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ORIGINAL ARTICLE

Bone health management in men undergoing ADT: examining enablers and barriers to care

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Abstract
Summary The study determined prostate cancer specialists' knowledge and concordance to guidelines regarding the diagnosis, management, and prevention of androgen deprivation therapy-induced osteoporosis. Despite high knowledge regarding bone health, most respondents did not routinely measure bone mineral density or use fracture risk assessment tools, suggesting a significant gap in the screening/monitoring of bone health.
Introduction The purpose of this study was to determine prostate cancer specialists' knowledge, practices, self-perceived competencies and barriers to providing guideline-concordant care in the diagnosis, prevention, and management of androgen deprivation therapy (ADT)-induced osteoporosis (OP).
Methods A number of 73 Canadian radiation oncologists and 83 urologists completed questionnaires assessing (i) knowledge regarding OP and consensus guidelines for bone health management in men receiving ADT, (ii) self-assessed competencies regarding bone health management, (iii) current practices regarding OP prevention and management, and (iv) self-perceived barriers to providing guideline-concordant care.
Results The majority of respondents were able to correctly identify the guideline-concordant frequency of repeat dual-energy X-Ray absorptiometry (DXA) scans (76.3 %), vitamin D (70.3 %), and calcium (53.2 %) intake and that bisphosphonates/denosumab should always be considered for patients with a history of one low-trauma fracture (57.6 %). Just under 1/3 (32.5 %) reported routinely measuring bone mineral density (BMD) prior to starting ADT and routinely measuring BMD 1–2 years following the initiation of ADT (36.6 %). Only 4.6 % of respondents routinely used a validated fracture risk assessment tool. Lowest self-assessed competency levels were reported in providing self-management education to patients to foster the uptake of healthy bone behaviors (HBBs) and managing patients who present with or develop osteopenia and OP. The most significant barriers to providing OP prevention and management were lack of time and lack of supporting structures.
Conclusions Despite high knowledge about appropriate bone health care among prostate cancer specialists, there remain significant gaps in screening and monitoring of bone health, suggesting the need to develop innovative strategies to overcome barriers to implementation.

Keywords Androgen deprivation therapy · Bone loss · Prostate cancer · Radiation oncologists · Urologists

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Introduction

Androgen deprivation therapy (ADT) is an effective and common treatment for prostate cancer and has been used increasingly as a treatment modality either on its own (primary

ADT) or in combination with surgery or radiation therapy (neoadjuvant/adjuvant ADT) [1, 2]. Approximately one in every two men diagnosed with prostate cancer is now expected to receive ADT at some point after diagnosis [1, 2]. While ADT has been shown to reduce tumor growth and disease-specific symptoms, extend survival, and improve quality of life [1, 3], these therapies are also associated with multiple long-term side effects [3–5].

One of most significant and well-known adverse effects of ADT is bone loss [4–11]. ADT results in rapid and dramatic hypogonadism, which causes clinically important decreases in bone mineral density (BMD) and muscle mass, and a subsequent increased susceptibility to osteoporosis (OP), falls, and fractures [7, 11, 12]. Fractures secondary to OP are associated with up to 20 % mortality, considerable functional impairment, extended hospitalizations, severe pain, sleep disturbances, fatigue, and depression [9] and are a significant cost to the health-care system [13, 14]. Men receiving ADT have been shown to have a 5- to 10-fold increased rate of loss of bone mass at the hip, spine, and radius with maximal bone loss during the first year after starting ADT [3, 4]. Fracture risk has been reported to be at least 50 % greater than the risk among non-users [6, 7]. A recent large US database study found that 58 % of men at high risk and 38 % of men at low risk for fracture at baseline developed at least one fracture after ADT initiation over the 12-year follow-up, which was associated with a 1.38-fold higher overall mortality risk [10].

Despite the high risk for accelerated bone loss and the devastating consequences of OP and fractures, emerging findings suggest that the majority of men on ADT do not routinely receive information regarding bone health management or regular evaluation and treatment for bone loss and osteoporosis [15–18]. A survey conducted in 2005 found that only 28 % of radiation oncologists and 5 % of urologists in Ontario, Canada, were ordering baseline BMD tests, less than 10 % of both specialist groups were prescribing bisphosphonates to manage bone health in men undergoing ADT, and wide variations existed in their practice patterns and risk perception surrounding ADT-related OP [15].

