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ORIGINAL ARTICLE

PSA screening: determinants of primary-care physician practice patterns

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BACKGROUND: The effect of practice guidelines and the European Randomised Screening for Prostate Cancer (ERSPC) and Prostate, Lung, Colorectal and Ovarian (PLCO) trials on PSA screening practices of primary-care physicians (PCPs) is unknown.

METHODS: We conducted a national cross-sectional on-line survey of a random sample of 3010 PCPs from July to August 2010. Participants were queried about their knowledge of prostate cancer, PSA screening guidelines, the ERSPC and PLCO trials, and about their PSA screening practices. Factors associated with PSA screening were identified using multivariable linear regression.

RESULTS: A total of 152 (5%) participants opened and 89 completed the on-line survey, yielding a response rate of 58% for those that viewed the invitation. Eighty percent of respondents correctly identified prostate cancer risk factors. In all, 51% and 64% reported that they discuss and order PSA screening for men aged 50–75 years, respectively. Fifty-four percent were most influenced by the US Preventative Services Task Force (USPSTF) guidelines. Also, 21% and 28% of respondents stated that their PSA screening practices were influenced by the ERSPC and PLCO trials, respectively. Medical specialty was the only variable associated with propensity to screen, with family medicine physicians more likely to use PSA screening than internists ($\beta = 0.21$, $P = 0.02$).

CONCLUSIONS: Half of the physicians surveyed did not routinely discuss PSA screening with eligible patients. The impact of the ERSPC and PLCO trials on PSA screening practices was low among US PCPs. USPSTF recommendations for PSA screening continue to be the strongest influence on PCPs' propensity to use PSA screening.

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Introduction

PSA screening is a commonly used test for early diagnosis of prostate cancer. The widespread use of PSA screening in the US has caused a stage migration of prostate cancer so that a large proportion of prostate cancers diagnosed are early stage tumors, most of which are associated with low risk cancer-specific mortality.[1–3] Consequently, the value of PSA as a prostate cancer screening test is under debate.

This controversy has also been fueled by the disparate results of two randomized controlled trials published in March 2009 on the efficacy of PSA screening for prostate cancer. The European Randomised Study of Screening for Prostate Cancer (ERSPC) demonstrated that PSA screening reduced prostate cancer-specific mortality by 20% at 9 years median follow-up.[4] The Prostate, Lung, Colorectal, and Ovarian (PLCO) trial observed no difference in prostate cancer deaths at 7 years of follow-up.[5]

PSA screening guidelines vary widely and many have been updated in the last 3 years. The American Cancer Society (ACS) and the American Urological Association (AUA) recommend annual PSA for men over age 40–50 years after discussion of the benefits and limitations of screening.[6,7] The AUA and ACS guidelines were updated in November 2009 and March 2010, respectively, after the publication of ERSPC and PLCO. However, the United States Preventive Services Task Force (USPSTF), whose guidelines were updated in 2008 before the publication of ERSPC and PLCO, recommends neither for nor against screening in men under 75 and recommends against screening for men over 75.[8]

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This survey was designed to assess the knowledge and beliefs of primary-care physicians (PCPs) about prostate cancer screening and prostate cancer screening guidelines. In addition, we sought to understand how the recently reported results of the ERSPC and PLCO trials and updated practice guidelines have influenced PCP perceptions and utilization of PSA screening.

Materials and methods

Study design

Study participants were PCPs practicing in the US in 2010. Participants were selected from the American Medical Association (AMA) Masterfile, a comprehensive list of licensed US physicians. We accessed the Masterfile through Direct Medical Data (Des Plaines, IL). Inclusion criteria were physicians board-certified in Internal or Family Medicine classified by the AMA as physicians in 'Office-Based', 'Medical Teaching', or 'Hospital Staff' practices. Residents, physicians with sub-specialty accreditation, and/or those in 'Administration' or 'Research' practices were excluded. A cross-sectional sample of 3010 PCPs was randomly selected from a total population of 140 091 using the criteria above. This sample size was chosen given that 96 respondents would be needed to provide an estimate of the beliefs of the overall population within a 95% confidence interval (CI) of 10 percentage points.[9] On the basis of the response rate to a similar survey, achieving an appropriate responding sample would require sending the questionnaire to approximately 3000 physicians.[10] The random sample was generated by *N*th name select, where *N* is equal to the desired sample size (3010) divided by the total population (140 091). On 20 July 2010, an invitation was e-mailed to the sample asking them to complete an on-line survey (http://www.questionpro.com) on PSA screening practices for prostate cancer. The entire sample was e-mailed again on 14 August 2010 to again ask for their participation in the survey. Participants who completed the survey were eligible to be randomly selected for a $200 gift certificate. This study was approved by UCSF's Institutional Review Board.

