and efficacy was presented in 2006,[7] and since then several phase 2 studies in patients with prostate cancer of favorable risk have suggested that SBRT is safe and efficacious.[8-14]

Given the lack of level 1 evidence and long-term results from phase 2 studies, the definitive use of prostate SBRT remains a hotly debated topic, with differing expert opinions.[15] Because definitive prostate SBRT can be delivered in up to 40 fewer treatments than standard fractionated radiation, the savings in time, travel, and cost that patients could incur are significant. As such, proponents argue that SBRT offers patients a cost-saving and convenient alternative to standard

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long-course radiotherapy.[16,17] Nevertheless, to the best of our knowledge, there is no expert consensus regarding prostate SBRT, and the drivers of and trends in its use are poorly understood.

Therefore, we sought to define national trends in definitive prostate SBRT use and determine whether its use increased after reports of its efficacy. We also sought to determine the factors associated with receipt of definitive prostate SBRT, with a focus on distance traveled for treatment to determine the influence of sociodemographic factors on treatment decisions. We used what to our knowledge is the largest clinical registry in the United States to address the objectives of the current study.[18,19]

MATERIALS AND METHODS

Study Population and Design

The study population was derived from the National Cancer Data Base (NCDB), a nationwide joint program of the American College of Surgeons Commission on Cancer (CoC) and the American Cancer Society that captures approximately 70% of newly diagnosed cancers diagnosed and treated at CoC-accredited cancer programs.[18,19] Patients diagnosed with localized cT1-4N0M0 prostate adenocarcinoma from 2004 through 2012 were identified (site code: C61.9; *International Classification of Diseases for Oncology, Third Edition* code: 8140) (888,868 patients). Patients without information regarding tumor stage (18,740 patients), Gleason score (36,020 patients), or prostate-specific antigen (PSA) level (108,613 patients) were excluded. For the purposes of the current study, we excluded patients treated with surgery (400,461 patients) or those who received radiotherapy other than EBRT with or without brachytherapy or who received palliative-intent EBRT (143,490 patients); palliative-intent treatments have been collected by the NCDB since 2003. The final study population consisted of 181,544 patients treated with definitive prostate EBRT. Definitive prostate SBRT was defined as the use of $\leq$5 fractions of treatment modalities coded as stereotactic radiosurgery not otherwise specified or linear accelerator (LINAC) radiosurgery. The first year of the study was 2004 because that is the first year that the NCDB included many of the clinical variables of interest, and the last year of the study was 2012 because that is the most recent year for which data were available. Figure 1 summarizes the study population selection criteria.

The institutional review board of the Brigham and Women's Hospital/Dana-Farber Cancer Institute approved the current study.

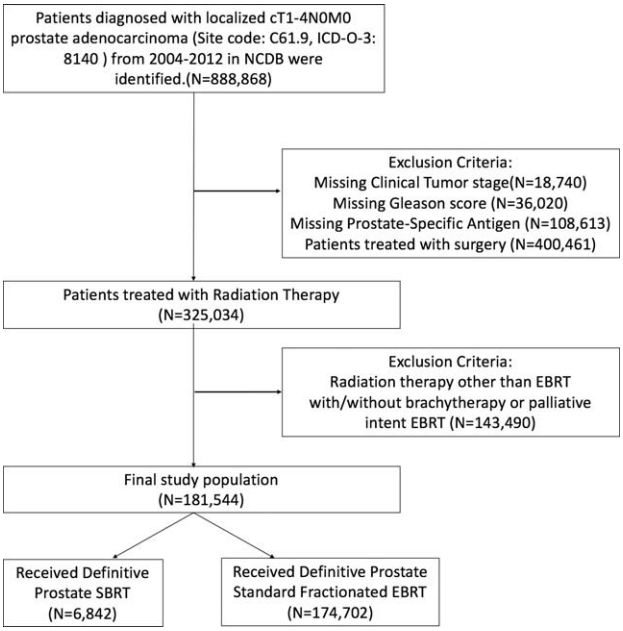

Figure 1. Eligibility and exclusion criteria for the study population. EBRT indicates external beam radiotherapy; ICD-O-3, *International Classification of Diseases for Oncology, Third Edition*; NCDB, National Cancer Data Base; SBRT, stereotactic body radiotherapy.

