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Does Travel Time to a Radiation Facility Impact Patient Decision-Making Regarding Treatment for Prostate Cancer? A Study of the New Hampshire State Cancer Registry

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Abstract

Purpose: We sought to determine whether further distance from a radiation center is associated with lower utilization of external beam radiation therapy (XRT).

Methods: We retrospectively identified patients with a new diagnosis of localized prostate cancer (CaP) within the New Hampshire State Cancer Registry from 2004 to 2011. Patients were categorized by age, D'Amico risk category, year of treatment, marital status, season of diagnosis, urban/rural residence, and driving time to the nearest radiation facility. Treatment decisions were stratified into those requiring multiple trips (XRT) or a single trip (surgery or brachytherapy). Multivariable regression analysis was performed.

Results: A total of 4,731 patients underwent treatment for newly diagnosed CaP during the study period, including 1,575 multitrip (XRT) and 3,156 single-trip treatments. Of these, 87.6% lived within a 30-minute drive to a radiation facility. In multivariable analysis, time to the nearest radiation facility was not associated with treatment decisions ($P = .26$). However, higher risk category, older age, married status, and winter diagnosis were associated with XRT ($P < .05$). More recent year of diagnosis and urban residence were associated with single-trip therapy (primarily surgery) ($P < .05$). There was a significant interaction between travel time and season of diagnosis ($P = .03$), as well as a marginally significant interaction with urban/rural status ($P = .07$).

Conclusion: Overall, further travel time to a radiation facility was not associated with lower utilization of XRT. These data are encouraging regarding access to care for CaP in New Hampshire.

Key words access to care, health disparities, prostate cancer, rural health, social determinants of health.

Treatment decisions for prostate cancer (CaP) are complex and incorporate diverse patient concerns. These include objective considerations such as disease risk, patient age and comorbidities, as well as subjective issues such as concern for particular side effects or treatment logistics. These subjective issues may significantly impact treatment decisions, given the absence of a "gold standard" treatment for prostate cancer.[1] As trade-offs in risk and convenience are complex, "shared decision-making" and multidisciplinary counseling are needed to ensure patients are fully educated regarding surgery and radiation therapy options and that their preferences are met.[2]

An important nonmedical consideration for patients contemplating treatment is the logistical ease or burden of therapy. External beam radiation therapy (XRT) is distinguished from other treatments by the need for daily visits to a radiation treatment facility for up to 9 weeks, compared with the singular events of surgery or brachytherapy. This presents a logistical challenge for some patients. Indeed, with other malignancies there are data suggesting that geographic distance to a radiation center impacts the likelihood of pursuing XRT, reflecting the difficulty of commuting. For example, Celaya et al demonstrated that distance to a radiation center was associated with lower compliance with adjuvant radiation therapy for breast cancer following breast-conserving surgery (BCS) in New Hampshire, as well as a higher probability of choosing mastectomy over BCS and radiation in the first place.[3] Other authors have demonstrated the significant impact of distance on treatment decisions for breast cancer.[4-8] For prostate cancer, however, there are limited prior studies evaluating the impact of travel burden on treatment decisions. Cetnar et al reported that travel distance was not associated with use of curative versus noncurative therapies in the state of Wisconsin, but there have been no studies evaluating associations with actual travel time, or decisions regarding types of therapy.[8] Urban versus rural residence, reflecting commuting time to larger hospitals, has been studied in relation to treatment decisions, with mixed results.[9,10]

We have anecdotally observed that some patients are deterred from pursuing XRT based on longer travel time and the need for daily commuting. This concern may be more relevant in a rural state such as New Hampshire where patients may live more remotely. Currently, there is a gap in knowledge whether travel time is a systematic impediment to pursuing XRT; if such an impediment exists, it would raise concerns regarding access to the full range of treatment options. To answer this question, we evaluated the association between travel time and treatment decisions for newly diagnosed prostate cancer in the New Hampshire State Cancer Registry.

Methods

After Institutional Review Board approval was obtained, we performed a retrospective query of the New Hampshire State Cancer Registry for patients with an incident diagnosis of clinically localized prostate cancer from 2004 to 2011. Addresses of patients were geocoded by TeleAtlas of Lebanon, New Hampshire, to an exact street address (n = 4,063; 85.9%), or to the ZIP code geographic centroid if only a post office box or rural route address was provided (n = 665; 14.1%); geocode was missing for 3 cases.