Survey instrument

The 34-question survey, which was created by the authors, obtained PCP demographics; knowledge of and confidence in their knowledge of prostate cancer risk factors and screening tests, and asked about their use of PSA screening and their reasons for either offering or not offering PSA screening to their patients (Supplementary Appendix). The questionnaire assessed the respondents' familiarity with and the degree to which they were influenced by three large randomized trials on prostate cancer screening and prevention: ERSPC, PLCO and the Prostate Cancer Prevention Trial (PCPT). PCPT, which was published in 2003, demonstrated that 5-alpha reductase inhibitors decreased the likelihood of prostate cancer detection; however, the benefit was limited to low-grade cancers.[11] PCPT was included as a 'positive control' to determine if time since publication of large prostate cancer clinical trials has an effect on PCP awareness of the trial and the influence of the trial on PCP practice patterns.

A pilot study was conducted among 26 PCPs in the San Francisco Bay Area Collaborative Research Network. The questionnaire was revised based on the feedback from the pilot study, and the revised survey was then e-mailed to the aforementioned national sample.

Measures

Responses were summarized with frequency tables. Three composite outcome variables were derived, which were based on a previously published questionnaire study of PSA screening practices:[12] 1) PCP knowledge of prostate cancer risk factors and screening guidelines (*knowledge score*), 2) confidence in their own prostate cancer knowledge (*confidence score*) and 3) propensity to screen for prostate cancer (*propensity to screen score*).

Knowledge score (0–5 scale, with 5 indicating the greatest knowledge) was computed from the correct responses to questions about major prostate cancer risk factors (African-American race, positive family history in first-degree relative), and the degree to which respondents were familiar with the screening guidelines and the ERSPC, PLCO and PCPT trials.

Confidence score (0–4 scale, with 4 indicating the highest confidence) was the mean of responses to questions ascertaining the respondents' confidence in their knowledge of prostate cancer risk factors, ability to explain and answer questions about PSA screening, the age at and the frequency with which PSA should be ordered, and when to refer to a urologist. Each of these questions was scored on a 5-point Likert scale.

Propensity to screen score (0–5 scale) was the mean score of 10 responses to questions that assessed the respondents' beliefs about the efficacy of PSA screening and their use of PSA. Responses ranged from 0 to 5, with the most positive response (for example, ordering PSA for $>75\%$ of men aged 50–75) given a value of 5. Please see appendix online for the questions included in the calculation of each outcome variable.

Statistical analyses

Multivariable linear regression using forward stepwise selection of covariates was used to identify physician characteristics associated with each outcome variable with a *P*-value set at 0.05. The variables were physician demographics (age, gender, ethnicity and race, medical specialty, family or friend with prostate cancer and years in practice), practice environment characteristics (percentage of African-American patients, number of patients with prostate cancer seen each month, practice region, and practice type), and the influence ERSPC and PLCO had on PSA screening practices. Practice type was classified according to the aforementioned AMA definitions. *P*-values <0.05 were considered significant. Statistical analysis was done using SAS 9.1 (SAS Institute, Cary, NC, USA).

Results

Sample

Of the 3010 PCPs, 41 (1.4%) had invalid e-mail addresses and 2830 never opened the e-mail asking for participation in the survey; hence, they viewed neither the survey

invitation nor the questionnaire content. In all, 152 (5%) of the randomly selected cohort opened the e-mail. Of these, 118 started and 89 completed the survey, yielding a response rate of 58% for those who viewed the invitation, and an overall response rate of 3.4% of the sample who were e-mailed the survey. The actual responding sample of 89 was smaller than the anticipated 96. This resulted in the reported results representing the beliefs and practices of the whole population within a margin of error of 10.39%. Respondents who completed the survey were similar to those who opened the e-mail but did not complete the survey (non-respondents), those who never opened the invitation (non-contacts), and the total population with regard to age, gender and region of practice (Table 1).

