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ORIGINAL ARTICLE

Low rates of bone mineral density measurement in Medicare beneficiaries with prostate cancer initiating androgen deprivation therapy

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Abstract
Background Men with prostate cancer who undergo androgen deprivation therapy (ADT) are at risk for bone loss and fractures. Our objective was to determine if Medicare beneficiaries with prostate cancer in the state of Texas underwent DXA scans when initiating ADT.
Methods We identified men diagnosed with prostate cancer between 2005 and 2007 in the Texas Cancer Registry/Medicare linked database, and who received parenteral ADT or orchiectomy. We identified DXA claims within 1 year before or 6 months after starting ADT. We examined use of bone conservation agents in the subgroup of patients enrolled in Medicare Part D. Multivariate logistic regression models were used to examine determinants of DXA use.
Results The analysis included 2,290 men (2,262 parenteral ADT, 28 orchiectomy); 197 (8.6 %) underwent DXA within 1 year before and 6 months after starting ADT. Men aged 75 years or older were more likely to undergo DXA than men aged 66–74 years (OR 1.5; 95 % CI 1.1–2.1). Those living in small urban areas were less likely to undergo DXA than those in big areas (OR 0.40; 95 % CI 0.19–0.82). Of the 1,060 men enrolled in Medicare part D, 59 (5.6 %) received bone conservation agents when starting ADT; 134 (12.6 %) either received bone conservation agents or underwent DXA.
Conclusions Fewer than one in ten Medicare beneficiaries with prostate cancer initiating ADT underwent a DXA exam. Variation in utilization was also related to residence area size. Further research is needed to identify whether the use of DXA in patients with prostate cancer receiving ADT will result in fracture prevention.

Keywords Medicare · Androgen deprivation therapy · Bisphosphonates · Bone mineral density · Prostate cancer

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Introduction

Androgens promote growth and survival of prostate cancer cells [1]. Androgen deprivation therapy (ADT) through surgical or medical castration is first line of therapy for metastatic prostate cancer, and is also sometimes used as neoadjuvant therapy in men with localized disease. Although ADT improves survival rates, it has important adverse effects, including nonmalignant bone complications. Androgens exert antiresorptive effects on bone, directly by promoting osteoblastic activity, and indirectly by inhibition of osteoclastic activity via conversion to estradiol [2]. Androgen deprivation is associated with accelerated bone loss and an increased risk for fractures, seen as early as 6 months after initiating therapy [3–8]. Moreover, many men with prostate cancer already have osteopenia, osteoporosis, or vertebral fractures before starting ADT [9–12], and other risk factors for osteoporosis such as advanced age, smoking, alcohol intake, decreased physical activity, and reduced vitamin D intake [13–15].

Men with prostate cancer who suffer osteoporotic fractures have poor prognosis and reduced survival [16–18]. Bisphosphonates and denosumab can improve bone mineral density (BMD) and reduce the risk of fracture in men with prostate cancer receiving ADT [9, 19–28]. However, universal treatment with bisphosphonates in this population has not been shown to be cost-effective, and measurement of BMD to identify patients at higher risk for fracture might be more efficient [29]. The 2009 National Comprehensive Cancer

Network (NCCN) recommended screening with dual-energy X-ray absorptiometry (DXA) prior to initiation of ADT [30]. NCCN 2012 guidelines recommend using the fracture risk assessment algorithm (FRAX) to assess fracture risk [31, 32]. However, few studies have evaluated FRAX scores in patients with prostate cancer receiving ADT [33, 34]; they were primarily descriptive and did not include an evaluation of fracture risk with respect to subsequent fractures. Moreover, the FRAX algorithm does not include ADT as a specific risk factor. The precise role of BMD measurement in men receiving ADT has not been well established. While there is data suggesting that the majority of fractures in healthy men occur in men whose BMD is not in the defined osteoporotic range, there are also studies that show that BMD is predictive of fractures in men with prostate cancer [35–37].

The objective of our study was to determine whether Medicare beneficiaries in the state of Texas, with prostate cancer and initiating ADT, underwent BMD measurement with DXA.

Methods

The institutional review boards at The University of Texas M. D. Anderson Cancer Center and the Texas Department of State Health Services approved this study, as did the privacy review board of the Centers for Medicare and Medicaid Services.