Statistical Analysis

Distribution and comparison of the clinical characteristics

Descriptive statistics were used to present the baseline characteristics, stratified by the type of definitive prostate EBRT received (SBRT or standard fractionated EBRT). Categorical variables were assessed using the chi-square test and included age (stratified at age 70 years), race/ethnicity, insurance status, distance traveled to the treatment facility (stratified at 25 miles [approximately 60 minutes of roundtrip travel] and 50 miles [approximately 2 hours of roundtrip travel]), PSA level (stratified at 10 ng/mL and 20 ng/mL), clinical tumor classification, Gleason score, hospital setting, zip code median household income, zip code educational level, and residence type. Continuous variables were compared using the Student *t* test or Mann-Whiney *U* test as appropriate and included age and median distance to the treatment facility. Travel distance was defined as the distance between patient zip code centroid and the street address of the treating facility.

Trends in SBRT use over time and by distance traveled to the treatment facility

For the purposes of illustration, crude definitive prostate SBRT rates by year were generated and displayed

TABLE 1. Distribution and Comparison of Clinical Characteristics Stratified by Definitive EBRT Fractionation Type

Characteristic	Received Definitive Prostate SBRT N=6842 (3.8%)	Received Definitive Prostate Standard Fractionated EBRT N=174,702 (96.2%)
Median age (IQR), y	68 (62-73)	69 (63-74)
Age (%), y[a]		
<70	3940 (57.6)	89,977 (51.5)
≥70	2902 (42.4)	84,725 (48.5)
Race/Ethnicity, no. (%)		
Non-Hispanic white	5377 (78.6)	129,346 (74.0)
African American	1030 (15.1)	29,893 (17.1)
Hispanic	160 (2.3)	7497 (4.3)
Other nonwhite	195 (2.9)	5545 (3.2)
Unknown	80 (1.2)	2421 (1.4)
Insurance status, no. (%)		
None	93 (1.4)	2820 (1.6)
Private	2388 (34.9)	56,621 (32.4)
Medicaid	107 (1.6)	4859 (2.8)
Medicare	3971 (58.0)	102,941 (58.9)
Other	152 (2.2)	4290 (2.5)
Unknown	131 (1.9)	3171 (1.8)
Median travel distance to treatment facility (IQR), mi	11.0 (5.1-23.3)	8.2 (3.9-17.6)
Travel distance to treatment facility, no. (%)		
<25 mi	5235 (76.5)	146,770 (84.0)
25-50 mi	911 (13.3)	18,536 (10.6)
>50 mi	696 (10.2)	9396 (5.4)
Charlson-Deyo Comorbidity Score, no. (%)		
0	5909 (86.4)	153,666 (88.0)
1	810 (11.8)	17,596 (10.1)
≥2	123 (1.8)	3440 (2.0)
Median PSA (IQR), ng/mL	6.2 (4.6-9.7)	7.0 (5.0-11.9)
PSA level, no. (%)		
<10 ng/mL	5200 (76)	119,067 (68.2)
10-20 ng/mL	944 (13.8)	32,546 (18.6)
>20 ng/mL	698 (10.2)	23,089 (13.2)
Clinical tumor classification, no. (%)		
T1	4895 (71.5)	107,547 (61.6)
T2	1823 (26.6)	58,120 (33.3)
T3	115 (1.7)	8454 (4.8)
T4	9 (0.1)	581 (0.3)
Gleason score, no. (%)		
6	3263 (47.7)	60,310 (34.5)
7	2855 (41.7)	76,209 (43.6)
8-10	724 (10.6)	38,183 (21.9)
Hospital setting, no. (%)		
Academic	3419 (50.0)	52,075 (29.8)
Nonacademic	3423 (50.0)	122,627 (70.2)
Zip code median household income, no. (%)		
<$38,000	956 (14.0)	31,986 (18.3)
$38,000-$47,999	1159 (16.9)	40,366 (23.1)
$48,000-$62,999	1565 (22.9)	45,841 (26.2)
≥$63,000	3155 (46.1)	56,293 (32.2)
Unknown	7 (0.1)	216 (0.1)
Zip code educational level (percentage with <high school diploma), no. (%)		
≥21%	1073 (15.7)	30,374 (17.4)
13%-20.9%	1428 (20.9)	45,582 (26.1)
7%-12.9%	2120 (31.0)	56,720 (32.5
<7%	2219 (32.4)	41,915 (24.0)
Unknown	2 (0.0)	111 (0.1)
Residence type, no. (%)		
Metropolitan	5829 (85.2)	141,774 (81.2)
Urban	78 (1.1)	26,332 (15.1)
Rural	772 (11.3)	3554 (2.0)
Unknown	163 (2.4)	3042 (1.7)