Urban versus rural status was determined by the Rural Urban Commuting Area (RUCA) classification of the patient's geocoded address.[11] RUCA codes are defined using population density, urbanization and daily commuting. The system has a total of 33 categories, which are commonly grouped together to form classifications of urban, large rural, and small rural. We used RUCA categorization C, which aggregates codes into urban and rural.

We obtained a list of facilities approved to provide radiation therapy in New Hampshire and Vermont from the New Hampshire Health Services Planning and Review Board. Approved radiation treatment facilities in Massachusetts and Maine were identified from their respective state cancer registries. Radiation facilities in New Hampshire and in surrounding states were geocoded in ArcGIS v.10.1 (ArcGIS ESRI, Redlands, CA, USA) using the 2012 Streetmap N.A. network dataset.[12] Travel time was then calculated from the patient's geocoded address to the closest radiation facility.

Patients were categorized by age, D'Amico risk category, year of treatment, marital status, urban/rural residence, and estimated travel time to the nearest radiation facility. D'Amico risk category is a widely used prostate cancer risk stratification tool that incorporates prostate-specific antigen (PSA), Gleason score, and stage of disease to predict 5-year recurrence risk. We determined that a 30+ minute commute would reasonably constitute a "longer" travel time, thus we stratified patients into <30 minutes versus 30+ minutes categories. Then, patients were stratified by treatment into "XRT" or "non-XRT" (surgery or brachytherapy alone). Only first treatment was considered, such that patients who underwent surgery and then adjuvant or salvage XRT were considered "non-XRT" patients. A multivariable logistic regression model was created to determine the relationship between travel time and choice of initial treatment. Statistical analysis was performed using R Core Team 2015[13] with add-on package "vis-reg."[14]

Results

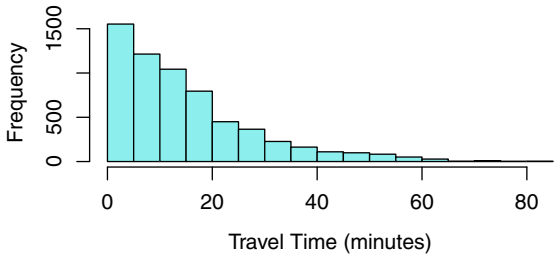
A total of 4,731 patients underwent XRT (1,575), surgery (2,531) or brachytherapy (625) as initial treatment for localized prostate cancer during the study period. These included 1,580 low-risk, 1,661 intermediate-risk, and 1,490 high-risk patients. Demographics and disease characteristics by treatment are shown in Table 1.

The distribution of travel times to the nearest radiation center was positively skewed (Figure 1). The median travel time was 12 minutes (mean 15.6 minutes), and 87% of patients had travel times <30 minutes. Outlying travel times of >140 minutes in 3 patients were excluded.

Table 1 Patient Characteristics at Diagnosis, New Hampshire Prostate Cancers, 2004-2011 (n = 4,731)