We used the Texas Cancer Registry (TCR)–Medicare database from the Comparative Effectiveness Research Consortium in Texas that links two large population-based sources of data; TCR and Medicare claims collected by the Centers for Medicare and Medicaid Services. The TCR is a statewide population-based registry, the fourth largest in the US. Approximately 98 % of all people aged 65 or older in the TCR are matched with data from Medicare claims. Medicare is a federally funded national social program which provides health insurance for all persons aged 65 years and older who have been legal residents in the US for at least 5 years. The Texas Medicare claims database contains claims for healthcare provided in Texas under hospital services (part A), supplemental insurance (part B), and, since 2006, prescription drugs (part D). Medicare parts A and B claims were available for this study from 2000 to 2009, and Medicare part D claims from 2007 to 2008. Additional participation in the state buy-in program, a surrogate for low socioeconomic status, was defined as receiving at least 1 month of coverage.

We identified all men aged 66 years or older with histologically diagnosed prostate cancer between 2005 and 2007 (first documented primary cancer) and residing in Texas at the time of diagnosis. Cohort selection criteria included the following:

1. Claim for orchiectomy or initial parenteral ADT between 2005 and 2008. Bilateral orchiectomy was identified in part A using the International Classification of Diseases 9 current procedural terminology (CPT) codes 62.4, 62.41, and 62.42. J codes were used to identify the initial part B claim for parenteral ADT.
2. Alive for at least 1 year after diagnosis. We assumed that the risk–benefit ratio of osteoporosis screening might not be perceived favorable in patients with limited life expectancy; significant changes in BMD are generally observed only after 1 to 2 year intervals [38].
3. Enrolled in Medicare parts A and B for at least 12 months before and 6 months after initiation of ADT. Participation in Medicare for this period of time was necessary to adequately evaluate use of BMD screening with DXA. Bone mineral density is not expected to change in less than 1 year; therefore, we assumed that if patients underwent DXA in the year before starting ADT, their healthcare providers may not have required a new test. We also allowed up to 6 months of follow-up after initiation of ADT for the patient to undergo DXA. We excluded patients enrolled in an additional health plan other than Medicare (health maintenance organization) because we had no access to data claimed under a different plan.

Claims for central DXA exams were captured in part B claims with CPT code 76075 before January 1, 2007, and 77080 after January 1, 2007.

Demographic data in the TCR included age, sex, and ethnicity. Disease stage was categorized as in situ, localized, regional, distant, or unknown. The population density of the patient's area of residence (census tract level) was classified as big metropolitan (population ≥1,000,000), metropolitan (metropolitan areas with a population of <1,000,000), urban (population of ≥20,000, non-metropolitan), small urban (population 2,500–19,999), or rural (population of <2,500).

Socioeconomic status variables were not available at the patient level, so a surrogate value was obtained from the 2000 US Census data based on the median for the patients' census tract as recorded in the TCR at the time of diagnosis, including education level, measured as the percentage of persons aged 25 years or older in the census tract with a high school education only, and median income.

A subgroup analysis was performed for patients who were also enrolled in Medicare part D drug plans (2007 or 2008) to examine the use of bone conserving agents, many of which are administered orally. We used J codes in part B claims to identify intravenous bisphosphonates (ibandronate, pamidronate, and zoledronic acid) and generic names to identify oral bisphosphonates (alendronate, risedronate, and ibandronate), calcitonin, and teriparatide in part D. We assumed that in some instances, healthcare providers might not have requested DXA because patients were already receiving bone conservation agents, or that they may have prescribed these agents without requesting DXA.

Statistical analysis

Our outcome variable was a DXA claim in the period of time ranging from 1 year before to 6 months after initiation of ADT. We compared demographic information, cancer stage, and surrogate socioeconomic data between patients who underwent DXA and those who did not. A multivariate logistic regression model was used to estimate the likelihood of DXA after controlling age, ethnicity, stage, size of area of residence, and socioeconomic variables.

During the period of the study, DXA was allowed reimbursable claim every 23 months, or more often, if medical necessity could be demonstrated. However, claims might have been denied. Curtis et al. found that 2–43 % of repeat DXA procedures performed within less than 23 months were denied, depending on the Medicare carrier [39]. We therefore conducted a sensitivity analysis, using a window of 2 years before initiation of ADT instead of 1 year, to adjust for the potential effect of Medicare denials.

We examined separately patients who did not undergo DXA during the year before starting ADT (excluding the month immediately prior to starting ADT) to determine which factors were associated with undergoing DXA after initiation of ADT (during the month before the first claim for ADT or within 6 months after). We included the month before initiation of ADT in our definition because some patients may have undergone DXA as ADT was being planned, which may have occurred before the prescription was filled. Finally, we examined the subgroup of patients who were enrolled in Medicare part D to evaluate the use of bone conservation agents at the time of initiation of ADT.