Abbreviations: EBRT, external beam radiotherapy; IQR, interquartile range; PSA, prostate-specific antigen; SBRT, stereotactic body radiotherapy.
[a] Percentage may not add up to 100 due to rounding.

graphically. The Mantel-Haenszel chi-square test for trend was used to examine the trend for crude rates of SBRT use over time. To determine whether any significant changes in definitive SBRT rates correlated with the publication of favorable reports in 2006, univariable joinpoint regression analysis (Joinpoint Regression Program, version 4.1.0) was used to analyze annual percent changes over time.[20] The Joinpoint Regression Program takes trend data and tests whether any statistically significant changes in trends occur using the Monte Carlo permutation method. Points at which statistically significant changes in trends occur are termed "joinpoints."

Estimates of odds of receipt of SBRT by travel distance to the treatment facility and other patient factors

To test the null hypothesis that there is no difference with regard to receipt of definitive prostate SBRT by travel distance to the treatment facility (<25 miles [referent], 25-50 miles, and >50 miles), univariable and multivariable logistic regressions were used to define odds ratios (ORs) and adjusted odds ratios (AORs) for the dependent endpoint of receipt of definitive prostate SBRT, respectively. Sociodemographic covariates included in the models were age (≤70 years [referent] and >70 years), race/ethnicity (Non-Hispanic white [referent], African American, non-black Hispanic, and other nonwhite), insurance status (none [referent], private, Medicaid, and Medicare), zip code median household income (<$38,000 [referent], $38,000-$47,999, $48,000-$62,999, and ≥$63,000), residence type (metropolitan [referent], urban, and rural), and zip code percentage with an educational level <high school diploma (≥21% [referent], 13%-20.9%, 7%-12.9%, and <7%). Clinical variables included in the models were PSA level (<10 ng/mL [referent], 10-20 ng/mL, and >20 ng/mL), clinical tumor classification (T1 [referent], T2, T3, and T4), Gleason score (6 [referent], 7, and 8-10), Charlson-Deyo Comorbidity Score (0 [referent], 1, and ≥2), and hospital setting (nonacademic [referent] and academic).

For the purposes of illustration, crude definitive prostate SBRT rates by year stratified by travel distance were generated and displayed graphically.

We used 95% confidence intervals (95% CIs) and a 2-sided P <.05 as criteria for clinical significance in all analyses. All statistical analyses were performed using SAS statistical software (version 9.4; SAS Institute Inc, Cary, North Carolina).

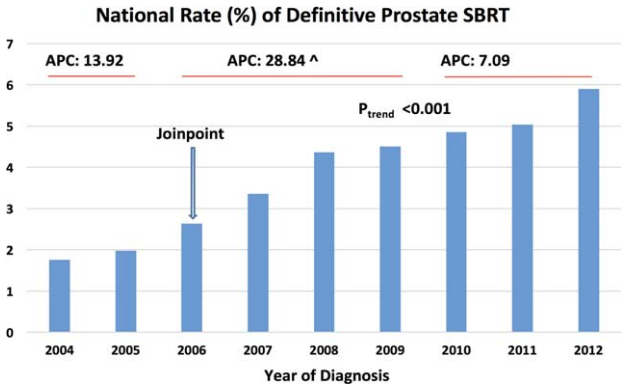

Figure 2. National crude rate of stereotactic body radiotherapy (SBRT) use as a percentage among patients who received external beam radiotherapy as their initial definitive therapy for localized prostate cancer. P for trend from 2004 to 2012 was <.0001. ^ indicates that the annual percentage change (APC) was significantly different from 0 at an α of .05 (P <.0001).

