



## Changes across time and geography in the use of prostate radiation technologies for newly diagnosed older cancer patients: 2006-2008

### *Types of Prostate Radiation*

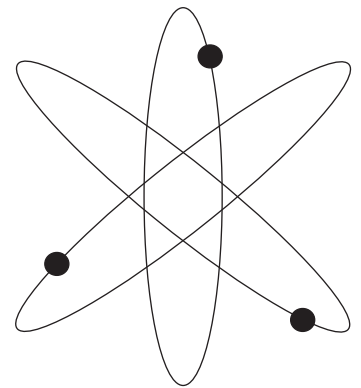
Prostate cancer is the most common nondermatologic cancer among adult males in the United States. The American Cancer Society estimated that 192,280 men would be diagnosed with and 27,360 men would die from prostate cancer in 2009.<sup>1</sup> Approximately 90 percent of prostate cancer cases are diagnosed while the cancer is confined to the prostate (i.e., clinically localized disease).<sup>2</sup>

The risk of dying from prostate cancer is low, approximately 3 percent. The disease course may be very slow even if left untreated.<sup>2</sup> The goal of clinical evaluation is to identify men who would benefit most from treatment to prevent prostate cancer deaths or disability while minimizing side effects.<sup>2</sup> Available treatments include watchful waiting, removal of the prostate (prostatectomy), radiation therapy from external beams or radioactive seeds placed within the tissue, cryotherapy (freezing the prostate), and androgen deprivation therapy (ADT).<sup>2</sup> Use of external beam radiotherapy and brachytherapy has increased over the last two decades.<sup>3</sup> Proton beam radiotherapy (PBRT) is another form of external beam radiotherapy that has applications in prostate cancer, which was examined in the Data Points report *Proton Beam Radiotherapy*.<sup>4</sup>

The two most common types of external beam radiotherapy in use during the last decade are three-dimensional conformal radiotherapy (3D CRT or CRT) and intensity-modulated radiotherapy (IMRT). IMRT allows more precise control of the radiation dose than CRT<sup>2</sup> and is associated with fewer rectal complications than CRT, although neither randomized nor contemporaneous comparisons exist.<sup>2</sup> IMRT also allows higher radiation dose delivery to the prostate (>80 Gy) than CRT, which may improve cancer-free outcomes, especially in higher risk tumors, although evidence is lacking.<sup>5</sup>

In 2000, Medicare began reimbursing for hospital-based IMRT of the prostate at a rate approximately four times that of the previous generation of external beam CRT.<sup>6</sup>

### Data Points # 16



Geographic and demographic variation is seen in the adoption of intensity-modulated radiotherapy (IMRT) as a replacement of conformal radiotherapy (CRT) for treatment of prostate cancer.

The increase in IMRT is associated with an increase in patients using external beam radiotherapy (EBRT) alone instead of in combination with brachytherapy.

IMRT has almost completely replaced CRT as the form of EBRT used in prostate cancer treatment.



In 2002, this payment change was expanded to include freestanding facilities.<sup>7</sup> IMRT is increasingly used in the treatment of several tumors and has been identified as a major factor in the rising cost of cancer care. In 2008, Medicare spent an estimated \$1 billion minimum on IMRT, mostly driven by treatment of prostate cancer.<sup>8</sup>

In a study using the linked Surveillance, Epidemiology, and End Results (SEER) Medicare claims database, Nguyen, et al., recently reported a significant increase in the use of IMRT for prostate cancer.<sup>9</sup> In 2002, 29 percent of those undergoing external beam radiation received IMRT. By 2005, that proportion had increased to 82 percent.<sup>9</sup> Prior examinations of the same database have shown tumor characteristics such as size or stage to be unrelated to use of CRT or IMRT.<sup>10</sup> Therefore, national trends can be studied using Medicare claims alone with minimal worry about confounding due to indication. We sought to expand the scope of study to include the entire U.S. Medicare population and update the findings of Nguyen, et al., to the 2006-2008 period (**Table 1**).