Analyses were performed using Statistical Analysis Software version 9.2 (SAS institute, Cary, NC).

Results

We identified 12,678 men with prostate cancer diagnosed between 2005 and 2007 (Fig. 1). Of these, 2,481 initiated ADT between 2005 and 2008. After exclusions, our final cohort included 2,290 men. Most men (74.8 %) had localized disease (Table 1). Twenty-eight men (1.2 %) underwent orchiectomy and 2,262 (98.8 %) parenteral ADT.

Of the 2,290 men in the cohort, 197 (8.6 %) underwent DXA within the specified 18-month window, 65 (2.8 %) during the year before starting ADT, and 135 (5.9 %) during the 6 months after starting ADT (3 men had DXA claims both before and after starting ADT). Of the 28 patients with orchiectomy, none underwent DXA. When we increased our time window to 30 months (2 years before initiation of ADT and 6 months after), 2,181 men were included; of these, 209 (9.6 %) underwent DXA, 84 (3.9 %) during the 2 years before starting ADT, and 130 (6.0 %) during the 6 months after starting ADT (5 men had DXA claims both before and after starting ADT).

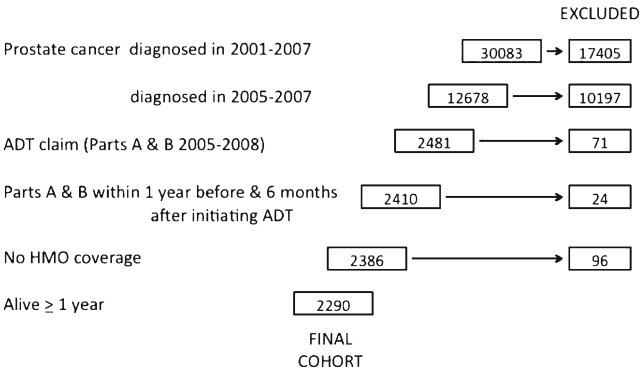

Fig. 1 Data sources and cohort selection. *ADT* androgen deprivation therapy, *HMO* health maintenance organization

Men aged 66–74 years were less likely to undergo DXA than older men (7.0 vs. 10.2 %, $p<0.007$) (Table 1). The patient's area of residence was also related to DXA use; men from small urban areas were less likely to have undergone DXA than those in big metropolitan areas or rural areas. Ethnicity and tumor stage were not related to DXA use, but because so few men underwent DXA, the sample sizes in each category were small.

In multivariate logistic regression analysis, only age and area of residence were associated with DXA use after controlling for all other demographic variables, cancer stage, type of ADT, and enrollment in the state buy-in program (Table 2). Patients aged 75 years or older were 1.5 times more likely to have undergone DXA compared with those who were younger (aged 66–74 years). Patients living in small urban areas were significantly less likely than those in big metropolitan areas or in rural areas to have undergone DXA. African-American men were less likely to have undergone DXA than non-Hispanic white men (OR 0.58, 95 % CI 0.30–1.1), although the difference did not reach statistical significance, possibly owing to the small number of men in each ethnic group. We examined potential interactions effects between independent variables. The only interaction term that was statistically significant was median income*state buy-in insurance, but since the latter variable was not significant in the final model, the interaction term was not included. The sensitivity analysis that included men who had undergone DXA within 2 years before starting ADT showed similar results for both univariate and multivariate analyses (data not shown).

The subgroup of patients who had not undergone DXA before starting ADT included 2,214 men; of these, 153 (6.9 %) underwent DXA at the time of first ADT claim (within 30 days before starting ADT) or within 6 months afterwards. Multivariate logistic regression showed similar results as for the entire cohort (data not shown).

The subgroup of men who were enrolled in Medicare part D included 1,060 men (46 % of the cohort); of whom, 1,043