In all 80% of respondents reported having a patient population in which non-Hispanic Caucasians comprised the largest racial and ethnic group; 10% of respondents had a patient population in which African-Americans were the largest racial group. The mean age at which PSA screening was initiated and ended was 47.8 years (95% CI 46.83–48.80) and 76.6 years (95% CI 75.06–78.21), respectively. Opinions about the utility of PSA screening varied widely (Figure 1).

Knowledge of prostate cancer and PSA screening

The mean knowledge score (0–5 scale) was 1.72 (interquartile range 1.05–2.25). Over 80% of respondents correctly identified prostate cancer risk factors. In all 83% felt they knew the correct age at which PSA screening should begin and 73% indicated they knew

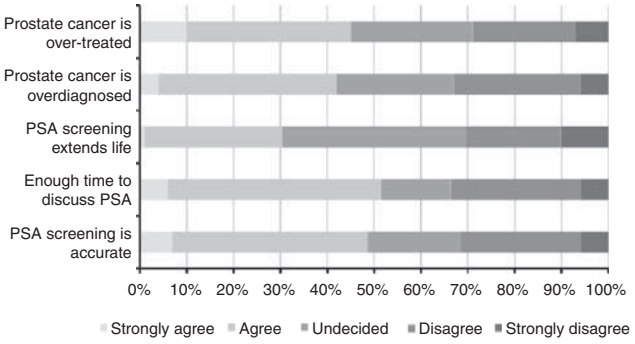

Figure 1 Respondents' ($n = 89$) beliefs about PSA screening for prostate cancer.

Table 1 Comparison of response groups to an e-mail invitation to physicians to participate in an online survey regarding PSA knowledge and practices

	Respondents, n = *89*	*Non-respondents*, n = *63*	*Non-contacts*, n = *2858*	*Remainder*[a] *population*, n = *140 091*
Age (years), mean (s.d.)	49.5 (9.14)	49.8 (9.57)	49.5 (9.85)	50.0 (10.16)
Gender, N *(%)*				
Female	28 (31)	21 (34)	972 (34)	47 901 (35)
Male	61 (69)	42 (66)	1886 (66)	88 841 (65)
Practice region, N *(%)*				
Northeast	23 (26)	18 (28)	543 (19)	27 029 (20)
Midwest	20 (22)	14 (23)	686 (24)	31 796 (23)
South	23 (26)	18 (28)	943 (33)	45 857 (33)
West	23 (26)	13 (21)	686 (24)	32 240 (24)
Practice classification, N *(%)*				
Office-based	76 (86)	56 (88)	2487 (87)	120 377 (88)
Hospital staff	11 (12)	6 (10)	314 (11)	1764 (1)
Medical teaching	2 (2)	1 (2)	57 (2)	14 781 (11)
Medical specialty, N *(%)*				
Internal medicine	49 (55)	16 (64)	1416 (50)	67 092 (49)
Family medicine	40 (45)	9 (36)	1442 (50)	69 830 (51)
Practice type, N *(%)*				
Academic	11 (12)			
HMO	3 (3)			
Hospital	7 (8)			
Private (1–5 physicians)	28 (31)			
Private (>5 physicians)	26 (29)			
VAMC/military base	6 (7)			
Community clinic	8 (9)			
Year residency completed, N (%)				
2000–2010	19 (21)			
1990–1999	38 (43)			
1980–1989	19 (21)			
1970–1979	13 (15)			
Mean/median (range)	1991/1992 (1973–2008)			

Abbreviations: HMO, health maintenance organization; VAMC, Veterans Affairs Medical Center.
[a]The remainder population of the American Medical Association Masterlist are board-certified family or internal medicine physicians not older than 90 years and practicing in an office-based, hospital-based or teaching institution. Totals that do not sum to zero are due to missing data.

the correct frequency with which PSA should be ordered. Respondents were most familiar with the USPSTF guidelines, with 42% reporting they were 'very familiar' with the recommendations. Fewer than 20% of respondents were very familiar with the ACS, AUA, or the American College of Preventive Medicine guidelines and 1% with National Comprehensive Cancer Network recommendations.

In all 10% and 11% of respondents reported having read the ERSPC and PLCO studies, respectively. Thirteen percent read the PCPT study. General awareness of these studies was slightly higher: in all 23 and 29% were familiar with the outcomes of the ERSPC and PLCO trials, respectively. The rest were unaware of the ERSPC and PLCO trials or did not have knowledge of the results.

