

Patterns of Care for Men With Prostate Cancer After Failure of Primary Treatment

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BACKGROUND. This study sought to determine trends in patterns of care after failure of primary prostate cancer treatment and to determine whether nonclinical factors influenced the receipt of secondary treatment.

METHODS. The authors identified individuals treated for nonmetastatic prostate cancer in the years 1991–1999 from the linked databases of Medicare and the National Cancer Institute's Surveillance, Epidemiology, and End Results registry. The outcome of interest was receipt of secondary therapy. They performed Cox proportional hazard analyses to investigate the link between demographic and clinical characteristics and the likelihood of receiving secondary treatment after either surgery or radiation.

RESULTS. Of 65,716 subjects who met our inclusion criteria, 10,200 (15%) received some form of secondary therapy. For men undergoing initial surgical or radiation therapy, tumor grade, year of diagnosis, and geographic region were associated with secondary therapy. No socioeconomic factors such as education, ethnicity, or income level were associated with secondary therapy.

CONCLUSIONS. Patterns of care after primary prostate cancer therapy continue to vary regionally. Standardized clinical algorithms and utilization of prostate-specific antigen testing appear to have influenced secondary therapy rates. *Cancer* 2006;107:258–65. © 2006 American Cancer Society.

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The widespread adoption of prostate-specific antigen (PSA) screening in the early 1990s led to a surge in new diagnoses of prostate cancer.¹ Three modalities are widely accepted as being efficacious in the treatment of early-stage tumors: radical prostatectomy (RP), brachytherapy (BT), and external beam radiation therapy (EBRT). However, recurrence rates after primary treatment for prostate cancer range from 5%–30%, regardless of which therapy is chosen.^{2–5} Controversy exists over the appropriate secondary treatment for prostate cancer recurrence as well as when to initiate therapy, and no national guidelines exist. The decision to administer postprostatectomy radiation may be triggered by pathologic features of the primary tumor, PSA recurrence, or rapid PSA doubling time.^{6,7} Likewise, the timing of androgen deprivation therapy (ADT) continues to be a contested issue.^{8–10} A review of a national prostate cancer data registry revealed that postsurgery secondary treatment is almost equally divided between radiation and ADT, whereas the predominant postradiation secondary treatment is ADT.¹¹

Few studies have examined patterns of care for men with prostate cancer recurrence, and even fewer have attempted to identify whether

geographic region, ethnicity, or socioeconomic status influences the receipt of secondary treatment.^{12,13} Variations in care resulting from such nonclinical factors suggest potential barriers to high-quality health care and, as such, provide targets for quality improvement efforts.

Our study had 2 aims. First, we sought to examine patterns of care along the disease trajectory of prostate cancer. Second, we assessed whether nonclinical factors influenced the receipt of secondary treatment. Extrapolating from the literature on primary treatment, we hypothesized that ethnic minorities and less affluent men would receive secondary treatment at lower rates than would their counterparts.

METHODS

Data Sources

We analyzed linked data from the Surveillance, Epidemiology and End Result (SEER) public use database and Medicare database for the years 1991 through 2001 identifying those who were diagnosed before 1995.¹⁴ The National Cancer Institute maintains the SEER tumor registry for 11 regions in the United States chosen to represent epidemiologically significant population subgroups. Five states (Connecticut, Hawaii, Iowa, New Mexico, and Utah) and 6 metropolitan areas (Detroit, San Francisco, Atlanta, Seattle, Los Angeles County, and San Jose-Monterey) constitute the 11 regions and reflect the general population in terms of education and poverty level. For our purposes, the SEER registry had 2 limitations: the registry tracks patients only for 4 months beyond their date of diagnosis, and it lacks individual socioeconomic data. Therefore, linkage with Medicare claims allowed us to obtain more granular socioeconomic data, as the Medicare files have incorporated variables from the 2000 U.S. Census regarding the patients' neighborhood characteristics as well as identified the subset of prostate cancer patients that had a claim for additional therapies. We created an analytic file with encrypted beneficiary identification numbers from Medicare inpatient, outpatient, and physician supplier (part B) claims.

