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Reimbursement and use of intensity-modulated radiation therapy for prostate cancer

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Abstract

The use of intensity-modulated radiation therapy (IMRT) for prostate cancer increased through the mid-2000s, in association with acquisition of the devices by large urology groups. More recently, reimbursement for IMRT in the office setting (generally representing freestanding facilities owned by physicians) has been declining. The aim of the study was to examine trends in IMRT use and related payments in the office versus hospital outpatient setting over time.

In this retrospective cohort study, a total of 66,967 men aged 66 years or older, with newly diagnosed prostate cancer from 2007 through 2012 were identified in a 20% national sample of Medicare claims. IMRT use in the office versus hospital outpatient setting was examined over time, adjusted for patient characteristics using multivariable logistic regression models. Mean reimbursement for IMRT treatments and total IMRT-related payments were plotted by year.

IMRT use increased from 28.6% to 38.0% of newly diagnosed men with prostate cancer over the study period, exclusively related to growth in the office setting. In particular, use in the office setting increased from 13.2% in 2007 to 22.1%, whereas use in the hospital outpatient setting remained essentially steady throughout the period around 15%. During the same period mean reimbursement for IMRT in the office setting declined from $504 per individual radiation treatment to $381, whereas it increased from $283 to $380 in the hospital outpatient setting. However, total IMRT-related payments in the office setting increased through 2011 due to increased utilization, falling only in 2012 (to $35.7 million from $48.3 million in 2011) related both to continued declines in reimbursement and a large reduction in new cases of prostate cancer.

In conclusion, use of IMRT in the physician office setting in men diagnosed with prostate cancer has continued to increase in the face of declining reimbursement. Total payments for IMRT fell only in 2012, following a substantial reduction in new cases of prostate cancer.

Abbreviations: IMRT = intensity-modulated radiation therapy, SEER = surveillance, epidemiology and end results.

Keywords: cancer, prostate, radiation therapy, reimbursement

1. Introduction

Although still the most common solid organ malignancy in men, with over 180,000 new cases a year, prostate cancer remains challenging to manage.[1] Many men with the disease will not die of it, even without any intervention, due to competing risks of death from age and comorbidities.[2] On the other hand, it remains the second most frequent cancer killer of men, suggesting the need to treat some cases aggressively. The ongoing uncertainties about who to treat and how have resulted in tremendous variation in treatment patterns, with management often driven by nonclinical factors, such as financial incentives for physicians.[3–5] One example is the dramatic reduction in use of androgen deprivation therapy for prostate cancer (previously a major revenue source for some urologists) following cuts in its reimbursement in 2005.[6]

More recently, large single-specialty urology groups have pooled capital to invest in the purchase of intensity-modulated radiation therapy (IMRT) vaults.[7] This allowed them to capture the technical component of fees related to its use, substantially increasing revenues. In this context, IMRT use for prostate cancer rose sharply through the early to mid-2000s.[8,9] Although reimbursement for IMRT was initially higher for treatment in the office setting (generally representing free-standing facilities owned by physician groups) than for treatment in the hospital outpatient setting (representing hospital-based facilities), it has been declining steadily in recent years. We therefore examined trends in use of IMRT and related payments for the treatment in the office versus hospital outpatient setting over time.

2. Methods

2.1. Data source and study population

This was a retrospective cohort study of a 20% sample of fee-for-service Medicare beneficiaries with newly diagnosed prostate cancer from 2007 through 2012, with follow-up available through December 31, 2013. The analytic sample included men who were eligible for both Medicare Parts A and B, excluding

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those participating in Medicare managed care plans (full flowchart presented in Fig. 1). Due to the requirement for Medicare coverage and at least a full year of Medicare claims prior to diagnosis of prostate cancer for assessment of pre-existing comorbidities, only men aged 66 years or older were included in the analyses. There were additional exclusions required to ensure completeness of the data for analytic purposes, such as those related to missing data or incomplete follow-up (detailed in Fig. 1).