RESULTS

Distribution and Comparison of the Clinical Characteristics

A total of 6842 patients received SBRT for localized prostate cancer. Higher SBRT use was associated with longer travel distance for treatment, younger age, white race, more affluent zip code of residence, academic treatment center, favorable disease characteristics, non-Medicaid insurance status, and fewer comorbidities (Table 1).

Trends in SBRT Use Over Time

Among patients treated with definitive EBRT, SBRT use increased from year to year, from 1.8% in 2004 to 5.9% in 2012 (P for trend <.0001) (Fig. 2). A joinpoint for increased use was identified in 2006 (P < .0001) (Fig. 2). The annual percent change in SBRT use was +13.92% from 2004 through 2005, +28.84% from 2006 through 2009, and +7.09% from 2010 to 2012, with significant differences noted between the periods for 2004 to 2005 and 2006 to 2009 (P < .0001), but not between 2006 to 2009 and 2010 to 2012 (P = .10) (Fig. 2).

Estimates of Odds of Receipt of SBRT by Travel Distance to the Treatment Facility

On univariable analysis, receipt of SBRT was found to be significantly associated with travel distance to the treatment facility, race/ethnicity, insurance status, Charlson-Deyo Comorbidity Score, PSA level, clinical tumor classification, Gleason score, zip code median household income, zip code educational level, and residence type

TABLE 2. Univariable and Multivariable Logistic Regression Defined ORs for Receipt of Definitive Prostate SBRT

Patient Characteristic	Unadjusted OR	*P*	AOR (95% CI)	*P*
Travel distance to treatment facility, mi				
<25	Referent		Referent	
25-50	1.36 (1.26-1.46)	<.0001	1.63 (1.51-1.76)	<.0001
>50	2.09 (1.92-2.27)	<.0001	2.35 (2.14-2.57)	<.0001
Age, y				
<70	Referent		Referent	
≥70	0.78 (0.75-0.82)	<.0001	0.83 (0.78-0.87)	<.0001
Race/Ethnicity				
Non-Hispanic white	Referent		Referent	
African American	0.83 (0.77-0.89)	<.0001	0.86 (0.80-0.93)	.0001
Hispanic	0.51 (0.44-0.60)	<.0001	0.52 (0.44-0.61)	<.0001
Other nonwhite	0.85 (0.73-0.98)	.024	0.79 (0.68-0.91)	.002
Insurance status				
None	Referent		Referent	
Private	1.28 (1.04-1.58)	.022	1.09 (0.88-1.35)	.45
Medicaid	0.67 (0.50-0.89)	.005	0.75 (0.56-1.00)	.05
Medicare	1.17 (0.95-1.44)	.140	1.27 (1.02-1.57)	.03
Other	1.07 (0.83-1.40)	.59	0.99 (0.76-1.29)	.94
Charlson-Deyo Comorbidity Score				
0	Referent		Referent	
1	1.20 (1.11-1.29)	<.0001	1.34 (1.24-1.44)	<.0001
≥2	0.93 (0.78-1.12)	.43	1.11 (0.92-1.34)	.28
PSA level, ng/mL				
<10	Referent		Referent	
10-20	0.66 (0.62-0.71)	<.0001	0.79 (0.74-0.85)	<.0001
>20	0.69 (0.64-0.75)	<.0001	0.94 (0.86-1.02)	.14
Clinical tumor classification				
T1	Referent		Referent	
T2	0.69 (0.65-0.73)	<.0001	0.78 (0.74-0.83)	<.0001
T3	0.30 (0.25-0.36)	<.0001	0.37 (0.31-0.46)	<.0001
T4	0.34 (0.18-0.66)	.0001	0.54 (0.28-1.05)	.07
Gleason score				
6	Referent		Referent	
7	0.69 (0.66-0.73)	<.0001	0.72 (0.69-0.76)	<.0001
8-10	0.35 (0.32-0.38)	<.0001	0.41 (0.37-0.44)	<.0001
Hospital setting				
Nonacademic	Referent		Referent	
Academic	2.35 (2.24-2.47)	<.0001	2.14 (2.03-2.25)	<.0001
Zip code median household income				
<$38,000	Referent		Referent	
$38,000-$47,999	0.96 (0.88-1.05)	.36	1.09 (0.99-1.19)	.09
$48,000-$62,999	1.14 (1.05-1.24)	.0001	1.26 (1.15-1.39)	.0001
≥$63,000	1.88 (1.72-2.02)	<.0001	2.01 (1.81-2.23)	<.0001
Zip code educational level (percentage with<high school diploma)				
≥21%	Referent		Referent	
13%-20.9%	0.89 (0.82-0.96)	.004	0.75 (0.69-0.82)	<.0001
7%-12.9%	1.06 (0.98-1.14)	.139	0.72 (0.66-0.79)	<.0001
<7%	1.50 (1.39-1.61)	<.0001	0.77 (0.70-0.85)	<.0001
Residence type				
Metropolitan	Referent		Referent	
Urban	0.71 (0.66-0.77)	<.0001	0.78 (0.71-0.85)	<.0001
Rural	0.53 (0.43-0.70)	<.0001	0.52 (0.41-0.65)	<.0001