Cohort Identification

We identified all subjects older than 20 years with a localized or regional prostate cancer diagnosed between 1991 and 1999 and an International Classification of Diseases (9th revision; ICD-9) code 185.0 indicating prostate cancer. In 1995, SEER collapsed all prostate cancer cases defined as "confined entirely to the organ" or "extended beyond the limits

of the organ of origin" as determined by clinical staging into the single category of localized/regional, rendering separation into 2 distinct stages impossible. Using the Medicare Provider Analysis and Review (MEDPAR) and Carrier Claims (NCH) files, we identified the initial (primary) treatment received by each patient. We classified primary treatment into RP, BT, EBRT with or without neoadjuvant hormones, and neoadjuvant hormone ablation with combination BT/EBRT (COMBO). For a therapy to be considered COMBO, the claims for BT and EBRT had to be within 294 days of each other. We excluded subjects with a code for radical retropubic prostatectomy (RRP) and EBRT within 365 days (1 year) of each other because we could not ascertain which therapy was primary, subjects receiving BT after RRP because anatomically that suggested miscoding, and subjects for whom SEER indicated a RRP but who did not have a matching MEDPAR claim. No patients were included who received only hormone ablation.

Covariates: Patient Characteristics

For each subject, we abstracted the following demographic variables from the SEER-Medicare linked database: age at diagnosis, race/ethnicity, median income by zip code, marital status, education level by census tract, and region of residence. Notice that individual socioeconomic data are not available; rather the National Cancer Institute links the subject's zip code and census tract information to the 2000 U.S. Census to generate income and education variables. Before releasing the data to investigators, the individual's zip code and census tract are then stripped from the file. We consolidated race/ethnicity into 4 categories: white, African American, Hispanic, and other. The 'other' category encompasses Asian Americans, Pacific Islanders, and Native Americans. The clinical variables included date of diagnosis, grade, stage limited to localized/regional, date of primary therapy, date and type of secondary treatment. Grade is classified in SEER as Grade 1–4: well differentiated, moderately differentiated, poorly differentiated, or undifferentiated. Each subsequent level confers a more aggressive cancer. We used ICD-9 codes listed on the inpatient records from the year before diagnosis date to calculate Charlson comorbidity index for each subject.

Outcome of Interest

The outcome of interest was secondary treatment. We, therefore, systematically searched for Current Procedural Terminology (4th edition; CPT-4) codes for codes indicating radiation therapy, ADT, or salvage prostatectomy respectively that were dated sub-

sequent to the primary therapy. For the purposes of this study, any radiation therapy or ADT initiated at least 12 months after RP constituted secondary therapy, regardless of whether it was intended as curative treatment. The definition of secondary therapy differed for radiation patients. Because ADT is often coupled with radiation therapy, care was taken to avoid misclassification of ADT as secondary therapy. We used the results of a randomized controlled trial (Radiation Therapy Oncology Group; RTOG 85-13) showing improved survival with 3 years of adjuvant ADT to define secondary therapy. ADT constituted secondary therapy if it was 1095 days (3 years) after the date of radiation administration.¹⁵ ADT administered before radiation therapy and/or ADT continued for less than 3 years from the last date of a claim for radiotherapy treatment was not counted as secondary therapy. Secondary therapy also consisted of BT occurring at least 295 days after the last date of radiation therapy. The median time to secondary treatment was 2 years; therefore, we followed patients until 2001 to follow the entire cohort adequately. Antiandrogens, bilateral orchiectomy, and luteinizing-hormone-releasing hormone agonists all constituted ADT.

Statistical Analysis

Descriptive statistics are presented for treatment sequence, clinical characteristics, and demographics. We present the frequencies for patients receiving secondary and tertiary therapies stratified by primary treatment.

We used Cox proportional hazard models to explore the relationship between receiving secondary treatment and demographic variables. We developed 2 different models each corresponding to one of 2 primary treatments: surgery or radiation.

We chose a survival model rather than logistic regression because we observed individuals for different lengths of time after their primary treatment. Logistic regression does not take into account time-to-event, i.e., it implicitly assumes that the time to event is constant. Logistic regression also does not have a mechanism for dealing with censored data. Therefore, a survival model avoids patient attrition by considering length of follow-up time. Our data cover the time span of 1991 through 2001. Because primary radiation treatment encompassed 3 years of ADT, we only included patients whose primary diagnosis was 1995 or earlier to allow time for secondary treatment. All variables were indicator variables except for age, percent without a high school education, and median income. We categorized year of diagnosis into 2-year intervals (1991 referent), ethni-