METHODS

We used the Chronic Condition Warehouse (CCW) claims-based algorithm to identify men newly diagnosed with prostate cancer. We identified men newly diagnosed between January 2006 and December 2008 by using the date the beneficiary first met the clinical criteria of the algorithm. We limited our study to men over age 65 who were alive and enrolled in Medicare fee-for-service (FFS) Parts A and B for at least 12 months after this date.

**Radiation therapy:** We identified men using radiation therapy treatments in the Part B (outpatient and carrier) claims using Healthcare Common Procedure Coding System (HCPCS) codes (**Table 2**).

**Table 1:** Percent distribution of older males undergoing radiation therapy by demography and year, 2006-2008\*

	2006	2007	2008	Overall
Total n	44,480	42,114	35,134	121,728
Total %	100.0 %	100.0 %	100.0 %	100.0 %
Age (years)				
66-69	20.8	20.0	20.7	20.5
70-74	34.4	34.8	36.3	35.1
75-79	29.7	29.9	28.5	29.4
80-84	11.9	12.2	11.6	11.9
85+	3.1	3.1	3.0	3.1
Race				
Non-Hispanic white	85.0	85.0	83.9	84.7
Black	9.2	9.0	9.4	9.2
Hispanic	3.7	3.8	4.2	3.9
Asian	1.4	1.3	1.5	1.4
American Indian	0.2	0.3	0.3	0.3
Other/unknown	0.5	0.6	0.6	0.6
Region				
Northeast	20.4	20.0	19.3	19.9
Midwest	23.6	23.6	22.9	23.4
South	41.0	41.7	42.8	41.8
West	15.1	14.7	14.9	14.9
State Assistance				
No	93.8	93.8	93.1	93.4
Yes	6.2	6.2	6.9	6.6

\* Limited to patients in Medicare FFS Parts A and B.

**Table 2:** Codes used to identify receipt of radiation therapy and surgery in outpatient and carrier claims

Type of Therapy	HCPCS/CPT Codes
Conformal radiation therapy (CRT)	77401 - 77416
Intensity modulated radiation therapy (IMRT)	77418, 0073T
Proton beam radiation therapy (PBRT)	77520 - 77525
Brachytherapy	
Low-dose rate (LDR)	77776 - 77778
High-dose rate (HDR)	77781 - 77784, 77785 - 77787
Radical prostatectomy*	
Minimally invasive	55866
Open	55810, 55812, 55815, 55840, 55842, 55845
NOS	60.5 (ICD-9 procedure code)

CPT: Common Procedural Terminology; ICD-9: International Classification of Diseases, Ninth Edition; NOS: not otherwise specified.

\* Used to exclude patients receiving postoperative radiation.

Patients with codes suggesting both IMRT and CRT were coded as IMRT.

**Radical prostatectomy:** We classified type of radical prostatectomy as minimally invasive or open if they had claims with select HCPCS codes, and NOS if the only indication of radical prostatectomy was an ICD-9 procedure code.

**Race/ethnicity:** Race and ethnicity were defined using the Research Triangle Institute Race Code, which uses a surname algorithm to assign Hispanic ethnicity.

**Hospital referral region (HRR):** We grouped beneficiaries into HRRs based on residential ZIP Code using a categorization obtained from the Dartmouth Atlas Web site.<sup>11</sup> We do not report percentages for HRRs with fewer than 30 resident prostate cancer patients in one year.

**Region:** We assigned region according to the four United States Census Bureau regions (Northeast, Midwest, South, and West) based on State of residence.

**State assistance:** We designated patients as receiving State assistance if the beneficiary Medicare Entitlement Buy-in indicator was between 01 and 09 in the month they were newly diagnosed.

The analysis is restricted to men who received radiation therapy within 12 months of the first date suggestive of prostate cancer in the claims. In addition to CRT and IMRT, we examined rates of proton beam therapy (a new form of external beam radiotherapy rarely used by prostate cancer patients) and brachytherapy (“internal” radiotherapy).

We exclude men who had radical prostatectomy within the 12 months of the first date suggestive of prostate cancer in the claims.