Confidence in knowledge

The mean confidence score (0–4 scale) was 2.93 (interquartile range 2.60–3.20). Respondents generally were confident in their knowledge of prostate cancer and ability to counsel patients about prostate cancer screening (Figure 2). The most common reasons for urological referral were a palpable prostate nodule (91%), PSA value $>4\,ng\,ml^{-1}$ (76%) and a PSA velocity $>0.75\,ng\,ml^{-1}$ per year (74%). Few respondents would refer a patient with a free PSA $<25\%$ (15%) or a PSA of $3\,ng\,ml^{-1}$ with an additional prostate cancer risk factor (22%).

Higher knowledge scores correlated with respondents' confidence in their knowledge ($r=0.42$, $P<0.01$). Regression analysis indicated that physicians who saw higher numbers of patients with prostate cancer each month had greater confidence in their prostate cancer knowledge ($\beta=0.12$, $P=0.02$).

Propensity to screen

The mean propensity to screen score (0–5 scale) was 2.05 (interquartile range 1.77–2.33). In all 51% of respondents reported discussing PSA screening with men aged 50–75 years; 64% ordered PSA for the same group. PCPs most often ordered PSA screening in response to a patient's age (47%), request (54%) or family history (57%) (Figure 3). Fifty-four percent were influenced by USPSTF guidelines. Of those aware of ERSPC or PLCO, approximately 25% reported the trials influenced a change in PSA screening practices with 16% reporting they were less likely to and 9% reporting they were more likely to offer PSA screening (Figure 4). Most respondents were either not influenced by the trials (39%) or were no more or less likely to offer screening but obtained greater confidence in their screening recommendations (36%).

Neither knowledge nor confidence scores correlated with propensity to screen. Medical specialty was associated with a higher propensity to screen ($\beta=0.21$, $P=0.02$); family medicine physicians were more likely to screen for prostate cancer (propensity to screen score = 2.17) than internists (propensity to screen score = 1.95).

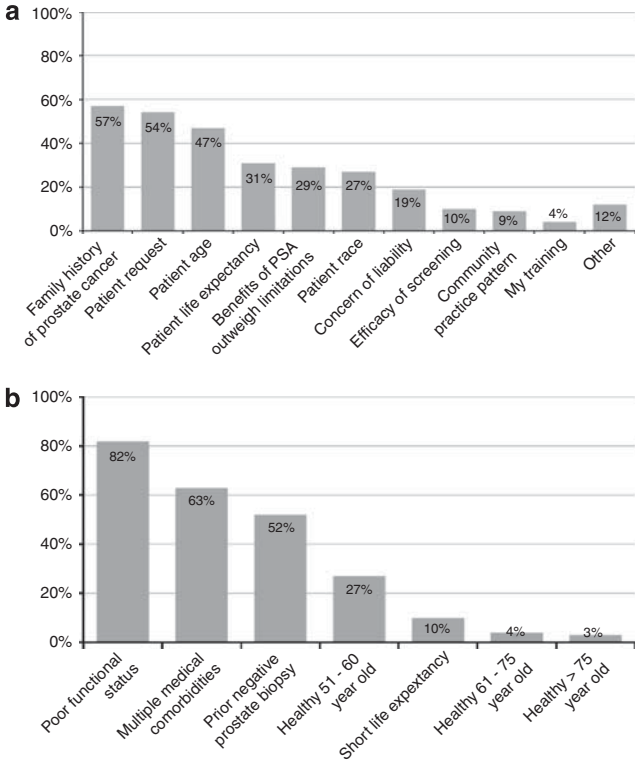

Figure 3 Factors affecting the decision to screen for prostate cancer ($n=89$). (**a**) Factors that most influence the decision to screen for prostate cancer. (**b**) Patient characteristics for recommending against PSA screening.