Incident cases of cancer were identified using a Medicare claims algorithm validated against cancer registry data. Briefly, we used a 5% sample of Medicare beneficiaries residing in a Surveillance, Epidemiology and End Results (SEER) registry catchment area to initially identify patients with 2 or more physician office visits associated with an International Classification of Diseases, 9th revision diagnosis code of 185 for "prostate cancer." To be considered a new diagnosis, men must have a claim for prostate biopsy in the 180-day period prior to the first office visit associated with a prostate cancer diagnosis. Among these men, we further excluded those with a diagnosis code for prostate cancer in the 12-month window prior to the biopsy. We then validated this algorithm using the Patient Entitlement Denominator Summary File, which identifies all incident cases in SEER regions, and found our algorithm to have a specificity and positive predictive value of 99.8% and 88.7%, respectively.

2.2. Study variables

The main study outcome was the use of IMRT as the initial management strategy within 12 months of diagnosis (i.e., a

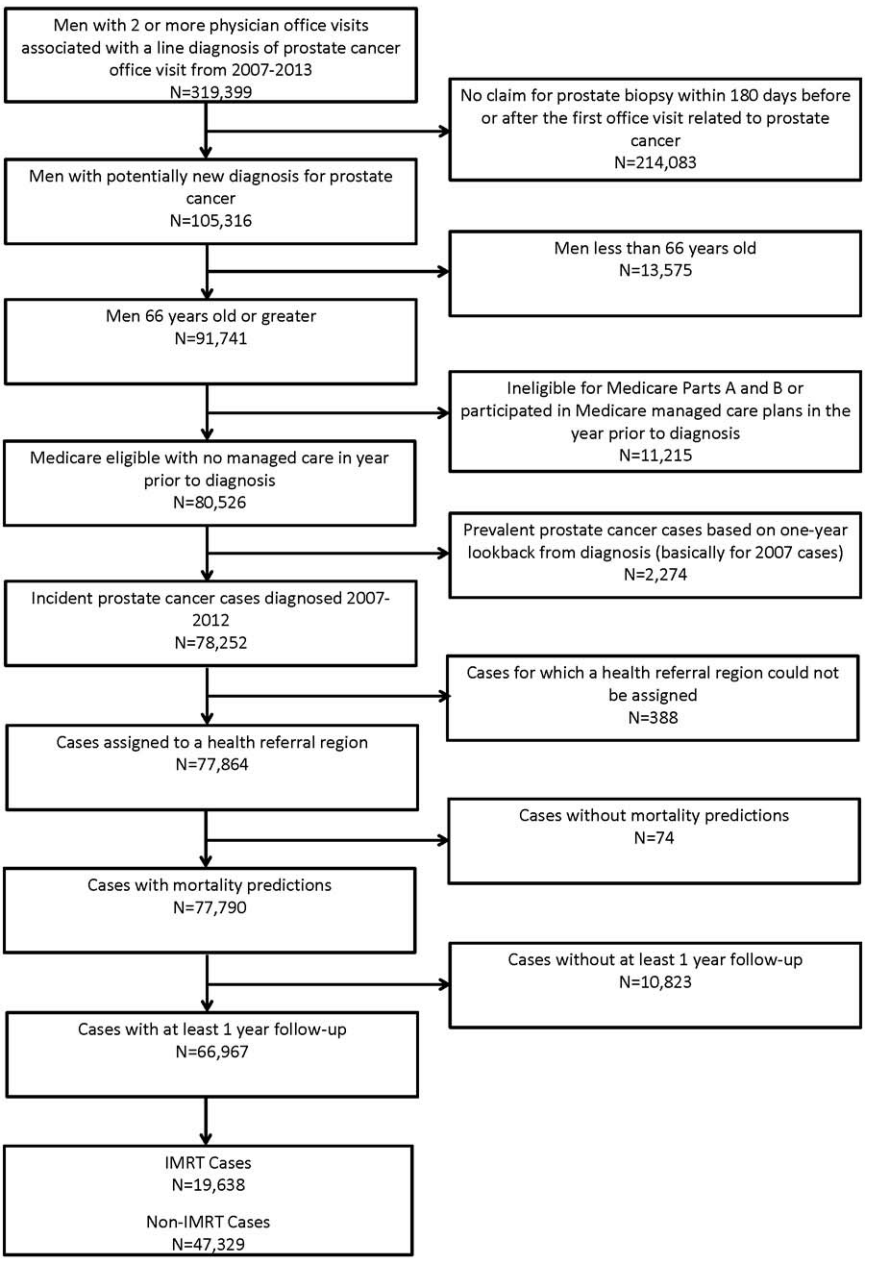


Figure 1. Flowchart for the analytic sample.

binary variable indicating whether or not IMRT was utilized), based on the presence of the relevant Medicare claims in the hospital-outpatient and carrier files indicating planning and treatment (Healthcare Common Procedure Coding System codes 77014, G0174 and codes in the range 77261–77999). Based on previously described approaches, the use of IMRT was further categorized by place of service into "office" if all the IMRT claims of a patient were present only in the carrier files, otherwise as "hospital outpatient" if any or all claims were present in the outpatient files.[10,11]

Reimbursement for IMRT over time in each setting was assessed by examining the mean dollar amount of payments on claims with code 77418 (representing delivery of each IMRT treatment) for each calendar year. Total payments for IMRT were calculated by summing up payments for all IMRT-related claims within 12 months of diagnosis for patients assigned to either the office or hospital outpatient setting, for each calendar year. All dollar amounts were inflation-adjusted and indexed to the year 2007.