We investigated trends in use of radiation therapy services over time in two ways. First, we created mutually exclusive categories (IMRT alone, CRT alone, PBRT alone, brachytherapy alone, and any combination of external beam radiation [IMRT or CRT] and brachytherapy).

We also measured any use of these therapies (CRT alone or in combination with other treatments, IMRT alone or in combination with other treatments, etc.). We mapped “Any IMRT” use during each year by HRR.

## RESULTS

We identified 121,728 men newly diagnosed with prostate cancer between 2006 and 2008 who received radiation therapy within 12 months of diagnosis.

Use of IMRT alone or in combination with other therapies increased from 62.2 percent of all radiation users in 2006 to 73.6 percent in 2008. Meanwhile, use of CRT decreased from 24.1 percent to 12.7 percent. Use of brachytherapy decreased overall (35.5 percent in 2006 to 30.3 percent in 2008), despite a small increase in the proportion of radiation users using HDR brachytherapy (2.8 percent in 2006 to 3.3 percent in 2008; **Table 3**).

Use of IMRT alone was the most common form of radiotherapy in 2006 (52.5%) and the proportion of users increased in 2008 (63.4%). The proportion of radiation users who used IMRT plus brachytherapy increased slightly over the same period from 9.7 percent to 10.1 percent. The share of radiation users who used HDR alone or any PBRT also increased slightly over the period (0.5% to 0.7% and 0.8% to 1.4%, respectively), while the share of people using CRT alone or CRT plus brachytherapy and LDR brachytherapy decreased (**Table 4**).

Overall, 7.9 percent of radiation users used CRT alone. This rate was higher in men ages 80-84 (12.6%) and men over 85 (29.0%), blacks (9.2%), American Indians (14.4%), men living in the Midwest (9.4%) and men receiving State assistance (11.7%; **Table 5**).

Brachytherapy alone made up 20.8 percent of radiation use. Rates were higher in younger men (66-69: 26.5%, 70-74: 23.4%), non-Hispanic white men (21.5%), and men living in the Midwest (23.7%).

Rates were much lower among men older than 85 (6.5%), Hispanic men (14.0%), and men receiving State assistance (13.8%) (Table 5).

The maps display the proportion of radiotherapy users in each HRR who used IMRT alone or in combination with another therapy. The proportion of HRRs with rates over 75 percent grew from 2006 to 2008 from 18.6 percent of HRRs to 40.7 percent (Figure 1).

CONCLUSIONS

IMRT allows the delivery of highly targeted radiotherapy, minimizing the likelihood of rectal toxicity and thus permitting higher doses to be delivered to the prostate. Higher doses of CRT are associated with lower tumor recurrence rates. Therefore, the combination of higher doses permitted with IMRT and lower rectal toxicity are potential reasons providers and patients find IMRT preferable to CRT in prostate cancer treatment. Yet we have no randomized comparisons or even contemporaneous nonrandomized comparisons of CRT and IMRT.<sup>5</sup> Higher Medicare reimbursements have provided incentive for IMRT use.<sup>9</sup>

IMRT has almost completely replaced CRT as the form of EBRT used in prostate cancer treatment. As of 2008, IMRT is used more often than CRT whether patients are receiving EBRT alone or in combination with other therapies. In fact, the shift toward IMRT has been associated with a move toward more EBRT as monotherapy—IMRT alone or CRT alone was used in 63.6 percent of patients in 2006 but 68.2 percent in 2008. Over the same time period, the use of brachytherapy decreased, both in men receiving CRT + brachytherapy and brachytherapy alone. The only brachytherapy use that increased was IMRT + brachytherapy.