		All Cases		Multiple Trips XRT		Single Trip Brachytherapy		Surgery		Total		*P*
		No.	%	No.	%	No.	%	No.	%	No.	%	chi^2
Age												<.001
	<50	136	2.9	2	0.1	2	0.3	132	5.2	134	4.2	
	50-65	2,469	52.2	424	26.9	278	44.5	1,767	69.8	2,045	64.8	
	66-75	1,702	36.0	787	50.0	303	48.5	612	24.2	915	29.0	
	>75	424	9.0	362	23.0	42	6.7	20	0.8	62	2.0	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	
D'Amico risk												<.001
	Low	1,580	33.4	305	19.4	408	65.3	867	34.3	1,275	40.4	
	Intermediate	1,661	35.1	606	38.5	160	25.6	895	35.4	1,055	33.4	
	High	1,490	31.5	664	42.2	57	9.1	769	30.4	826	26.2	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	
Residence												<.001
	Rural	1,997	42.3	786	50.0	273	43.8	938	37.2	1,211	38.5	
	Urban	2,721	57.7	785	50.0	351	56.3	1,585	62.8	1,936	61.5	
	Total	4,718	100.0	1,571	100.0	624	100.0	2,523	100.0	3,147	100.0	
Travel time to radiation (minutes)												<.001
	≤30	4,144	87.6	1,335	84.8	535	85.6	2,274	89.8	2,809	89.0	
	>30	587	12.4	240	15.2	90	14.4	257	10.2	347	11.0	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	
Diagnosis year												.001
	2004-2006	1,515	32	567	36	316	51	632	25	948	30	
	2007-2011	3,216	68	1,008	64	309	49	1,899	75	2,208	70	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	
Marital status												.001
	Not Married	870	18.4	336	21.3	125	20.0	409	16.2	534	16.9	
	Married/common law	3,732	78.9	1,192	75.7	485	77.6	2,055	81.2	2,540	80.5	
	Unknown	129	2.7	47	3.0	15	2.4	67	2.6	82	2.6	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	
Season at DX												.006
	Winter	1,135	24.0	421	26.7	132	21.1	582	23.0	714	22.6	
	Nonwinter	3,595	76.0	1,154	73.3	493	78.9	1,948	77.0	2,441	77.3	
	Unknown	1	0.0	0	0.0	0	0.0	1	0.0	1	0.0	
	Total	4,731	100.0	1,575	100.0	625	100.0	2,531	100.0	3,156	100.0	

Figure 1 The Distribution of Travel Time (in Minutes) Among Men With Localized Prostate Cancer.



In multivariable analysis, travel time to a radiation facility was not associated with treatment decisions, either when dichotomized (Table 2) or treated continuously. Changing the threshold for longer versus shorter travel time continued to be nonsignificant (ie, 15 minutes, 20 minutes). Older age (>65 years), higher D'Amico risk category (intermediate/high), married status, and winter season of diagnosis were associated with a higher likelihood of XRT ($P < .05$). Urban residence and more recent year of diagnosis were associated with higher likelihood of non-XRT treatment, primarily surgery ($P < .05$). Interaction terms demonstrated that increasing travel time was associated with lower likelihood of XRT during nonwinter (vs winter) months ($P = .03$) and for urban (vs rural) patients ($P = .07$) (see Figures 2A and B).

Discussion

Decisions regarding treatment for prostate cancer integrate diverse concerns including disease risk, patient

Table 2 A Multivariable Analysis of Factors Affecting Likelihood of Undergoing XRT for Localized Prostate Cancer

			95% Confidence Interval	
Variable	*P* value	OR	Lower	Upper
Age (centered at 65)[a]	<.001	2.18	2.06	2.31
Diagnosis in years 2007-2011	.016	0.83	0.71	0.97
Intermediate risk	<.001	1.94	1.61	2.33
High risk	<.001	2.82	2.34	3.41
Not married[b]	.007	0.74	0.59	0.92
Urban residence	<.001	0.50	0.36	0.69
Travel time (centered at 30 minutes)[c]	.26	0.98	0.94	1.02
Winter diagnosis[d]	<.001	1.58	1.25	2.00
Urban residence × travel time	.074	0.99	0.97	1.00
Winter diagnosis × travel time	.028	1.01	1.00	1.03

[a]ORs shown for 5-year increment.
[b]Includes divorced, widowed, separated, or never married.
[c]ORs shown for 5-minute increment.
[d]Months of December, January, February.