Since that study, new guidelines and recommendations on how best to diagnose, prevent, and manage ADT-induced OP have been published [19–23]. One of the most notable of these are the consensus guidelines developed and published by the Genitourinary Radiation Oncologists of Canada (GUROC) in 2006, which have now been published and adopted as Canadian national practice guidelines [20]. These guidelines, which are comparable with other ADT-specific recommendations, suggest performing baseline and repeat (1–2 years) dual-energy X-Ray absorptiometry (DXA) to measure BMD, evaluating 10-year fracture risk using a validated prediction algorithm (i.e., FRAX or CAROC) [19, 20, 23] and provide recommendations for the use of pharmacologic therapy for those with a high fracture risk [19]. These guidelines also stress the importance of initiating and maintaining healthy bone behaviors (HBBs) in all men on ADT, including exercising, optimizing vitamin D and calcium intake, limiting alcohol and caffeine consumption, and smoking cessation [20]. These may improve bone mineral density, delay or prevent the need for pharmacotherapy, and reduce muscle weakness resulting in decreased risk of falls and fractures [15].

However, despite growing awareness of ADT-related bone adverse effects and the publication of multiple guidelines providing recommendations around bone health management, recent studies continue to point to gaps in the bone health care of men on ADT. For example, population-based data on BMD use in men starting ADT showed that few men, even those with prior osteoporosis or fragility fractures, underwent BMD screening up to 2008 [24], and a recent single-center audit showed that only 28 % of 149 men were appropriately screened and managed for osteoporosis [25].

Thus, gaps in the quality of bone health care continue to exist for men on ADT. One contributing factor may be knowledge or practices of prostate cancer specialists who prescribe ADT. The purpose of this study was to determine the knowledge regarding current practice guidelines, practices, and perceived competencies of Canadian prostate cancer specialists in the diagnosis, prevention, and management of ADT-induced OP. Further, we sought to identify perceived barriers to providing guideline-concordant care.

Methods

This cross-sectional survey-based study was conducted between July and December 2012 and involved practicing urologists and genitourinary radiation oncologists across Canada. Contact information for eligible participants was obtained from the Canadian Urological Association (CUA), and its subsidiary group the Canadian Urologic Oncology Group (CUOG), and the GUROC. Participants who were not currently practicing radiation oncology or urology, or who did not treat patients with prostate cancer, were excluded from the study.

Dillman's tailored design method (TDM), a widely recognized and effective method for maximizing survey response rates, was used [26]. Based on TDM, a three-point contact method was used to contact potential participants, and the questionnaire was distributed both on paper and online.

The self-report questionnaire was adapted from Alibhai et al. [15] and based on an updated review of the literature on ADT-induced OP and the GUROC national consensus guidelines. The questionnaire consisted of 78 items in five key sections: (a) clinical practice profile including practice setting, years of experience, and number of patients treated with ADT; (b) knowledge regarding osteoporosis and current guidelines/recommendations for bone health management in men receiving ADT; (c) self-assessed competencies regarding

bone health management; (d) current practices regarding OP prevention and management; and (e) self-perceived enablers and barriers to the uptake of current guidelines. The World Health Organization's three categories of BMD (normal, osteopenia, and OP) [27] were used for questions involving the recommended interventions for patients undergoing ADT. The final version of the revised questionnaire was reviewed by a urologist, a radiation oncologist, and a bone health specialist for face and content validity. Participant responses in the knowledge and current practices sections were compared to the Canadian consensus guidelines regarding ADT and bone health [20].

The study received research ethics board approval from the University Health Network (UHN).