Table 3: Older males newly diagnosed with prostate cancer by radiation therapy type and year, 2006-2008

	2006	2007	2008
Total	44,480	42,114	35,134
	%	%	%
Any external beam therapy	87.3	87.1	87.7
Any IMRT	62.2	68.4	73.6
Any CRT	24.1	17.5	12.7
Any PBRT	1.0	1.2	1.4
Any brachytherapy	35.5	33.1	30.3
Any HDR	2.8	3.2	3.3
Any LDR	33.5	30.8	27.9

Table 4: Percent distribution of older males newly diagnosed with prostate cancer by combinations of radiation therapy and year, 2006-2008\*

	2006	2007	2008
Total	44,478	42,113	35,131
	%	%	%
Total	100.0	100.0	100.0
IMRT + brachy	9.7	9.7	10.1
IMRT alone	52.5	58.7	63.4
CRT + brachy	3.6	2.4	1.5
CRT alone	11.1	7.0	4.8
HDR alone	0.5	0.6	0.7
LDR alone	21.6	20.4	18.0
PBRT alone or + brachy	0.8	1.1	1.4
Other**	0.1	0.1	0.0

\*These categories are mutually exclusive. Men receiving both IMRT and CRT are placed in the IMRT groups. Men receiving HDR and LDR are in the HDR group.  
\*\* Other in this case is patients with more than two types of radiation (e.g., PBRT+IMRT+HDR).

**Table 5:** Percent distribution of older males newly diagnosed with prostate cancer by demography and combinations of radiation therapy and year, 2006-2008\*

	IMRT only	IMRT + BT	CRT only	CRT + BT	BT only	Other	Overall
Total n	70,320	11,954	9,581	3,118	25,300	1,455	121,728
Total %	57.8	9.8	7.9	2.6	20.8	1.2	100
<b>Age (years)</b>							
66-69	50.8	11.7	6.2	3.1	26.5	1.8	100
70-74	55.6	10.9	5.9	2.9	23.4	1.3	100
75-79	61.6	9.3	7.2	2.4	18.6	0.9	100
80-84	66.2	6.4	12.6	1.5	12.4	0.8	100
85+	59.9	3.4	29.0	0.8	6.5	0.5	100
<b>Race</b>							
Non-Hispanic white	57.1	9.7	7.8	2.5	21.5	1.3	100
Black	60.2	10.1	9.2	2.9	17.1	0.4	100
Hispanic	65.3	10.0	7.7	2.3	14.0	0.7	100
Asian	59.2	13.4	5.8	2.5	17.9	1.4	100
American Indian	56.2	4.0	14.4	4.0	19.6	1.7	100
Other/unknown	55.9	11.6	5.7	4.4	21.0	1.4	100
<b>Region</b>							
Northeast	64.0	10.2	6.6	1.7	17.0	0.4	100
Midwest	57.5	6.3	9.4	2.6	23.7	0.5	100
South	56.5	11.9	7.4	2.7	20.4	1.2	100
West	53.3	9.2	8.6	3.3	22.4	3.2	100
<b>State assistance</b>							
No	57.4	9.9	7.6	2.6	21.3	1.3	100
Yes	63.4	8.3	11.7	2.5	13.8	0.3	100

\*These categories are mutually exclusive. Men receiving both IMRT and CRT are placed in the IMRT groups.

The shift toward IMRT has not occurred as rapidly in some groups. Older patients, blacks, American Indians, and men receiving State assistance continue to receive CRT more frequently than their peers. This may reflect poorer access to care, including new technologies, among disadvantaged groups.

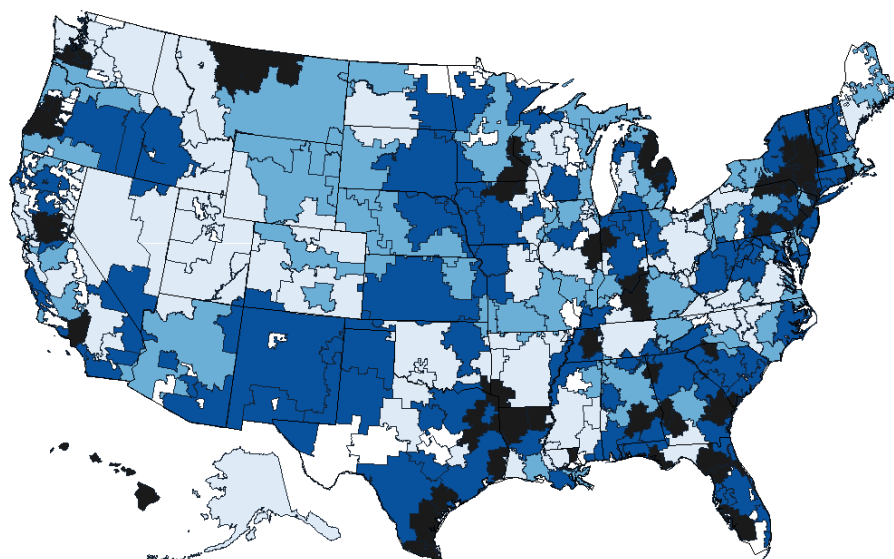
The Midwest has also been slower to adopt IMRT than other regions. However, a comparison of IMRT use across the United States between 2006 and 2008 (**Figure 1**) points to greatly expanding use through the central Midwest, including Kansas, Iowa, and Indiana.