Predictor variables included in the analysis were age (operationalized as a 5 category variable divided as age at diagnosis 66–69, 70–74, 75–79, 80–84, or ≥85 years), and race (operationalized as a 3-category variable as White, Black, or Other/Unknown). In addition, as differences in patient characteristics could affect suitability for aggressive treatment such as radiation therapy, we assessed the comorbidity index of patients using claims for the 12-month window prior to diagnosis, based on established methods.[12] This index was operationalized as a 4 category variable (score of 0, 1, 2, or ≥3). Furthermore, because intervention is generally not recommended for patients with a life expectancy less than 10 years, we also included a variable assessing each patient's risk of noncancer death within 10 years of diagnosis, categorized by quartiles. This was previously developed based on a model predicting all-cause mortality using a 5% sample of Medicare beneficiaries without a cancer diagnosis (available as part of the SEER-Medicare database) incorporating age, socio-economic class, comorbidity, census tract, and time at risk.[8] The model allows assignment based on the characteristics noted of a probability of death over a 10-year period to each patient. The patients are then divided into quartiles based on this probability, with the variable representing the quartile (first, second, third, or fourth) in which the patient resides. A variable indicating socio-economic class was estimated at the zip code level, using methods described by Diez-Roux, and categorized by tertiles.[13] The variable was based on a neighborhood socioeconomic summary score derived in the referenced study through a combination of factors representing dimensions of wealth, education, and occupation. Each patient was assigned a score based on their zip code of residence, with patients divided into tertiles based on their score (operationalized as a 3-category variable).