Abbreviations: 95% CI, 95% confidence interval; AOR, adjusted odds ratio; OR, odds ratio; SBRT, stereotactic body radiotherapy.

(All $P < .004$) (Table 2). After robust multivariable adjustments for all patient factors found to be associated with receipt of SBRT, longer travel distance for treatment of 25 to 50 miles or >50 miles was increasingly associated with higher adjusted odds of SBRT receipt when compared with travel distances <25 miles (1.63 [95% CI, 1.51-1.76] and 2.35 [95% CI, 2.14-2.57], respectively; both $P < .0001$) (Table 2). Crude SBRT rates over the study period stratified by travel distance are shown in Figure 3; it is interesting to note that there was an increasing trend toward SBRT use for all patients regardless of travel distance from 2004 through 2012 (*P* for trend for all <.0001), although relative differences between travel distances remained constant.

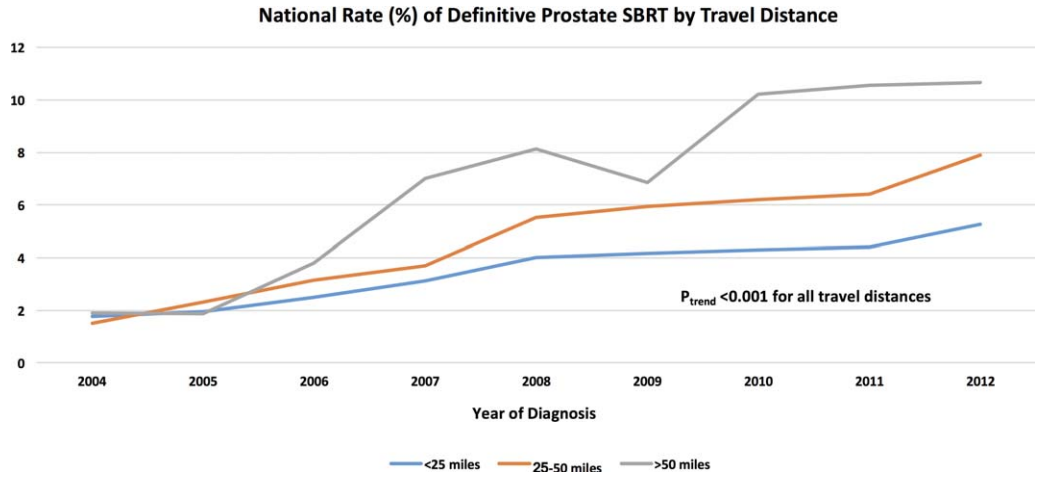

Figure 3. National crude rate of stereotactic body radiotherapy (SBRT) use shown as a percentage among patients who received external beam radiotherapy as their initial definitive therapy for localized prostate cancer stratified by travel distance to the treatment facility. *P* for trend from 2004 to 2012 was <.0001 for all travel distances.

Estimates of Odds of Receipt of SBRT by Other Patient Factors

Black, Hispanic, or other nonwhite patients were found to be significantly less likely to receive SBRT compared with white patients (AOR, 0.86 [95% CI, 0.80-0.93; $P = .0001$]; AOR, 0.52 [95% CI, 0.44-0.61; $P < .0001$]; and AOR, 0.79 [95% CI, 0.68-0.91; $P = .002$], respectively) (Table 2). Age <70 years, non-Medicaid insurance, Charlson-Deyo Comorbidity Score of 0, PSA level <10 ng/mL, clinical T1 classification, Gleason score of 6, academic hospital setting, zip code median household income ≥$63,000, and metropolitan residence all were found on multivariable analysis to be significantly associated with an increased odds of SBRT receipt (Table 2).