Given the large-scale conversion to IMRT, it seems unlikely that physician groups are using both CRT and IMRT in their treatment of prostate cancer. If CRT becomes less accessible, we may expect IMRT use to increase in other tumors, perhaps even in tumors where the indications for IMRT are not very strong (i.e., where the risk of adjacent organ toxicity is not as critical as in prostate cancer). Monitoring IMRT use should be a priority for these other cancers as well as for groups of prostate cancer patients and patients in areas of the country that have been slower to adopt this new technology.

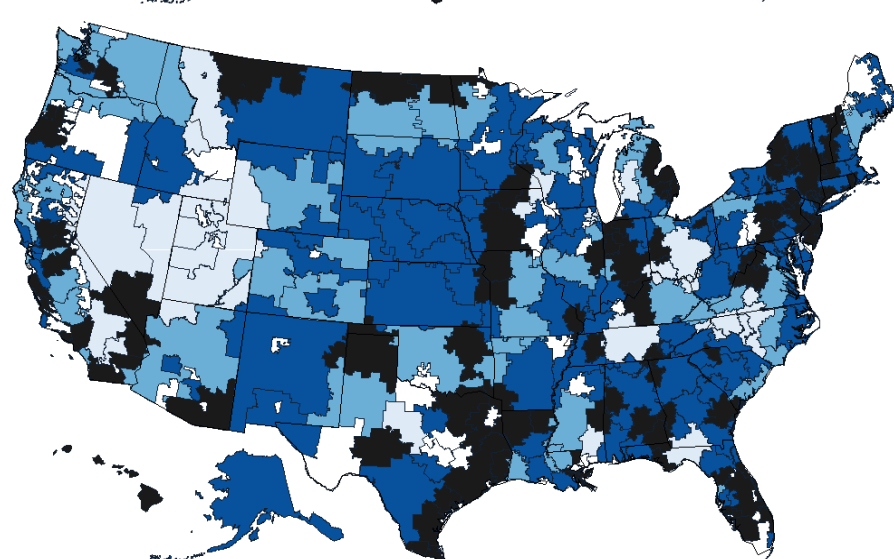


**Figure 1:** Proportion of men receiving radiation therapy for prostate cancer who received IMRT alone or in combination with other radiation therapies, 2006-2008