2.3. Statistical analyses

Characteristics (age, race, comorbidity index, socio-economic class, and predicted risk of noncancer mortality) of patients treated in the office versus hospital outpatient settings with IMRT in 2007 and 2012 were compared using chi-square tests. Use of IMRT in the office and hospital outpatient settings were examined over time in multivariable logistic regression models (given the binary nature of the outcome) with age, race, socio-economic class, comorbidity index, and predicted mortality as operationalized above entered into the model as predictor variables.[14] The adjusted percentages of patients treated with IMRT in each setting and in either (total) were computed by back-transforming the predicted use from the models and plotted for each calendar year.[15] These percentages were calculated based on predicted marginal means for each calendar year based on the multivariable logistic regression model and then converted from the log-odds scale to percentages via an inverse logit function.[15] In addition, a stratified analysis was performed among only patients in the highest quartile of predicted mortality (the mortality variable was omitted from the multivariable models). Mean payments for each IMRT treatment (based only on code "77418") in the office and hospital outpatient settings were plotted by calendar year. Total payments (based on all relevant codes) for patients in the office and hospital outpatient settings were also plotted by the calendar year. All analyses were carried out using computerized software (SAS 9.4, Cary, NC). All tests were 2-tailed and the probability of Type 1 error was set at 0.05. The study protocol was judged to be exempt by the institutional review board of the University of Michigan.

3. Results

Table 1 presents characteristics of men aged 66 years or older, with newly diagnosed prostate cancer, treated with IMRT in 2007 and 2012, stratified by whether they received treatment in an office or hospital outpatient setting. Patients treated in either setting were very similar with respect to the examined characteristics, with the only significant difference occurring in 2007, with a slightly greater percentage of patients in the highest socio-economic class being managed in the hospital outpatient setting. Patients treated in 2012 were somewhat younger, more likely to be Black, and have more comorbidities than those in 2007.

As shown in Figure 2A, use of IMRT among newly diagnosed men aged 66 years or older with prostate cancer has continued to increase from 28.6% in 2007 to 38.0% in 2012. Almost all the growth occurred in the office setting, increasing from 13.2% of newly diagnosed men with prostate cancer (aged 66 years or older) in 2007 to 22.1% of such men in 2012 (adjusted odds ratio 1.13 [95% confidence interval, 1.12–1.15] per calendar year over study period), whereas use in the hospital outpatient setting remained essentially steady throughout the period around 15% (adjusted odds ratio 1.0 [95% confidence interval, 0.99–1.02] per calendar year over the study period). This pattern was similar among men in the highest quartile of predicted mortality (Fig. 2B) though there was modest growth in the hospital outpatient setting from 2010 to 2012 (adjusted odds ratio 1.05 [95% confidence interval, 1.02–1.07] per calendar year over the entire study period). In addition, there was a plateau in use of IMRT in the office setting between 2011 and 2012 (adjusted odds ratio 1.15 [95% confidence interval, 1.12–1.17] per calendar year over the entire study period). During the same period, mean reimbursement per IMRT treatment claim declined in the office setting from $504 in 2007 to $381 in 2012, whereas it increased from $283 to $380 in the hospital outpatient setting (Fig. 2C).

As shown in Figure 3, total payments for IMRT in the office setting increased until 2010–2011 despite declining reimbursement (median payment for a course of IMRT was $27140 in 2007 versus $25158 in 2011) due to growth in the number of men treated. There was a substantial drop in total payments in the office setting in 2012, from $48.3 million in 2011 to $35.7 million in 2012. This was related to decreases both in reimbursement for IMRT and the number of men treated. Specifically, the median payment for a course of IMRT dropped

Table 1

Characteristics of patients treated with IMRT in 2007 and 2012, stratified by place of service.