Statistical analyses were conducted with IBM SPSS® Statistics 20 for Windows®. Descriptive statistics were used to summarize the participants' practice profile, knowledge, current practices, perceived barriers and enablers to guideline-concordant care, self-assessed competencies, and concordance to guidelines and recommendations. Chi-square analyses were conducted to explore relationships between awareness of and concordance with guidelines/recommendations, knowledge, self-assessed competencies, practice profile, current practices, and perceived barriers and enablers. For all analyses, a p value of less than 0.05 was considered statistically significant. For all questionnaire responses, comparisons were made between radiation oncologists and urologists. Where statistically significant differences were noted by specialty group, these are reported. Otherwise, results are presented in aggregate.

Results

A total of 156 questionnaire packages were completed including 73/120 from radiation oncologists (GUROC members; response rate 60.8 %) and 83/445 (response rate 18.7 %) from urologists (CUA/CUOG members). The majority of respondents had been practicing for >5 years (77.4 %), saw ≥6 new prostate cancer patients per month (71.8 %), and were working within a university-affiliated setting or regional cancer center (78.2 %), which is typical in Canadian practice [15]. Radiation oncologists were more likely to be working in a university-affiliated center or regional cancer center compared to urologists, saw significantly more new prostate patients per month, and started more patients on ADT per month (all p values <0.05).

Knowledge

Participant knowledge is summarized in Table 1. The majority of respondents (both urologists and radiation oncologists) were able to correctly identify the guideline-concordant recommendations for the number of years for repeat DXA scans (76.3 %), vitamin D intake (70.3 %), and, to a lesser extent, calcium intake (53.2 %). Urologists were more likely than radiation oncologists to identify guideline-concordant calcium intake (61.4 vs. 43.8 %, p=0.037). There was lower knowledge regarding guideline-concordant recommendations for exercise (20.7 %) with the majority of respondents underestimating guideline-based recommendations. Few respondents (23.1 %) were able to correctly identify the risk of OP for an otherwise healthy 60-year-old man, and 37.8 % could correctly identify the risk for development of OP after 1 year of ADT. For both of these items, respondents tended to overestimate absolute risk. The majority of respondents were able to correctly identify that first- or second-line agents such as bisphosphonates or denosumab should always be considered for patients that have a history of one low-trauma fracture (n=90, 57.6 %), more than one fracture (n=117, 75 %), or for patients exceeding 20 % 10-year risk of major osteoporotic fracture (n=91, 58.3 %).

Table 1 Results of respondent knowledge assessment

Knowledge item	Correct/guideline-concordant response	Guideline-concordant response given, *n* (%)	Median response (IQR)	Not sure, *n* (%)
Frequency of repeat DXA scan following baseline assessment for men on ADT	1–2 years	119 (76.3)	2 (1–2) years	30 (19.2)
Vitamin D daily intake for men on ADT	800–1000 IU	102 (70.3)	1000 (800–1000) IU	17 (10.9)
Elemental calcium daily intake for men on ADT	1000–1200 mg	83 (53.2)	1000 (1000–1500) mg	19 (12.3)
Minimum amount of exercise/week for men on ADT	≥150 min/week	29 (20.7)	90 (90–150) min/week	53 (34.0)
OP risk for an otherwise healthy 60-year-old man	2–6 %	36 (23.1)	10 (5–20) %	25 (16.0)
OP risk following 1 year of continuous ADT with normal baseline BMD	<5 %	59 (37.8)	10 (5–20) %	28 (17.9)

IQR is reported as a range from 25th to 75th centile

ADT androgen deprivation therapy, *BMD* bone mineral density, *DXA* dual-energy X-ray absorptiometry, *OP* osteoporosis

Current practices

Participants were asked to report what current practices they typically engage in regarding bone health (see Tables 2 and 3). Most participants reported that they usually or always recommend calcium (91.6 %) and vitamin D (91.6 %) supplementation, exercise (86.4 %), and avoiding tobacco (64.9 %) for patients starting ADT who presented with normal BMD. Fewer respondents reported providing recommendations on limiting alcohol intake (40.3 %). These figures increased slightly when patients presented with baseline BMD in the osteopenic or osteoporotic range. Two thirds of respondents (66.2 %) reported usually or always recommending bisphosphonates to patients with OP.