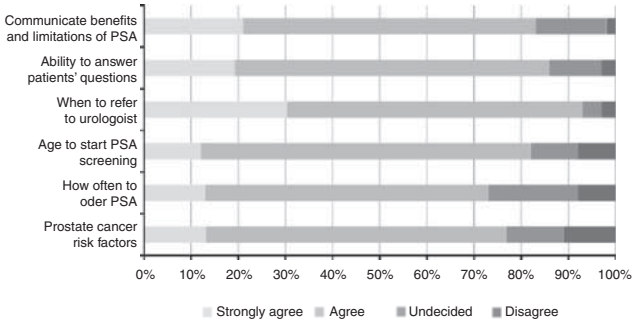

Figure 2 Respondents' ($n=89$) self-reported confidence in their prostate cancer screening knowledge. Respondents were asked to report the degree to which they were confident in their ability to perform the above tasks or their degree of confidence in their knowledge of the above prostate cancer-knowledge domains.

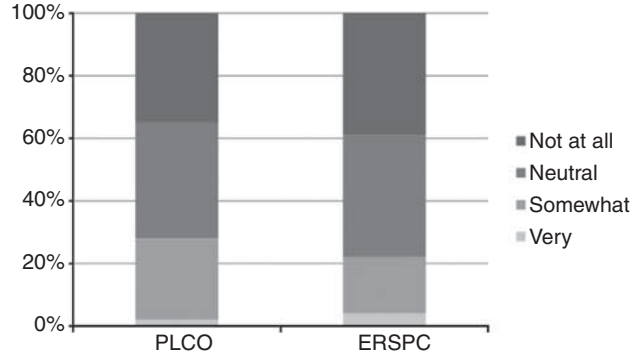

Figure 4 Respondents' ($n=89$) self-reported influence of Prostate, Lung, Colorectal and Ovarian (PLCO) and European Randomised Screening for Prostate Cancer (ERSPC) on PSA screening practices.

Discussion

This survey assessed the influence of the ERSPC and PLCO trials on PSA screening practices among a national sample of PCPs practicing in the United States. In the post-ERSPC and PLCO era, we observed that the USPSTF guidelines had far more self-reported influence on PSA screening practices than these large randomized clinical trials or the updated guidelines of other professional organizations.

In this study, PCPs started and stopped ordering PSA for patients at a mean age of 48 and 77, respectively. Over a quarter of respondents reported recommending against PSA testing in healthy men between 51–60 years old. The sample surveyed reported ordering PSA screening for approximately two-thirds of their male patients aged 50–75 years, although fewer (51%) regularly discussed PSA screening with patients regardless of whether they ordered the test. This differs from the National Survey of Primary-Care Physician Practices Regarding Prostate Cancer Screening which reported that 80% of PCPs reported discussing PSA screening with all male patients.[13] This survey was conducted in 2007–2008, before the publication of the 'new' USPSTF prostate cancer screening recommendations. The 2002 USPSTF recommendations did not recommend against screening men over the age of 75 years.[14] The stronger statement against prostate cancer screening in the 2008 recommendations may have influenced PCPs to avoid ordering screening or discussing it with their patients. The National Survey of Primary-Care Physician Practices Regarding Prostate Cancer Screening was mailed, rather than e-mailed, to potential participants along with a $40 incentive to complete the survey. Therefore, the response bias in the two studies may be different and could contribute to the disparate rates of discussing PCPs discussing PSA screening with patients.

The self-reported screening rate for patients aged 50– 75 observed in this study (64%) was higher than the rates reported in our prior study conducted among PCPs in a single academic medical center, where 86% screened fewer than 60% of their male patients over 50.[12] This prior study was smaller in size, reflected the specific screening practices of a single institution, and conducted earlier in time (2003) before the publication of ERSPC and PLCO. In 2002, Kim *et al*. reported in a national survey of 381 physicians that 67% of family physicians and 40% of internists routinely used PSA screening for men over age 50.[15] We also observed similar PSA screening rates and that family medicine physicians were more likely to offer PSA screening than internists. It is not clear from our survey what underlies this difference, particularly as knowledge and self-reported influence of the USPSTF recommendations was similar among both specialties.

We found patient-specific factors (for example, patient age, request for screening and functional status) influenced the decision to order PSA screening, which is consistent with the previous studies.[12] However, ERSPC and PLCO, which were published concurrently and received significant attention in the lay press, have had little impact on PSA screening practices. This is consistent with the stability of PSA screening for men aged 55–74 before and after the publication of ERSPC and PLCO and the stability of finasteride utilization for prostate cancer prevention before and after the publication of PCPT in the Veterans' Affairs hospital system.[16,17] This suggests that individual studies have little impact on effecting changes practice patterns regarding prostate cancer despite substantial time since publication in high-impact journals. Berrow *et al*. reported that divergence of clinical practice from research evidence is often due to concerns about the adequacy and applicability of the research and concerns about the ability of the medical community to enact changes based on evidence.[18] Further investigation into what factors are important for the incorporation of evidence on PSA screening into clinical practice would be illuminating, particularly when the outcomes of clinical trials differ.