Characteristics	Patients treated with IMRT in 2007			Patients treated with IMRT in 2012		
	Office N (%)	Hospital outpatient N (%)	*P**	Office N (%)	Hospital outpatient N (%)	*P***
Total N	1662	2023		1634	1131	
Age, years:			.77			.76
66–69	319 (19.2)	375 (18.5)		401 (24.5)	260 (23.0)	
70–74	558 (33.6)	699 (34.6)		578 (35.4)	395 (34.9)	
75–79	504 (30.32)	633 (31.3)		454 (27.8)	327 (28.9)	
80–84	239 (14.4)	272 (13.5)		166 (10.2)	127 (11.2)	
≥85	42 (2.5)	44 (2.2)		35 (2.1)	22 (2.0)	
Race:			.39			.10
White	1502 (90.4)	1805 (89.2)		1412 (86.4)	1003 (88.7)	
Black	130 (7.8)	170 (8.4)		175 (10.7)	108 (9.6)	
Other/unknown	30 (1.8)	48 (2.4)		47 (2.9)	20 (1.8)	
Socio-economic class tertiles:			.009			.42
1st	545 (32.8)	606 (32.8)		493 (30.2)	352 (31.1)	
2nd	642 (38.6)	745 (36.8)		576 (35.3)	415 (36.7)	
3rd	475 (28.6)	672 (33.2)		565 (34.6)	364 (32.2)	
Comorbidity index			.47			.32
0	1000 (60.1)	1187 (58.7)		891 (54.5)	585 (51.7)	
1	396 (23.8)	483 (23.9)		379 (23.2)	287 (25.4)	
2	145 (8.7)	207 (10.2)		198 (12.1)	130 (11.5)	
≥3	121 (7.3)	146 (7.2)		166 (10.2)	129 (11.4)	
Predicted Mortality quartiles:			.59			.15
1st	276 (16.6)	324 (16.0)		335 (20.5)	198 (17.5)	
2nd	404 (24.3)	524 (25.9)		410 (25.1)	289 (25.6)	
3rd	544 (32.7)	671 (33.2)		482 (29.5)	330 (29.2)	
4th	438 (26.3)	504 (24.9)		407 (24.9)	314 (27.8)	

IMRT = intensity-modulated radiation therapy.

* From chi-square statistic comparing patient characteristic between the office and hospital outpatient IMRT users in 2007.

** From chi-square statistic comparing patient characteristic between the office and hospital outpatient IMRT users in 2012.

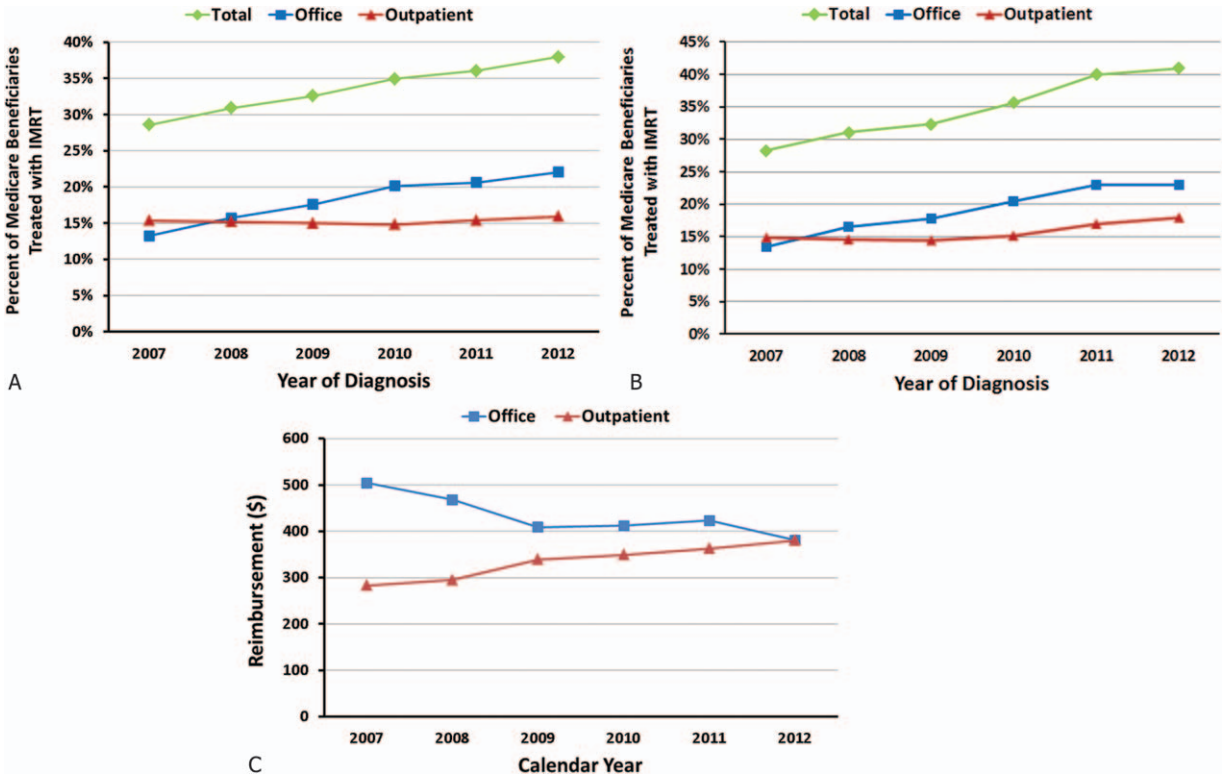
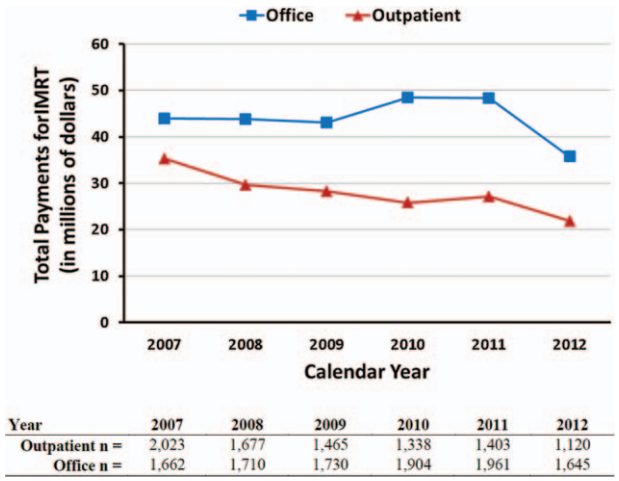