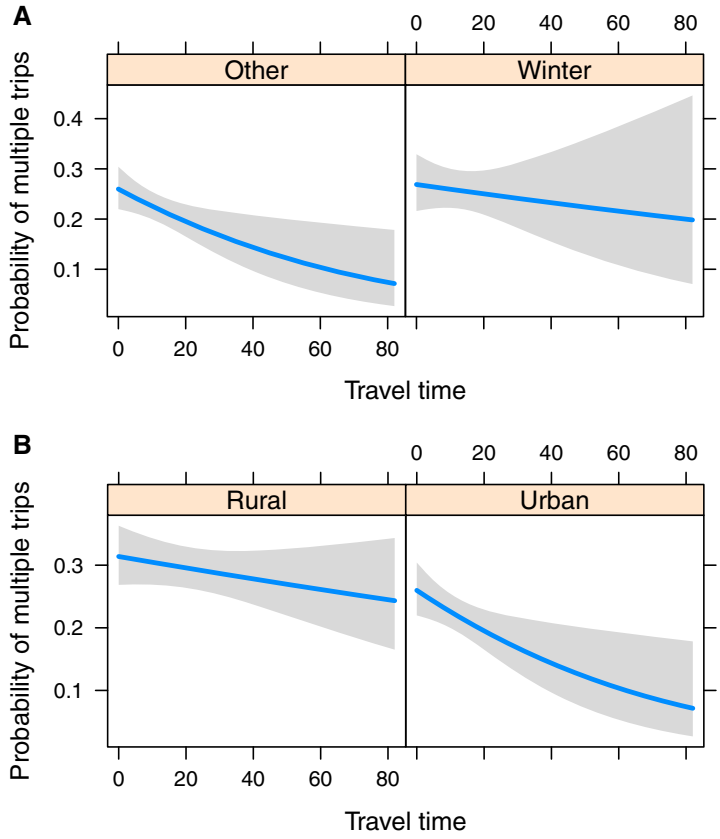
health status, resource availability, and subjective patient factors.[1] Shared decision-making (SDM) has become an integral part of treatment discussions to guide patients through this complex process.[2,15-17] The absence of a "gold standard" treatment for prostate cancer, with guidelines suggesting consideration of all treatment options,[18] has increased the role of logistical and nonmedical considerations in these discussions. While the outcome of SDM discussions is often that 1 treatment is preferred for an individual, this is not true a priori and a detailed discussion is needed to assist patients with their decisions.

New Hampshire is a largely rural state, with tertiary care concentrated at several larger centers. Our institution hosts a multidisciplinary prostate cancer clinic where patients throughout the region may be referred for SDM discussions with a urologist and radiation oncologist. In this clinic we have remarked that patients have cited the challenge of a longer daily commute as a deterrent to XRT. This raised concern that geography may be impeding equal access to all treatment options in our state. Indeed, prior study of breast cancer treatment in New Hampshire has shown that travel distance may influence treatment decisions. Celaya et al reported that women with early stage breast cancer were less likely to choose breast conserving surgery (BCS) plus radiation, rather than mastectomy, if they lived farther from a radiation facility. Furthermore, those who did elect BCS were less likely to use adjuvant radiation if they lived >20 miles away.[3] There have been similar related studies as well.[4-8]

Our literature search revealed only 1 prior study evaluating the relationship between travel distance and prostate cancer treatment decisions. Cetnar et al found that calculated distance to nearest radiation facility was not associated with decision for curative therapy or XRT in Wisconsin.[9] These authors used a different method of calculating distance (the North American Association of Central Cancer Registries' "great circle distance calculator"). Notably, they used distance ("as a crow flies") rather than calculated travel time based on the road network that may not represent actual travel burden. There have been other studies evaluating the relationship between urban/rural residence, which reflects commuting time to large town/metropolitan centers, and treatment decisions. These studies have yielded mixed results; patients in rural Georgia were more likely to pursue XRT compared with urban counterparts, while this relationship was absent in Wisconsin.[9,10]

In our analysis, we found that travel time to the nearest radiation center was not associated with treatment decisions for prostate cancer; those with longer travel time were no less likely to pursue XRT. This provides reassurance regarding access to XRT in New Hampshire. We used a 30-minute threshold to determine longer versus shorter travel time based on a subjective impression that this would constitute a more burdensome daily trip. Interestingly, 87% of travel times were 30 minutes or less, which reflects that most patients do live relatively close to radiation centers in this region; in fact, median travel time was 12 minutes. Numerous community hospitals offer XRT, which may facilitate access, whereas tertiary surgical care such as robotic prostatectomy tends to be offered at a smaller number of centers. One conclusion of our study is actually that the large majority of patients live relatively proximate to a radiation center. Nonetheless, 12.4% of patients did have travel times >30 minutes,

Figure 2 The Interaction Between (A) Winter Season and Travel Time and (B) Rural Residence and Travel Time.



and in our large cohort this represents 587 patients, thus we believe we were able to meaningfully compare treatment decisions in relation to this variable.