In this study, the majority of PCPs reported that their PSA screening practices were significantly influenced by USPSTF guidelines, but were relatively unfamiliar with and not influenced by other guidelines. Consequently, it is unlikely that the changes to the AUA and ACS guidelines in 2009 and 2010, respectively, will impact PCP PSA screening practices and that PSA utilization will change in the future unless the USPSTF guidelines also change.[16] The current USPSTF guidelines to not screen men aged $\geqslant$75 years reference the 2005 study conducted by Bill-Axelson *et al*. that reported an overall mortality benefit for prostatectomy versus watchful waiting in a cohort of Swedish men with primarily clinically detected, as opposed to PSA-detected, prostate cancer, with the greatest benefit noted in men younger than 65 years.[19,20] The publication of ERSPC and PLCO should provide the all professional organizations with contemporary and robust evidence to revise future PSA screening guidelines, which serve to codify and translate evidence into clinical practice.

However, incorporation of contemporary screening trial results into a consensus statement is not straightforward given their disparate results and different designs. Furthermore, the interpretation of ERSPC and PLCO has been controversial. There was a high frequency of PSA screening in the control arm of the PLCO study and a relatively low compliance rate with recommended prostate biopsies in the intervention arm. It is also possible the 'harms' of needing to treat 40 men with biopsy-proven prostate cancer to save one life found in ERSPC may influence PCPs to be less aggressive about offering PSA screening. Active surveillance, in which treatment for low-risk prostate cancer can be deferred until the point where disease characteristics become more aggressive and hence a greater risk to health, is a means of decreasing 'over-treatment' of prostate cancer. The preliminary results of the Prostate Cancer Intervention versus Observation Trial (PIVOT) indicate that radical prostatectomy may reduce mortality in men with high-risk disease.[21] This risk reduction with surgery was not seen in those with low risk disease, which suggests that this cohort may be best managed by active surveillance. Further dissemination of active surveillance as a preferred method of managing low risk prostate cancer may reduce the number of men needed to treat to save one life, and may change the way clinicians and their patients view the potential risks and benefits of PSA screening. However, it is not known what number needed to treat would significantly tip the balance in favor of PSA screening.

Limitations

The study is limited by the low overall number of responses, which was due to potential participants who were unaware of the study because they did not open the invitation. This limitation may be inherent to e-mailed surveys as e-mails could be blocked by a spam filter or simply deleted before being read. We showed that respondents were similar to non-respondents and to the total population with respect to age, gender and region of practice. Assessment of demographic variables such as age and gender, which are associated with response bias, have been shown to be more important than overall survey response rates.[22,23] However, it is likely that other sources of response bias for which we could not account exist, such as physicians with more interest in PSA screening, or those with more confidence in their prostate cancer knowledge would have been more likely to respond to the survey. An additional limitation is that this study reflects only the practices and beliefs of physicians, which may not be representative of other providers involved in PSA screening such as nurse practitioners or physician assistants. Finally, self-report about practice patterns may not accurately represent reality.

Conclusions

PSA screening is not routinely discussed with eligible patients. Knowledge of the ERSPC and PLCO trials was low among US PCPs as was the impact that these trials have had on PSA screening practices. USPSTF PSA screening recommendations, which were published before ERSPC and PLCO, continue to be the strongest influence on primary-care physicians' propensity to use PSA screening.

Conflict of interest

Dr Cooperberg is a consultant for Amgen, Dendreon, and Centocor Ortho Biotech and has received honoraria from Takeda and Abbott Pharmaceuticals. Dr Carroll is a consultant for Myriad. These companies did not have a role in the conception, design or interpretation of this study. Drs Tasian, Potter, Greene, and Chan and Ms Janet Cowan declare no conflict of interest.

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Supplementary Information accompanies the paper on the Prostate Cancer and Prostatic Diseases website (http://www.nature.com/pcan)