TABLE 1
National Practice Patterns in Men with Early-Stage Prostate Cancer

Primary	Treatment Sequence		n
	Secondary	Tertiary	
Surgery	None	None	21,152 (81)
	Radiation/ADT	None	3862 (15)
	Radiation	ADT	915 (4)
Radiation	None	None	27,647 (86)
	ADT	None	4322 (13)
Brachytherapy	None	None	2401 (84)
	Radiation/ADT	None	213 (7)
	Radiation/Surgery	ADT	247 (9)
Combination	None	None	4053 (90)
	ADT/Radiation	None	448 (9)
	Radiation	ADT	6 (<1)

Values in parenthesis indicate percentage.

city as Caucasian (referent), African American, Hispanic, and other, grade as 2, 3, and 4 compared with 1 (well-differentiated referent), marital status as married versus unmarried (referent), comorbidities as 0 (referent) compared with less than or equal to 2 or greater than 2, and specified Utah as the referent SEER regions. All statistical analyses were performed with SAS 8.02 (SAS Institute, Cary, NC).

RESULTS

We identified 66,014 patients treated for nonmetastatic prostate cancer in the years 1991–1999. Of those, 65,266 (98.8%) met our inclusion criteria. We excluded 34, 95, and 619 because of surgery or radiation within 1 year, BT after surgery, and treatment date that predated date of diagnosis, respectively.

Depending on which modality was employed as primary treatment, 81%–89% of the patients received no additional treatment. Table 1 depicts the breakdown of patients' secondary and tertiary treatments stratified by primary therapy. Overall, 10,200 patients received some form of secondary therapy. For clarity, both secondary and tertiary therapies are considered herein as secondary therapy.

Patient characteristics are shown in Table 2 for those who underwent surgery or any form of radiation alone as compared with those receiving any secondary therapy. To allow for proper comparison, Table 2 reflects only patients undergoing surgery in the years 1991–1995 and radiation in the years 1991–1995 ($n = 34,248$). Subjects receiving either form of radiation as primary therapy were older than those receiving surgery. As the age of the patients in-

TABLE 2
Sociodemographics of Men Undergoing Primary Therapy Alone vs. Secondary Therapy for Prostate Cancer

	<i>n</i>			<i>P</i>
	Surgery	Radiation	Secondary	
Mean age				
<65	328 (3)	212 (2)	220 (2)	0.001
65–70	7344 (60)	3883 (30)	4750 (46)	
71–75	3804 (31)	4912 (38)	3443 (35)	
>76	701 (6)	3864 (30)	1787 (17)	
Ethnicity				
Caucasian	10,212 (84)	10,831 (84)	6244 (86)	0.001
African American	725 (6)	1097 (9)	522 (7)	
Hispanic	647(5)	359 (3)	236 (3)	
Other	593 (5)	584 (4)	307 (4)	
Marital status				
Single	608 (5)	636 (5)	347 (5)	0.001
Married	10,285 (85)	9907 (77)	5965(82)	
Divorced/widowed	1004 (8)	1538 (12)	734 (10)	
Unknown	280 (2)	790 (6)	263 (3)	
Census tract % non-high school grade				
<7	2634 (27)	2497 (23)	1463 (24)	0.001
7–12.5	2428 (25)	2603 (24)	1512 (25)	
12.5–20	2411 (25)	3006 (28)	1686 (28)	
>20	2218 (23)	2759 (25)	1395 (23)	
Median income (zip code)				
<38,500	2781 (24)	3113 (25)	1791 (25)	0.001
38,500–48,499	2896 (25)	3194 (26)	1769 (25)	
48,500–62,000	3084 (26)	3134 (25)	1765 (25)	
>62,000	3008 (25)	3006 (24)	1732 (25)	
Grade				
1	1453 (11)	2494 (19)	664 (9)	0.001
2	8592 (71)	8229(64)	4386 (60)	
3	2097 (17)	2068 (16)	2203 (30)	
4	35 (1)	80 (1)	56 (1)	
Region				
Atlanta	624 (5)	570 (4)	371 (5)	0.001
Connecticut	768 (6)	1910 (15)	975 (13)	
Detroit	1299 (11)	2868 (22)	1366 (19)	
Hawaii	297(2)	419 (3)	207(3)	
Iowa	1220 (10)	1612 (13)	1029 (14)	
Los Angeles	2416 (20)	1100 (9)	837 (11)	
New Mexico	738 (6)	586 (4)	338(5)	
San Francisco	1377 (11)	1474 (11)	606 (8)	
San Jose-Monterey	674 (6)	481 (4)	342 (5)	
Seattle	1704 (14)	1353 (11)	783 (11)	
Utah	1060 (9)	498 (4)	455 (6)	
Year				
1991–1992	5611 (46)	5978 (46)	3752 (51)	0.001
1993–1994	4897 (40)	5189 (40)	2812 (39)	
1995	1669 (14)	1704 (13)	745 (10)	