DISCUSSION

Using what to the best of our knowledge is the largest registry of incident prostate cancers in the United States, we found that use of definitive prostate SBRT increased greater than 3-fold from 2004 to 2012, with a significant increase in use starting in 2006, coinciding with early reports of favorable efficacy and safety. At the end of the study period, definitive SBRT rates remained modest, peaking at nearly 6%. It is interesting to note that long-distance travel for treatment was associated with greater than twice the odds of receipt of definitive prostate SBRT compared with short-distance travel. These findings provide insight into the potential drivers of definitive SBRT use and thus may be able to inform patient counseling and outreach efforts.

It is interesting to note that the increased use of prostate SBRT observed in the current study occurred during a time when this therapy was considered experimental with unknown long-term clinical risks, and was not listed in the NCCN guidelines as a potential alternative to standard long-course radiation. A majority of SBRT occurred in academic cancer centers, in which these treatments may have been performed as part of clinical trials or by clinicians with clinical expertise and access to the appropriate technology and facility support to safely provide extreme hypofractionated radiotherapy. The significant uptake in prostate SBRT use in 2006 coincided with the early presentation of favorable safety and efficacy data associated with extreme hypofractionation.[7] Furthermore, a significant trend toward increased SBRT use continued through 2012 (the end of our study period), which coincided with the publication of several phase 2 clinical trials from 8 cancer centers suggesting that SBRT has similar early outcomes compared with other forms of radiotherapy.[8-14] Nevertheless, the absolute rate of prostate SBRT during the current study period remained modest in comparison with the uptake of standard fractionation intensity-modulated radiotherapy, most likely given the unclear long-term implications.[21] We would expect the rate of prostate SBRT to continue increasing after being cautiously listed as a potential definitive therapy option in the 2014 NCCN guidelines, and its use to be guided further by an ongoing phase 3 randomized noninferiority clinical trial.[22]

The current study finding that long-distance travel was strongly positively associated with definitive prostate

SBRT use suggests that treatment decisions with unknown long-term clinical implications may be strongly driven by sociodemographic factors. The reasons and directionality behind the findings of the current study can be explained by multiple competing hypotheses. One potential explanation is that patients with a greater travel burden may have an increased risk of economic burden and risk of financial toxicity with long-course radiotherapy (given the costs associated with time, work loss, and greater travel), which may drive treatment decisions. High economic burden has been demonstrated to be a barrier to the receipt of appropriate cancer care, and travel distance is a significant factor in adherence to cancer treatment.[23,24] As such, patients with a greater travel burden (and/or economic burden) may be more likely to pursue short-course SBRT as a more convenient and potentially less financially burdensome treatment option.

An alternative hypothesis is that patients with the means (financial and otherwise) to travel to centers at which SBRT is offered (which tend to be academic centers located in metropolitan areas) are those who are most likely to seek out SBRT and travel long distances for the treatment. The results of the current study demonstrated that patients who were younger, of higher socioeconomic status (SES), were white, and had non-Medicaid insurance were those most likely to receive SBRT, and this group certainly represents a cohort with greater means to travel longer distances for treatment. This group of patients may be influenced to travel to centers at which SBRT is offered based on information or advertisements from treating centers that short-course SBRT offers a treatment that is equally efficacious as standard long-course treatment (especially because NCCN guidelines are not necessarily widely disseminated among patients). Ultimately, these hypotheses are not mutually exclusive, because patients are at risk of financial toxicity with cancer treatments across SES strata, including patients with high SES.[25] Therefore, patients who are younger, with higher SES, and are white may both: 1) be more likely to have the means to travel longer distances to a center with SBRT; and 2) also may be likely to be driven by the implications of financial toxicity. Patients who are younger and of higher SES represent a predominantly actively working population that may be at risk of the greatest delta in financial losses between long-course and short-course treatments given the differences in losses associated with time away from work, time in general, and cost between the 2 treatment approaches. Nevertheless, even after adjusting for all sociodemographic and clinic factors on multivariable analysis, travel distance remained strongly associated with receipt of SBRT. Ultimately, the data provided in the NCDB cannot distinguish between these and other potential hypotheses, and it is likely the case that the drivers of the association between travel distance to the treatment facility and prostate SBRT are multifactorial.