In terms of BMD monitoring, only 32.5 % of respondents (n=50) reported that they routinely (≥80 % of patients) measure BMD prior to starting ADT and 36.6 % (n=56) reported that they routinely (every 1–2 years) measure BMD following the initiation of ADT. Of note, respondents who reported routinely measuring baseline and/or repeat BMD had more years of practice, started more patients on ADT per month, had higher guideline-concordant knowledge regarding routine DXA scans, had greater awareness of GUROC guidelines and knowledge of recommendations, reported fewer barriers to providing care in terms of access to BMD screening programs, and were more likely to have received some specialized training in osteoporosis (all p values <0.05; data not shown.). Only 4.6 % (n=7) of respondents routinely used either the FRAX or CAROC tool to assess the 10-year fracture risk stratification of patients, and 37.3 % (n=57) had never even heard of them.

When OP was detected in a patient undergoing ADT, 30.8 % (n=48) of respondents indicated they would treat the patient themselves. Urologists were more likely to treat patients themselves compared to radiation oncologists (41.0 vs. 19.2 %, p=0.005). Referrals were most commonly made to the patient's primary care physician (n=74, 47.4 %), endocrinologist (n=36, 23.1 %), or to an OP clinic (n=30, 19.2 %).

Self-assessed competencies

Figure 1 summarizes the self-assessed competency levels of all respondents. The areas with highest-rated competency ("skilled" and "very skilled" responses) were providing specific recommendations regarding vitamin D (n=98, 64.0 %) and calcium (n=95, 62.0 %) intake. Lowest competency levels ("unskilled" and "very unskilled" responses) were reported in providing self-management education to patients to foster the uptake of HBBs (n=62, 40.5 %), managing patients who present with or develop osteopenia and OP (n=63, 41.2 %), and providing education to patients at appropriate reading and language levels (n=63, 41.2 %).

Participants were asked about training/education that they had previously received regarding bone health. The majority reported that they had received at least some training or education in providing information on secondary prevention to prostate cancer survivors (n=119, 77.8 %), prescribing bisphosphonates (n=93, 60.8 %), OP (n=90, 58.8 %), and interpreting BMD results (n=80, 52.3 %); however, few (n=30, 19.6 %) had received at least some education on assessing fracture risk using a fracture risk assessment tool. Radiation oncologists

Table 2 Respondent prescription practices of considering bisphosphonates and denosumab for patient scenarios

Scenario	Never n (%)	Sometimes n (%)	Always n (%)	Not Sure n (%)
A patient with one fragility fracture	7 (4.5)	37 (23.7)	90 (57.7)	22 (14.1)
A patient with more than one fragility fracture event	0	18 (11.5)	117 (75.0)	21 (13.5)
A patient exceeding 20% 10-year risk of major osteoporotic fracture	1 (0.6)	34/ (21.8)	91 (58.3)	30 (19.2)

Shaded cells represent guideline-concordant responses

Table 3 Current practices and guideline-concordance of respondents

Treatment Recommendation by Bone Density	Never/Rarely n (%)	Sometimes n (%)	Usually/Always n (%)
Normal			
Calcium	5 (3.2)	8 (5.2)	141 (91.6)
Vitamin D	3 (1.9)	10 (6.5)	141 (91.6)
Exercise	8 (5.1)	13 (8.4)	133 (86.4)
Limit alcohol to 2 drinks per day	70 (45.4)	22 (14.3)	62 (40.3)
Avoid tobacco	37 (24.0)	17 (11.0)	100 (64.9)
Bisphosphonates	105 (68.2)	40 (26.0)	9 (5.8)
Osteopenia			
Calcium	4 (2.6)	2 (1.3)	148 (96.1)
Vitamin D	4 (2.6)	3 (1.9)	147 (95.5)
Exercise	11 (7.1)	7 (4.5)	136 (88.3)
Limit alcohol to 2 drinks per day	59 (38.3)	22 (14.3)	73 (47.4)
Avoid tobacco	35 (22.7)	13 (8.4)	106 (68.8)
Bisphosphonates	53 (34.4)	53 (34.4)	48 (31.1)
Osteoporosis			
Calcium	2 (1.3)	2 (1.3)	150 (97.4)
Vitamin D	3 (1.9)	2 (1.3)	149 (96.8)
Exercise	9 (5.8)	6 (3.9)	139 (90.3)
Limit alcohol to 2 drinks per day	56 (36.3)	19 (12.3)	79 (51.3)
Avoid tobacco	34 (31.8)	11 (7.1)	109 (70.8)
Bisphosphonates	25 (16.2)	27 (17.5)	102 (66.2)