Values in parenthesis indicate percentage.

creased, the number receiving secondary therapies decreased. We also noted variation among ethnic groups, although African Americans were more likely to receive primary radiation. Fewer radiation patients were married, and more were divorced/widowed.

TABLE 3
Multivariate Analysis Predicting the Likelihood of Secondary Treatment After Surgery for Prostate Cancer, 1991–1998*

Demographics	Odds ratio	95% confidence interval
Year of treatment		
1992–1993	0.99	0.91–1.08
1994–1995	0.93	0.84–1.03
1996–1997	0.86	0.77–0.96
1998	0.78	0.66–0.93
Married	0.96	0.88–1.04
Grade		
Grade 2	1.8	1.59–2.08
Grade 3	4.2	3.67–4.86
Grade 4	5.56	4.00–7.71
Region		
San Francisco	0.79	0.68–0.91
Connecticut	1.26	1.09–1.46
Detroit	1.09	0.96–1.24
Hawaii	0.98	0.76–1.25
Iowa	1.11	0.98–1.25
New Mexico	0.82	0.70–0.97
Seattle	0.98	0.87–1.11
Los Angeles	0.7	0.62–0.80
Atlanta	1.16	0.99–1.35
San Jose	1	0.85–1.18
Ethnicity		
Black	0.94	0.82–1.08
Hispanic	1	0.86–1.16
Other	0.88	0.73–1.05
Socioeconomic parameters		
Median income (zip code)	0.99	0.99–1.00
No high school education (census tract)	0.99	0.99–1.00

* Controlling for age and Charlson comorbidity index.

There was a slight tendency for surgical patients to be better educated and have larger median incomes. Grade 2 tumors were the predominant tumor grade for patients receiving surgery, radiation, or secondary therapy. However, almost one-third of all patients requiring secondary therapy had Grade 3 tumors. Geographic region greatly influenced surgical and radiation rates: Los Angeles had surgical rates almost twice that in other regions, whereas Detroit had radiation rates almost twice that found in other regions. The receipt of secondary therapies varied 3-fold among the regions with the lowest rates in New Mexico and the highest in Detroit. Finally, year of diagnosis varied inversely with secondary therapy with earlier years being more likely to receive further treatment.

Table 3 presents the multivariate model of factors associated with receipt of secondary therapy after surgical therapy. We identified no associations between demographic or socioeconomic factors and the use of secondary therapy after surgery. For pa-

TABLE 4
Multivariate Analysis Predicting the Likelihood of Secondary Treatment After Radiation for Prostate Cancer, 1991–1995*

Demographics	Odds ratio	95% confidence interval
Year of treatment		
1992–1993	1.42	1.29–1.55
1994–1995	2.21	1.99–2.46
Married	1	0.926–1.09
Grade		
Grade 2	1.51	1.37–1.67
Grade 3	2.69	2.41–3.00
Grade 4	1.78	1.18–2.67
Region		
San Francisco	0.66	0.53–0.82
Connecticut	1.35	1.11–1.64
Detroit	1.2	0.99–1.46
Hawaii	0.94	0.70–1.27
Iowa	1.26	1.03–1.53
New Mexico	1.03	0.81–1.33
Seattle	0.78	0.63–0.96
Los Angeles	1.31	1.06–1.61
Atlanta	1.11	0.87–1.41
San Jose	0.92	0.71–1.18
Ethnicity		
Black	0.99	0.87–1.13
Hispanic	1.08	0.88–1.34
Other	1.1	0.89–1.35
Socioeconomic parameters		
Median income (zip code)	1	0.99–1.01
No high school education (census tract)	1	0.99–1.01

* Controlling for age and Charlson comorbidity index.

tients undergoing initial surgical therapy, year of diagnosis, tumor grade, and geographic region were the only factors associated with secondary therapy. Patients diagnosed after 1996 were significantly less likely to require secondary therapy. Patients with Grade 3 and 4 tumors were 4 and 6 times more likely to receive secondary therapy. Connecticut was the only region with a significantly higher proportion of patients receiving secondary therapy after surgical intervention. Conversely, patients in San Francisco, New Mexico, and Los Angeles were significantly less likely to undergo secondary therapy after surgery.