Figure 2. (A) Adjusted percent of Medicare beneficiaries with a new diagnosis of prostate cancer treated with IMRT from 2007 through 2012 (n = 66,967), in the office setting (blue squares), hospital outpatient setting (red triangles) or either setting (green diamonds). (B) Adjusted percent of Medicare beneficiaries in the highest quartile of predicted noncancer mortality (n = 16,748) with a new diagnosis of prostate cancer treated with IMRT from 2007 through 2012 (n = 66,967), in the office setting (blue squares), hospital outpatient setting (red triangles) or either setting (green diamonds). (C) Mean payments for the IMRT treatment claim (code 77418) among Medicare beneficiaries with newly diagnosed prostate cancer, in dollars, from 2007 through 2012, in the office setting (blue squares), hospital outpatient setting (red triangles). IMRT = intensity-modulated radiation therapy.



Year	2007	2008	2009	2010	2011	2012
Outpatient n =	2,023	1,677	1,465	1,338	1,403	1,120
Office n =	1,662	1,710	1,730	1,904	1,961	1,645

Figure 3. Total Medicare payments for all IMRT-related claims among Medicare beneficiaries with newly diagnosed prostate cancer, in millions of dollars, from 2007 through 2012, in the office setting (blue squares) and hospital outpatient setting (red triangles). Sample size for Medicare beneficiaries treated with IMRT in each setting is provided by year immediately below the figure. IMRT = intensity-modulated radiation therapy.

from $25158 in 2011 to $21847 in 2012, and the number of men treated in the office setting dropped from 1961 in 2011 to 1645 in 2012 (data shown in Fig. 3).

4. Discussion

We demonstrated a steady increase in the proportion of men with newly diagnosed prostate cancer aged 66 years or older treated with IMRT throughout the period from 2007 to 2012, almost exclusively related to growth of its use in the office setting. This occurred in the face of substantial declines in reimbursement for IMRT in the office setting. However, total payments for IMRT in the office setting continued to increase until a sharp, 26% drop occurred in 2012 due to a combination of continued cuts in its reimbursement and a large reduction in men treated (as noted in data shown in Fig. 3).