Table 1 Patient characteristics and DXA claims

		All (n=2,290) (% over total)	DXA (n=197) (% with DXA per row category)	P value (DXA vs. no DXA)
Age group, years	66–74	1,153 (50.4 %)	81 (7.0 %)	0.007*
	≥75+	1,137 (49.6 %)	116 (10.2 %)	
Ethnicity	Non-Hispanic white	1,691 (73.8 %)	151 (8.9 %)	>0.20
	Hispanic	345 (15.1 %)	32 (9.3 %)	
	African-American	226 (9.9 %)	12 (5.3 %)	
	Other	28 (1.2 %)	2 (7.1 %)	
Stage	Localized	1,712 (74.8 %)	152 (8.9 %)	>0.20
	Regional	141 (6.2 %)	13 (9.2 %)	
	Distant	123 (5.4 %)	7 (5.7 %)	
	Unknown	314 (13.7 %)	25 (8.0 %)	
Type of ADT	Parenteral ADT	2,262 (98.8 %)	197 (8.7 %)	0.10
	Orchiectomy	28 (1.2 %)	0 (0 %)	
Type of parenteral ADT	Abarelix	2 (0.1 %)	0 (0 %)	>0.20
	Goserelin	190 (8.3 %)	14 (7.4 %)	
	Histrelin	68 (3.0 %)	5 (7.4 %)	
	Leuprolide	1,842 (80.4 %)	163 (8.8 %)	
	Triptorelin	160 (7.0 %)	15 (9.4 %)	
Area of residence	Big metropolitan	1,101 (48.1 %)	94 (8.5 %)	0.001*
	Metropolitan	659 (28.8 %)	77 (11.7 %)	
	Urban	185 (8.1 %)	11 (5.9 %)	
	Small urban	300 (13.1 %)	10 (3.3 %)	
	Rural	44 (1.9 %)	5 (11.4 %)	
State buy-in enrollment	Yes	290 (12.7 %)	23 (7.9 %)	0.66
	No	2,000 (87.3 %)	174 (8.7 %)	
Census tract surrogate variables [a]				
% with high school	Q1: 2.84–19.63 %	573 (25.0 %)	58 (10.1 %)	>0.20
	Q2: 19.64–26.53 %	572 (25.0 %)	61 (10.7 %)	
	Q3: 26.54–32.65 %	575 (25.1 %)	42 (7.3 %)	
	Q4: ≥32.66 %	569 (24.9 %)	36 (6.3 %)	
Median annual income	Q1: $8,063–$30,133	575 (25.1 %)	52 (9.0 %)	>0.20
	Q2: $30,134–$37,924	570 (24.9 %)	38 (6.7 %)	
	Q3: $37,925–$51,611	576 (25.2 %)	57 (9.9 %)	
	Q4: ≥$51,612	568 (24.8 %)	50 (8.8 %)	

DXA dual energy x-ray absorptiometry, *ADT* androgen deprivation therapy, *Q* quartile

*Statistically significant

[a] Categories represent quartiles, data was missing for one patient

underwent parenteral ADT and 17 orchiectomy. Of these, 59 (5.6 %) received bone conservation agents within 6 months after ADT. In addition, 91 (8.6 %) underwent DXA within 1 year before or 6 months after starting ADT. Overall, 134 men (12.6 %) either received bone conservation agents after starting ADT or underwent DXA during the time window considered (16 men underwent both). Table 3 shows the results of the logistic regression analysis model. Men with distant cancer were 7.6 times more likely to have undergone DXA or have received bone conservation agents than patients with milder disease, and 82 % of them received zoledronic acid. Men who underwent orchiectomy were less likely than those who underwent parenteral ADT to undergo DXA or receive bone conservation agents. Men in rural areas were 4.6 times more likely than men in big metropolitan areas to undergo DXA or receive bone conservation agents, primarily related to DXA use (19 % of patients in rural areas underwent DXA compared with 8 % in big metropolitan areas, p=0.02). Finally, we observed that significantly fewer men in the third quartile of census tract educational levels underwent DRX or received bone conservation agents compared with men in the first. No differences in other quartiles and no decreasing trends suggesting "dose effects" were observed.