With regard to race and ethnicity, black and Hispanic men were observed to be significantly less likely to receive SBRT compared with white men. This finding persisted after adjusting for variables such as prostate cancer prognostic factors, travel distance, comorbidity status, age, treatment center, income, insurance type, and education. The reasons for this observed pattern likely are multifactorial. Prior reports have suggested that minority patients have less trust in the medical system for historical reasons, and may be less likely to receive a therapy that is considered experimental or unproven.[26-28] Furthermore, black men tend to harbor more aggressive disease and are at a higher odds of dying of prostate cancer compared with their white counterparts, and therefore clinicians may be less willing to recommend an experimental therapy to potentially higher risk patients when alternative proven therapies exist.[29,30] Provider implicit bias also is a well-studied factor that may contribute toward differential rates of use of SBRT.[31-33] Last, it remains possible that there are other factors not captured in the NCDB that may contribute toward racial disparities in SBRT use. If long-term data demonstrate that SBRT is as efficacious as current standard forms of EBRT, a concerted effort will be needed to ensure equal access to this technology, regardless of clinicosociodemographic characteristics.

Other studies similarly have demonstrated an increasing rate of receipt of definitive prostate SBRT, but to our knowledge have not explored the relationships between travel distance or dissemination of literature and patterns of SBRT use.[16,34] To our knowledge, the current study is the first to highlight these important relationships and how travel distance to the treatment facility and dissemination of favorable literature may be major drivers of SBRT use. Nevertheless, the results of the current study must be viewed within the limitations of the study. Although to our knowledge the NCDB represents the nation's largest cancer database, the current study did not contain data from cancer centers that are not CoC accredited, and therefore these data may not reflect those centers. Furthermore, the current study included data only up to 2012 and therefore we were unable to determine SBRT rates after publication of the pooled analysis of phase 2 clinical trials or after SBRT was cautiously listed as a potential definitive therapy in the 2014 NCCN guidelines.[3,35] Last, the drivers and directionality of the

observed associations cannot be clearly defined based on the data provided in the NCDB.

Despite its potential limitations, we believe the current study is a robust and comprehensive report regarding the national trends and patterns of use of definitive prostate SBRT. The absolute national rate of definitive SBRT for localized prostate cancer has increased nearly 3-fold since 2004, with a significant increase in use coinciding with early reports of favorable safety and efficacy. Long-distance travel for treatment was associated with greater than twice the odds of definitive prostate SBRT receipt compared with short-distance travel, suggesting that treatment decisions with unknown long-term clinical implications may be strongly driven by sociodemographic factors. A concerted effort needs to be made to further explore definitive prostate SBRT as a safe and potentially less burdensome treatment option, balanced with an effort to ensure that patients who may be more likely to pursue SBRT are aware of the potential long-term clinical uncertainty in contrast to the high-level data supporting standard treatment approaches.

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CONFLICT OF INTEREST DISCLOSURES

Felix Y. Feng has received a grant from and acted as a paid consultant for Medivation/Astellas; acted as a paid consultant for Celgene, Dendreon, Ferring, and GenomeDx; and received grant funding from Varian for work performed outside of the current study. James B. Yu has received funding from 21st Century Oncology for work performed outside of the current study. Paul L. Nguyen has acted as a paid consultant for Medivation, Ferring, Dendreon, GenomeDx, and Nanobiotix and has received research funding from Astellas, Janssen, and 21st Century Oncology for work performed outside of the current study.

AUTHOR CONTRIBUTIONS

All authors participated in the conception and design of this study and in the drafting and critical revision of the article. All authors contributed to some aspect of the technical, administrative, or material support of this article. **Brandon A. Mahal, Yu-Wei Chen**, and **Paul L. Nguyen** had full access to all the data in the study and take responsibility for the integrity of the data and accuracy of the analyses.

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