The treatment patterns we observed are consistent with the theory of physician-induced demand, which states that physicians influence patient demand for treatment to suit their own interests.[16–18] One prediction from this theory is that in the face of declining prices, physicians may increase the volume of services to sustain their income. Empirical support for this is available in various clinical contexts.[19–22] For example, following reductions in reimbursement for certain chemotherapeutic drugs in 2005 due to the Medicare Modernization Act, administration of chemotherapy for lung cancer increased.[19] In our study context, a substantial portion of the IMRT use in the office setting likely represents physician-owned devices. The large capital investment required to purchase and maintain an IMRT vault may have placed particular pressure on owning practices to increase the volume of men treated to sustain revenues as reimbursement for IMRT declined.

Our study findings should be considered in the context of certain limitations. First, this study was based on Medicare data and the patterns observed may be different among patients with other forms of health insurance or among younger patients. However, the majority of men diagnosed with prostate cancer are Medicare eligible, and we were particularly interested in the impact of Medicare reimbursement policies. Second, there may be further issues regarding the generalizability of our findings given the substantial number of patients excluded for analytic purposes (see Fig. 1). Third, we could not directly identify whether patients treated in the office setting received IMRT from physician-owned practices. Furthermore, we could not examine rates of use in the office versus hospital outpatient setting because we did not have practice level data. As such, our ability to draw causal inferences about the influence of reimbursement on the observed patterns is limited. Nevertheless, our findings are consistent with other literature in the prostate cancer context suggesting that self-referral relationships in practices can drive utilization of care.

The study findings have 3 important implications for health reform and the value of prostate cancer care. First, in a fee-for-service payment environment, reductions in reimbursement may lead providers to increase volume of services, both potentially leading to a less than expected savings in terms of cost and notably, to more overtreatment. In our study, IMRT use increased substantially even among men in the highest quartile of predicted noncancer mortality. As these men have very limited life expectancy, even in the absence of a cancer diagnosis, they are highly likely to die of causes other than their prostate cancer.[2,23] These men are, therefore, unlikely to benefit from intervention directed at their cancer and current national guidelines recommend conservative management.[24] Second, the degree of reduction in reimbursement may need to be very large to effect any change. For example, cuts to reimbursement in androgen deprivation therapy by over 50% per dose were associated with reduction in its inappropriate use by 30%.[6] In our study, net cost savings to Medicare only occurred in 2012, after continued cuts in reimbursement. Nevertheless, this appeared to have no impact on the percent of men diagnosed with prostate cancer being treated with IMRT. Finally, the large reduction in the number of men treated with IMRT in 2012 was entirely due to a drop in the number of men newly diagnosed with prostate cancer that year (the percent of diagnosed men who were treated continued to increase through 2012) and was a substantial contributor to the reduction in total payments for IMRT that year. This was almost certainly related to reduced prostate-specific antigen (PSA) screening following recommendations made against it in 2012 by the United States Preventive Services Task Force.[25] This reinforces the point that much of overtreatment for prostate cancer can be traced back to inappropriate use of PSA screening. Policies aimed at screening therefore represent another important lever for influencing the value of prostate cancer care.

A final point is that current and upcoming health reforms focusing on improving the value of health care, such as the Medicare Access and CHIP Reauthorization Act (MACRA), will undoubtedly influence how men with prostate cancer are managed.[26] Further cuts to reimbursement and requirements for financial savings embedded in these initiatives will place particular pressure to limit use of costly treatment options such as IMRT to scenarios where the benefits are clear-cut. This in turn may lead to an appropriate increase in use of watchful waiting approaches for men with limited life expectancy, or active surveillance for healthier men with favorable risk tumors.

In conclusion, this study demonstrates increasing use of IMRT in the office setting among men aged 66 years or older with prostate cancer over the period from 2007 through 2012, during which reimbursement for the treatment in that context was falling.

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