Table 2 Multivariate logistic regression model for use of DXA

Independent variables[a]		OR (95 % CI)	*P* value
Age, years			
(66–74)	≥75	1.5 (1.1–2.1)	0.007*
Race			
(Non-Hispanic White)	Hispanic	0.87 (0.53–1.4)	>0.20
	African-American	0.58 (0.30–1.1)	0.10
	Other	0.77 (0.18–3.4)	>0.20
Stage			
(Localized)	Regional	1.2 (0.6–2.1)	>0.20
	Distant	0.7 (0.3–1.6)	>0.20
	Unknown	0.8 (0.5–1.2)	>0.20
Type of ADT			
(Triptorelin)	Leuprolide	1.0 (0.57–1.8)	>0.20
	Goserelin	0.76 (0.35–1.6)	>0.20
	Histrelin	0.77 (0.26–2.2)	>0.20
Area of residence			
(Big metropolitan)	Metropolitan	1.3 (0.92–1.9)	0.14
	Urban	0.67 (0.33–1.3)	>0.20
	Small urban	0.40 (0.19–0.82)	0.012*
	Rural	1.5 (0.54–4.2)	>0.20
Enrolled in state buy-in (No)	Yes	0.92 (0.54–1.6)	>0.20
% with high school [b]			
(Q1: 2.84–19.63 %)	Q2: 19.64–26.53 %	1.0 (0.66–1.5)	>0.20
	Q3: 26.54–32.65 %	0.74 (0.46–1.2)	>0.20
	Q4: 32.66 %+	0.70 (0.41–1.2)	0.18
Median annual income [b]			
(Q1: $8,063–$30,133)	Q2: $30,134–$37,924	0.80 (0.50–1.3)	>0.20
	Q3: $37,925–$51,611	0.92 (0.58–1.5)	>0.20
	Q4: $51,612+	0.71 (0.41–1.2)	>0.20

There were 2,258 patients included in analysis (excluding cases with missing data and those with a claim for orchiectomy, none of whom underwent DXA)

DXA dual energy x-ray absorptiometry, *ADT* androgen deprivation therapy, *Q* quartile

*Statistically significant

[a] Reference category in brackets

[b] Categories represent quartiles; data was missing for one patient

Discussion

Our objective was to examine the use of BMD measurement with DXA in Texas Medicare beneficiaries with prostate cancer initiating ADT. We used liberal time windows to assess the appropriateness of management, assuming that DXA within a year before or 6 months after starting ADT could be considered adequate. Only a minority of men, fewer than one in ten, and none of those who underwent orchiectomy had a DXA claim. To our knowledge, this is the first population-based study examining BMD screening practices in this patient population in the US, identifying patients in a state registry linked to Medicare claims. Two smaller studies evaluated practices at single institutions. A retrospective chart review of 174 men with prostate cancer initiating parenteral ADT at Henry Ford Hospital in Detroit found that only 9 % underwent DXA [34]. Nelson reported better results at their institution where 38 % of men with prostate cancer receiving ADT underwent DXA [40]. We are only aware of two population-based studies, both in Canada. A study in British Columbia showed that after the British Columbia Cancer Agency published key recommendations in 2004 for BMD measurement in patients undergoing ADT, screening increased from 7.5 to 25 % [41]. A separate study in Ontario showed that BMD screening in men with prostate cancer undergoing ADT increased between 1995 and 2008, reaching 18 % in 2008 [42]. Although the authors of the study concluded that a screening rate of 18 % was low, this rate is double what we observed in Texas. Our findings and those of others suggest that BMD screening in these patients is low across all geographic regions that have been examined. While our study did not specifically address the outcomes of screening, it is well known that treatment of osteoporosis prevents fractures. Patients with prostate cancer receiving ADT are at increased risk for fractures, and therapy with bisphosphonates or denosumab reduces this risk [9, 19–28]. Universal therapy is not a recommended approach, and therefore BMD screening can assist in selecting those patients who can benefit from therapy [29].

Table 3 Multivariate logistic regression model for use of bone conservation agents or DXA in patients enrolled in Medicare part D

Independent variables [a]		OR (95 % CI)	*P* value
Age, years			
(66–74)	≥75	1.4 (0.91–2.0)	0.13
Ethnicity			
(Non-Hispanic white)	Hispanic	0.96 (0.53–1.7)	>0.20
	African-American	1.0 (0.52–2.0)	>0.20
	Other	0.73 (0.16–3.3)	>0.20
Stage			
(Localized)	Regional	1.5 (0.65–3.6)	>0.20
	Distant	7.6 (4.1–14.0)	<.0001*
	Unknown	1.4 (0.82–2.4)	>0.20
Type of ADT			
(Parenteral ADT)	Orchiectomy	0.12 (0.02–1.00)	0.05*
Area of residence			
(Big metropolitan)	Metropolitan	1.3 (0.81–2.2)	>0.20
	Urban	0.92 (0.41–2.1)	>0.20
	Small urban	1.1 (0.56–2.2)	>0.20
	Rural	4.6 (1.6–13.6)	0.01*
Enrolled in state buy-in (No)	Yes	0.98 (0.58–1.6)	>0.20
% with high school [b]			
(Q1: 3.87–19.75 %)	Q2: 19.76–26.88 %	1.3 (0.75–2.2)	>0.20
	Q3: 26.89–32.89 %	0.41 (0.21–0.81)	0.01*
	Q4: ≥32.90 %	0.73 (0.38–1.44)	>0.20
Median annual income [b]			
	Q2: $27,938–$35,426	1.5 (0.84–2.7)	0.16
(Q1: $8,063–$27,937)	Q3: $35,427–$49,512	1.5 (0.80–2.8)	>0.20
	Q4: ≥$49,513	1.3 (0.65–2.6)	>0.20