Shaded cells represent guideline-concordant responses

reported higher levels of education and training than urologists in osteoporosis management; however, urologists reported higher levels of education and training than radiation oncologists in interpreting BMD and providing information on secondary prevention to prostate cancer survivors ($p<0.05$).

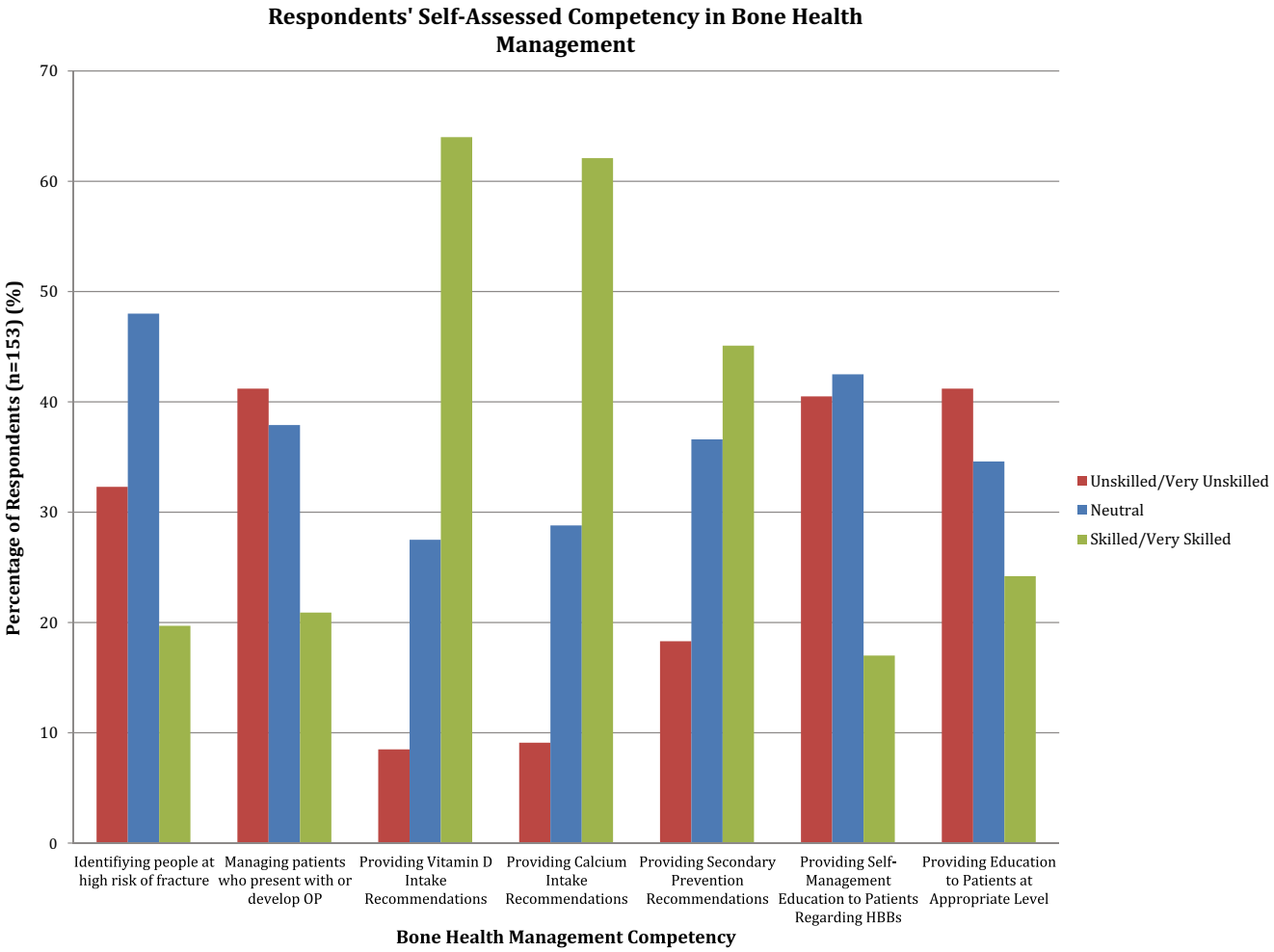

Fig. 1 Respondents' self-assessed competency in bone health management

Barriers to care

Table 4 summarizes respondents' perceived barriers to guideline-concordant care. The most significant barriers for respondents were lack of time to counsel patients on HBBs and the lack of supporting structures such as patient educational resources and communication systems.

Discussion

Uptake of ADT-specific bone health recommendations was evaluated in this national survey assessing prostate cancer specialists' knowledge, practices, and perceived competencies in the diagnosis, prevention, and management of ADT-induced OP. Overall results are encouraging, suggesting that

Table 4 Respondents' perceived barriers to providing guideline-concordant bone health care

	Not a barrier, *n* (%)	Barrier, *n* (%)	Significant barrier, *n* (%)
Lack of knowledge/training regarding ADT and bone health guidelines	47 (30.7)	81 (52.9)	25 (16.3)
Reimbursement for additional time required to address bone health	88 (58.3)	46 (30.5)	17 (11.3)
Lack of time to counsel patients on HBBs	50 (32.9)	62 (40.8)	40 (26.3)
Lack of patient adherence and follow-up regarding HBBs	44 (29.1)	87 (57.6)	20 (13.2)
Difficulties coordinating care among multidisciplinary health-care providers	40 (26.5)	85 (56.3)	26 (17.2)
Lack of supporting structures	31 (20.5)	84 (55.6)	36 (23.8)
Lack of access to BMD screening programs	75 (50.0)	55 (36.7)	20 (13.3)

BMD bone mineral density, *HBB* healthy bone behaviors, *ADT* androgen deprivation therapy