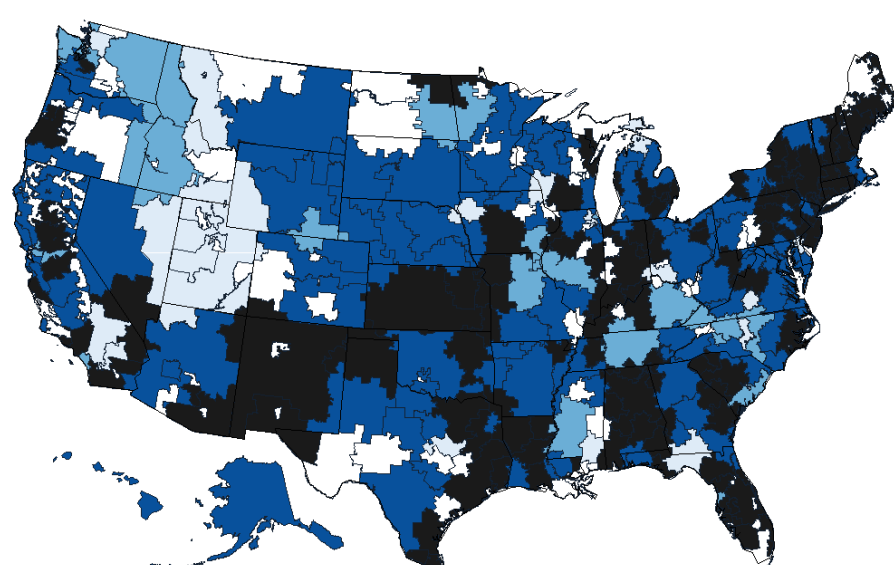
2006



2007



2008



% radiotherapy users receiving IMRT	# HRRs in each category		
	2006	2007	2008
≤ 50	71	30	20
>50-60	60	48	21
>60-75	98	110	99
>75	57	90	125
Too small to calculate	21	29	42
Total	307	307	307

HRR: Hospital Referral Region.

IMRT: Intensity modulated radiation therapy.

## REFERENCES

1. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2009. *CA Cancer J Clin* 2009;59(4):225-49.
2. Wilt TJ, Shamliyan T, Taylor B, et al. Comparative effectiveness of therapies for clinically localized prostate cancer. Comparative Effectiveness Review No. 13. (Prepared by Minnesota Evidence-based Practice Center under Contract No. 290-02-0009). Rockville, MD: Agency for Healthcare Research and Quality; 2008.
3. Jani A, Johnstone P, Liauw S. Prostate cancer modality time trend analyses from 1973 to 2004: a Surveillance, Epidemiology, and End Results registry analysis. *Am J Clin Oncol* 2010;33(2):168-72.
4. Jarosek S, Elliott S, Virnig BA. Proton beam radiotherapy in the U.S. Medicare population: growth in use between 2006 and 2009. Proton Beam Radiotherapy. Data Points #10 (prepared by the University of Minnesota DEcIDE Center, under Contract No. HHSA2902010013I). Rockville, MD: Agency for Healthcare Research and Quality; January 2012. AHRQ Publication No. 12-EHC005.
5. Ip S, Dvorak T, Yu WW, et al. Comparative evaluation of radiation treatments for clinically localized prostate cancer: an update. Technology Assessment Report Project ID: CANT1209 (Prepared by the Tufts Evidence-based Practice Center under Contract No. 290-2007-1005-I). Rockville, MD: Agency for Healthcare Research and Quality; 2010.
6. Department of Health and Human Services Health Care Financing Administration. Office of Inspector General; Medicare Program; Prospective Payment System for Hospital Outpatient Services; Final rule with comment period. 65 Federal Register 68 (7 April 2000), 18469 and 18554.
7. Centers for Medicare & Medicaid Services. Physician fee schedule search. Baltimore, MD. Available at: [www.cms.gov/apps/physician-fee-schedule/search/search-criteria.aspx](http://www.cms.gov/apps/physician-fee-schedule/search/search-criteria.aspx) (Accessed May 15, 2012).
8. Carreyrou J, Tamman M. A device to kill cancer, lift revenue. *Wall Street Journal*. 2010 Dec 7. Available at: [online.wsj.com/article/SB10001424052748703904804575631222900534954.html](http://online.wsj.com/article/SB10001424052748703904804575631222900534954.html) (Accessed May 15, 2012).
9. Nguyen PL, Gu X, Lipsitz SR, et al. Cost implications of the rapid adoption of newer technologies for treating prostate cancer. *J Clin Oncol* 2011;29(12):1517-24.
10. Elliot SP, Adejoro OO, Jarosek SL, et al. Intensity modulated radiation therapy (IMRT) replaces 3-dimensional external beam radiotherapy in prostate cancer treatment. *J Urol* 2012 Apr;187(4):1253-8.
11. Dartmouth Atlas of Health Care. Tools. Available at: [www.dartmouthatlas.org/tools/](http://www.dartmouthatlas.org/tools/). (Accessed November 9, 2011).

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