Table 4 shows the multivariate model depicting the association of these same factors with receipt of secondary therapy after initial radiation therapy. We noted year of diagnosis was associated with secondary therapy. However, the later the year of diagnosis, the more likely the patients were to receive secondary therapy. Tumor grade and geographic region were again significant. Grade 3 and 4 tumors are positively associated with secondary therapy. We found more geographic variation in secondary therapy after radiation than after surgery. Men in Con-

necticut, Iowa, and Los Angeles were significantly more likely to receive secondary therapy, whereas those in San Francisco and Seattle were less likely.

DISCUSSION

Our most important finding is that patterns of care vary to a great degree after either primary surgery or radiation therapy. This finding suggests that ambiguity exists over how best to treat prostate cancer patients subsequent to primary therapy. Although this discussion focuses on prostate cancer patients, ambiguity exists in all medical fields leading to differential healthcare utilization. As the medical system faces escalating costs, minimizing variations in utilization is germane to all physicians.

Intuitively, when one considers the underlying mechanisms of the 2 treatments, one might believe that less ambiguity exists after surgical therapy. The goal of a RP is to remove the offending organ to render the patient free of prostate cancer. A pelvic lymph node dissection may be performed concurrently for staging purposes. In this setting, PSA becomes a binary tool: a detectable PSA indicates residual cancer, and an undetectable PSA indicates cure. In our analysis, we examined receipt of secondary therapy after primary surgical treatment and found that only year of diagnosis, grade, and geographic region were associated with secondary therapy. Although one is tempted to equate need for secondary therapy as a failure to cure the patient with primary therapy, this may not be true. In this analysis, we cannot differentiate between adjuvant and salvage post-prostatectomy radiation. Hence, the more cautious interpretation is that patients receiving secondary therapy after RP had an indicator of high-risk disease (e.g., seminal vesicle involvement or positive margins) or biochemical recurrence.^{16,17} Even though we considered the parameters that place a patient at high risk to be well delineated, practice patterns may reflect uncertainty on the part of the providers as to when secondary therapy is indicated.^{16–18} This uncertainty is not without foundation. The natural history of prostate cancer progression is such that only one-third develop metastasis within 8 years of recurrence.⁴ Therefore, if everyone were immediately given secondary therapy, only one-third would benefit. Patient selection and timing of secondary treatment remain contested in urologic circles.

After 1996, the year of diagnosis was negatively associated with secondary treatment. We postulate that widespread use of PSA testing led to the identification of earlier-stage prostate cancer. The suggestion from this data is that a greater number of these

patients had organ-confined disease and have yet to experience biochemical recurrence, thus ameliorating the need for secondary treatment. Whether this finding is due to a cancer 'cure' or is an artifact of lead-time bias remains to be seen.¹⁹

We found geographic region to be the other variable examined after primary surgical therapy that demonstrated significant variation. One possible explanation for geographic variation is patient tumor characteristics. PSA screening practices may account for differences in tumor characteristics. If PSA screening is less prevalent in Connecticut, for example, patients may present with higher-stage disease increasing the likelihood that they may need secondary treatment; hence our odds ratio was 1.29. Likewise, if screening is less frequent in African Americans and they present with higher stage disease, the odds ratio would be higher. We did not find that to be the case. Another theory to account for geographic variation is provider uncertainty. We have previously discussed the controversy surrounding patient selection for secondary therapy. However, our failure to find any associations between additional therapy and age, ethnicity, or marital status suggests that there is some consensus among providers as to the indications for additional therapy.

Our analysis of secondary therapy after radiation suggests that uncertainty exists among these providers as well. One area of uncertainty is how to define recurrence. PSA as a detection tool subsequent to radiation is not straightforward. Although radiation preferentially destroys tumor cells because of their higher mitotic rate, viable prostate remains after radiation therapy. In this situation, using PSA to evaluate for recurrence becomes more problematic. The definition of recurrence proposed by American Society for Therapeutic Radiology and Oncology (ASTRO) is 3 consecutive increases in posttreatment PSA after achieving a nadir.²⁰ This definition was disseminated in 1997 and rapidly adopted across the country.^{21,22} Controversy arose regarding the sensitivity and specificity of the ASTRO definition, as investigators found 4 other definitions better captured biochemical recurrence.^{23,24} Although this pursuit for improvement is admirable, each time the definition of recurrence changes the decision-making process becomes more confusing for both provider and patient.