prostate cancer specialists in Canada are relatively knowledgeable regarding current ADT and bone health guideline recommendations for screening, vitamin D intake, and antiresorptive therapy. Gaps in knowledge regarding the specific recommendations for calcium intake and amount of exercise were identified and may be the result of changing guidelines and confusion regarding safe calcium intake [28]. In addition, we found that respondents were routinely recommending engagement in HBBs such as calcium and vitamin D intake and exercise to all their patients starting ADT. These findings again are promising and suggest that a positive shift in practice is occurring when we compare these results to those previously reported, which were substantially lower [25].

Interestingly, while these are encouraging findings, research from our group and others suggests that patients receiving ADT are still not getting the message; the majority of men on ADT remain unaware that bone loss is a side-effect of ADT, have low knowledge about OP, and report low levels of susceptibility to OP despite their relatively high risk [18]. In addition, the majority of men on ADT are not engaging regularly in HBBs, particularly, calcium and vitamin D intake and exercise [16, 18, 29, 30]. Reasons for this disconnection are still unclear. It may be that patients do not understand or remember what they are being told, and the fact that the focus of these appointments is primarily on the treatment of the prostate cancer within high-volume clinics. In this case, the provision of written tailored information, feedback of BMD results, use of standardized checklists, and implementation of supplemental group education classes may be useful to improve patient awareness of bone health and understanding of HBBs [31–33]. In a pilot study conducted by Nadler et al., a sample of patients were sent personalized letters explaining their DXA and fracture risk assessment results along with an OP education booklet. At 3 months post-intervention, these patients had significantly increased their knowledge of OP, reported greater feelings of susceptibility, and increased overall daily calcium intake and vitamin D supplementation [33].