We found that urban residence was associated with greater use of single-trip therapy (primarily surgery), rather than XRT. This mirrors findings in the report by Steenland et al regarding treatment decisions in Georgia.[10] We hypothesize that urban residence, and its associated proximity to larger hospitals, offers easy access to more state-of-the-art surgical care (eg, robotic prostatectomy) and leads to greater likelihood of pursuing this treatment.

As winter in northern New England can be inclement, we evaluated the impact of season of diagnosis on treatment decisions. Winter diagnosis was associated with greater usage of XRT, which was somewhat counterintuitive given challenges of commuting during this season for treatment. However, this is less unexpected when reflecting on the logistics of therapy and considerations of the disease. Season of diagnosis is not necessarily season of treatment, as many patients will undergo androgen deprivation therapy (ADT) therapy for 2+ months, which gives flexibility regarding when to initiate radiation. Furthermore, many prostate cancers will have a slow course and do not require immediate treatment; thus some patients will simply delay treatment until the weather improves.

To assess more subtle associations between travel time and treatment decisions, we created interaction terms between travel time and season of diagnosis, as well as urban/rural residence. Indeed, longer travel time was associated with decreased likelihood of XRT for patients diagnosed in nonwinter (versus winter) months, and to a lesser extent for urban (vs rural) patients. It is possible that frequent use of ADT in advance of XRT leads to these counterintuitive findings, in which longer travel time in winter months was associated with lower use of XRT, as these patients would not typically initiate XRT until the spring. Ultimately, these conclusions are speculative, however, and further study is needed to better understand this potential phenomenon.

Other factors were associated with treatment decisions as well. Older age and higher risk category, not surprisingly, were associated with greater likelihood of XRT; at least conventionally, older patients with higher-risk cancer have been steered toward nonsurgical treatment.

Interestingly, though, more recent year (post-2006) diagnoses were associated with higher likelihood of single-trip intervention, which largely represented surgery. This reflects our recent findings, published separately, that surgical intervention has become significantly more common for all risk categories in recent years in New Hampshire, likely because of changing treatment paradigms (ie, more aggressive use of surgery for higher-risk cancer) and the advent of robotic surgery to the state.[19] Finally, "married" status was associated with XRT; speculatively, it may be that those who are married have greater logistical support for daily treatments. Further study of marital status and social relationships is needed to understand how these might impact treatment decisions on a systematic basis.

Limitations and Strengths

This study has several limitations. Although the analyses used high quality data collected by a population-based, state cancer registry, the variables include very little personal risk factor information; thus, there may be confounders affecting treatment decisions that are not controlled for in our analysis. Due to limitations in the data, we used the nearest radiation facility in our analyses, and this was not necessarily the facility chosen by the patient for treatment. Presumably, some men may have chosen to have radiation (or surgery) at a more distant facility, but in those cases it would seem that travel time was not a major concern. We used a "reasonable" but somewhat arbitrary cutoff for longer versus shorter travel time of 30 minutes; we did not choose the median or mean travel time because this was relatively low. Still, given the large cohort size we believe we were still able to make meaningful comparisons between those with longer and shorter commuting times. Finally, some unusual situations are not captured in our data, such as patients who have temporary housing for the duration of their treatment. We hypothesize that these situations are sufficiently rare to not skew the data sufficiently.

Strengths of the study included use of calculated travel time on a road network rather than travel distance to the nearest radiation center. Another strength of our study was inclusion of out-of-state radiation facilities to determine "closest facility," as patients do seek care in adjoining states depending on proximity and preferences.

We believe that further study is warranted to better understand how geography and resource availability may impact decisions regarding prostate cancer treatment. While studies like this evaluate population-based factors, future study merging these factors with patient-level data (eg, disease risk, use of shared decision-making) are needed to clarify how to optimize treatment of this complex condition. Similar study in states with greater geographic distances, such as in the Midwest, may corroborate or disprove our findings.

Conclusion

Travel time to a radiation center was not associated with decisions regarding XRT versus alternative therapies for treatment of localized prostate cancer in the state of New Hampshire. This may result from relative proximity to a treatment center for most of the population, and flexibility in timing of XRT for many diagnoses. Overall these findings are encouraging regarding access to all treatment options for prostate cancer in New Hampshire.

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