Interestingly, the more recent the radiation therapy, the more likely the patients were to receive secondary therapy. The results of a randomized controlled trial by the RTOG 85-31, which demonstrated a survival benefit from adjuvant hormone ablation may have been disseminated even before publication in 1997 at international meetings such as American

Society for Clinical Oncologists.¹⁵ RTOG 85-31 specified 3 years of ADT for high-risk prostate cancer patients. Although using this 3-year window to define secondary therapy is evidence based, this window precludes us from researching the effect of secondary treatment on survival. To test this effect, our entire cohort would need greater than 4-years of follow-up to identify secondary treatment beyond this time period.

We also found that no patient received a RP subsequent to external beam radiotherapy. We believe this finding also represents dissemination of information regarding the difficulty of such a procedure. The morbidity in terms of blood loss and incontinence is unacceptably high in this clinical scenario.

In neither analysis was secondary therapy associated with any sociodemographic surrogates. We previously demonstrated using SEER public use files that geographic region, income, and ethnicity were all independently associated with primary treatment, or lack thereof.²⁵ However, that study focused on patients less than 65 years of age. The failure to identify differences by SES or ethnicity in this study may be due to the fact that Medicare insurance affords all patients some access to health care. Patients who face substantial cost-sharing or experience lapses in health care coverage may be more prone to skip follow-up care.

Our hypothesis that African Americans would receive less secondary treatment as a result of financial barriers, an altered perception of cancer risk, or failure to undergo posttreatment follow-up was not supported.^{13,26} However, until we controlled for overall survival time, African Americans were less likely to receive secondary therapy as compared to Caucasians. This finding suggests that African Americans even when controlling for stage, grade, and comorbidities have worse survival. Thus, the possibility exists for 2 effects to be offsetting each other. If African Americans present with higher stage disease, they should have an increased likelihood of secondary treatment, but this increase may be offset by a decreased survival time.

Our work highlights key issues facing the health-care system today. Rarely do physicians have a binary tool such as PSA to aid in medical decision making. Most patient care scenarios are more complex resembling the situation surrounding radiation therapy. For therapies that confer a less quantifiable clinical benefit, few practice guidelines exist to help physicians navigate this difficult terrain. Therefore, it is hardly surprising that utilization of secondary therapies varies when physicians have little evidence on which to base decisions. Our work implicitly also

suggests that providers may be 'over-treating' prostate cancer patients. Recent observational studies suggest that low-grade tumors do not require primary treatment, as competing causes are ultimate cause of mortality.²⁷ If initial therapy is not necessary, perhaps recurrence is over-treated as well. However, the data included in the present study is not adequate to address this issue.

Our study is limited by several factors. First, we may have failed to detect socioeconomic differences because we lack individualized data. Although we have used the most granular socioeconomic surrogates available (census tract and zip code), they still do not capture information at the individual level. We limited the definition of additional ADT after radiation to hormonal therapy occurring after a 3-year window. Our findings may have changed if we shortened this window. Such a change would have led to even more patients receiving secondary therapy after radiation, but if the associations would change is unclear. However, the results of the randomized trial provided a good basis on which to determine the cut-off. Another limitation is our failure to know the specific stage of the patient. Separation of the localized from regional disease may have detected different patterns. We also lack provider or institution data. Practice patterns surrounding the use of secondary therapies may vary between academic and nonacademic settings. SEER-Medicare is limited to men aged 65 years and older. This is an unavoidable consequence of our dataset. The use of secondary therapy may be different in younger men who, although potentially were caught early in the disease trajectory, also have a longer anticipated follow-up time in which to experience a recurrence. Hence, practice patterns may be different in these men. Further, with the explosion of information technology and access to literature, practice patterns may have changed in the years since our study period.

Patterns of care after primary therapy for early stage prostate cancer vary greatly, even after the advent of PSA screening. Despite dissemination of standardized definitions and results of randomized controlled trials, variation by geographic region persists for all prostate cancer patients, suggesting a need for large-scale efforts to promote evidence-based, high-quality care.

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