Despite high levels of awareness regarding BMD screening, we found that only ~1/3 of respondents routinely measure BMD prior to and following the initiation of ADT. While previously reported evidence has suggested lower levels of BMD measurement ranging from ~8–18 %[24, 34–37], the current findings are in line with a recent retrospective chart review study from the British Columbia Cancer Agency which reported baseline BMD screening rates of 25 % following the dissemination of the GUROC guidelines to oncologists across the province [17]. Both findings suggest that significant gaps in current guideline-concordant practice remain. Screening for OP can help to prevent fractures by identifying those at high risk and selecting those who can benefit from prophylactic therapy [38]. The reasons for these low rates were not assessed as part of this study. However, barriers to screening and treatment were identified, including lack of time, structural support, training, and coordination among the healthcare team. These should be addressed through policy, system, and infrastructure improvements. Research in non-cancer populations have demonstrated that knowledge translation strategies such as formal education of health-care providers, trainees, and patients; implementation of clinical decision support technology and electronic prompts/reminders; the use of quality benchmarking with incentives; and even promoting competitive data sharing among physicians so they can compare their performance to their colleagues can help improve rates of screening for OP and adherence to clinical guidelines [39–41]. The effects of these strategies on physician practices and patient outcomes, as well as understanding if these practice trends are occurring internationally are areas of future study. Our team is currently conducting a phase II RCT of two strategies to improve bone health in men receiving ADT. The first strategy includes written educational material about bone health and ADT provided to the patient and their primary care physician. The second strategy involves providing the same written educational material to the patient and a referral to and counseling from a bone health care coordinator. These strategies are tested against a wait-list control [42]. In another study, we are testing a multifaceted knowledge translation intervention, entitled *BoneRx*, to facilitate uptake of guideline-concordant bone health care into practice and increase patient awareness and promote the uptake of HBBs. *BoneRx* consists of two elements: (1) a pre-populated "healthy bones prescription" which will prompt the prostate cancer specialist initiating ADT to order a BMD test and includes clear guideline-specific recommendations in terms of calcium, vitamin D intake, and exercise and (2) the provision of a patient booklet entitled "*Building Strong Bones*: *For Men Taking Androgen Deprivation Therapy*."

The majority of respondents in the study reported referring patients to primary care or bone health specialists when OP was detected. This is not surprising and is in fact appropriate given that bone health does not typically fall under the scope of practice for urologists or radiation oncologists, and self-assessed competency in the treatment of OP was fairly low in this study. The involvement of primary care physicians may be of help to increase BMD monitoring along with other general preventative medical services, but requires coordinated communication and care plans [24, 43].

Study strengths and limitations must be considered when interpreting the current findings. Strengths of this study include the comprehensive examination of a number of important areas related to ADT and bone health within the context of recently published guidelines. In addition, there were adequate numbers of both urologists and radiation oncologists, the two main specialist groups that treat patients with early-stage prostate cancer. Limitations include a low response rate

for the urologists which increases the risk of sampling bias and could result in either an over- or underestimation of knowledge and practice, and the reliance on self-report of current practices which may or may not reflect actual practice. In addition, since this study was restricted to Canadian physicians, the findings may differ in other countries that have alternate health-care systems and where specific guidelines may not currently exist. Finally, based on recommendations from the International Osteoporosis Foundation and the International Society of Clinical Densitometry, there has been a shift toward standardization of bone mineral density test reporting in recent years to using young female normative data for T-score calculations. This will likely result in a downshifting of future fracture risk for men on ADT (i.e., fewer high-risk men). While this may result in fewer men on ADT being treated by their radiation oncologist or urologist for bone health issues or referred by their prostate cancer physician to an osteoporosis specialist, the ultimate impact of this move on bone health care in this population remains to be determined.

In conclusion, our results suggest that the majority of prostate cancer specialists in Canada are familiar with current guidelines regarding ADT and bone health and make appropriate recommendations regarding healthy bone behaviors to their patients. However, despite high knowledge, there remains a significant care gap in terms of screening and monitoring of bone health suggesting the need to develop innovative strategies to overcome barriers to implementation which may include the development of supporting structures and tools and/or improved coordination of care with primary care physicians. Screening and monitoring of bone health along with the appropriate initiation of prophylactic therapy and effective promotion of healthy bone behaviors may reduce ADT-related fractures and the risk of mortality and morbidity.

Conflicts of interest Ali Damji, Katie Bies, Shabbir Alibhai, and Jennifer Jones declare that they have no conflict of interest.

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