There were 1,059 patients included in analysis, with 134 having a claim for bone conservation agents or for a DXA exam

DXA dual energy x-ray absorptiometry, *ADT* androgen deprivation therapy, *Q* quartile

*Statistically significant

[a] Reference category in brackets

[b] Categories represent quartiles, data missing for one patient

The reasons for low rates of BMD screening are unclear. We examined whether use of bone conservation agents might have led to fewer screenings; conceivably, providers could perceive that BMD screening for patients already being treated might not be necessary. However, this was not the case; only 5.6 % of the men in the Medicare part D sub-analysis were receiving bone conservation agents within 6 months after starting ADT. Furthermore, many of these men had advanced disease and were receiving zoledronic acid. We found that slightly more patients aged 75 years or older (10.2 %) compared with those aged 66–74 years (7.0 %) underwent DXA, but few other factors were found to be associated with DXA use. In particular, low socioeconomic status, which has been shown to be a predictor of less BMD screening in general (non-cancer) populations, was not associated with DXA use in our study [43]. However, for our analysis, we did not have individual patient data and used surrogate data derived from median values in census tracts instead. Interestingly, patients living in small urban areas were less likely to undergo DXA than those residing in big metropolitan areas or rural areas. Patients in rural areas might seek cancer care in large cities and therefore receive similar interventions to those living in metropolitan areas. Ethnicity has been associated with BMD screening in female (non-cancer) Medicare beneficiaries suffering from a hip fracture, with African-American women being half as likely to undergo screening as white women [44]. In our study, African-American men were less likely to undergo testing (OR 0.58) compared with white men, but because so few patients (5 vs. 9 %) were tested, the difference was not statistically significant.

Osteoporosis screening in elderly men in general is recommended by guidelines, but screening rates remain very low [39]. Providers may underestimate the risk of osteoporosis in men, and the benefits of osteoporosis screening [45, 46]. Healthcare-related factors include competing demands during the patient encounter and low reimbursement rates for DXA. Previous studies among non-cancer populations have shown that point-of-care clinical decision support systems, such as electronic reminders, education of physicians and patients, and incentive-driven quality benchmarks can improve rates of screening for osteoporosis [47, 48]. Implementation of these measures in settings specifically providing healthcare to cancer patients has not been assessed.

The precise indication of BMD measurement in men with prostate cancer undergoing ADT requires further consideration. In the general population, many fractures in otherwise healthy men occur in individuals who do not have osteoporosis as defined by DXA. Algorithms that include other risk factors for fracture have been proposed. FRAX can be estimated both with and without BMD. While its use has been reported in men receiving ADT, there is insufficient data to suggest that it is indeed a better determinant of fractures than DXA in this population (especially the non-DXA algorithm). The FRAX algorithm does not specifically inquire about ADT as a risk factor, and inclusion under a particular category has not been validated.

To our knowledge, this is the first population-based study using Medicare beneficiaries to evaluate DXA use among men with prostate cancer undergoing ADT. Because we used administrative datasets, there are limitations to our findings. We were unable to determine whether DXA may have been requested but not performed or reimbursed in some instances because we only had access to claims. We did not examine healthcare provider characteristics because the data available to us did not have unique provider identifiers that could be linked to other data. We did not include patients receiving oral non-steroidal anti-androgens because these drugs are thought to be less deleterious to bones than parenteral ADT or orchiectomy, and very few patients received oral agents alone. Because individual patient factors such as education and income were not available, we only examined surrogate variables. Finally, our data only evaluated patients residing in Texas, and although the state is ethnically diverse and has been a large recipient of national migrants, it cannot be generalizable to other US states or countries.

In summary, the use of DXA in Medicare beneficiaries in Texas with prostate cancer who were undergoing ADT was markedly low, despite the well-known deleterious effects of ADT on bones. Additional research is needed to evaluate the role of BMD measurement in patients with prostate cancer receiving ADT, and to further identify the determinants of low utilization and variation in this population.

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Conflict of interest The authors do not have financial relationships that would result in conflict of interest. We have full control of primary data and we agree to allow journal to review our data.

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