Use of forecasted assessment of quality of life to validate time-trade-off utilities and a prostate cancer screening decision-analytic model

Scott B. Cantor PhD,* Ashish A. Deshmukh MPH,† Murray D. Krahn MD‡ and Robert J. Volk PhD§

*Professor, †Graduate Research Assistant, Department of Health Services Research, The University of Texas MD Anderson Cancer Center, Houston, TX, USA, ‡Professor, The Toronto Hospital, Toronto, ON, Canada and §Professor, Department of General Internal Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

Correspondence

Scott B. Cantor, PhD
Professor
Department of Health Services
Research - Unit 1444
The University of Texas MD Anderson
Cancer Center
PO Box 301402
Houston
TX 77230-1402
USA
E-mail: sbcantor@mdanderson.org

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Abstract

Purpose To determine whether the forecasted assessment of how someone would feel in a future health state can be predictive of utilities (e.g. as elicited by the time-trade-off method) and also predictive of optimal decisions as determined by a decision-analytic model.

Methods We elicited time-trade-off utilities for prostate cancer treatment outcomes from 168 men. We also elicited forecasted assessments, that is, an informal, non-quantitative, descriptive evaluation, of impotence and incontinence from these men. We used multivariate regression analysis to explore the relationship between forecasted assessment and reluctance to trade length for improved quality of life, that is, the unwillingness to trade length of life for improved quality of life in the time-trade-off utility assessment and the relationship between the forecasted assessments and the optimal decision of whether to undergo screening for prostate cancer as determined from a previously published decision-analytic model.

Results Importance of sexual function was strongly related to impotence utilities ($P < 0.05$). Based on the multivariate analysis, significant predictors for the utility of severe incontinence were family income, family history of prostate cancer, work status and attitude towards needing to wear an incontinence pad. However, no variables were statistically significant predictors for the utility of complete impotence. The importance of sexual functioning was a significant predictor of the optimal decision.

Conclusion Anticipated difficulty adjusting to adverse health effects were highly related to preferences and could be used as a proxy measure of utility. Similarly, the importance of sexual functioning, a future preference, was highly related to the optimal decision, which validates our previously published decision-analytic model.

Introduction

Guidelines for prostate cancer screening have changed in recent years; yet prostate cancer remains the second most lethal cancer affecting men in the United States and the most common form of non-skin cancer.^{1,2} An estimated 238 590 new cases of prostate cancer and 29 720 deaths due to prostate cancer will occur in the United States in 2013.² The changes in screening guidelines reflect generally accepted findings that prostate cancer is often slow growing and that men's preferences for the potential outcomes of treatment, including urinary incontinence and impotence, should be considered in making informed medical decisions. Medical decision making is aided by information and insight: information about the potential outcomes from the disease and the potential benefits and adverse consequences of treatment, and insight regarding the potential preferences of the individual for varying states of health.

Research on preferences for different health states among men considering screening for prostate cancer and potential outcomes for prostate cancer treatment has led to various conclusions. Researchers have sought to answer several questions: (i) Do utilities associated with prostate cancer treatment remain stable or change over time?^{3,4} (ii) Are sociodemographic characteristics and baseline genitourinary function predictive of preferences?⁵ (iii) What factors, other than sociodemographic characteristics, influence the medical decision-making process – prostate cancer screening discussion features, knowledge of the disease, perceived high risk for prostate cancer, importance of test costs and discomfort, source of information?⁶ A major question that remains unanswered is whether an individual's forecasted assessment of loss of sexual function or urinary control (i.e. future health states) impacts his preferences for valuations of impotence and incontinence and optimal decision for cancer screening. (Here, we use the term 'forecasted assessment' to mean an informal, non-quantitative, descriptive evaluation of a

health state.) Decision analyses for both prostate cancer screening and treatment have shown the importance of preferences and utilities of health outcomes. Incorporating utilities for health states in decision-analytic models has shown decreases in quality-adjusted life expectancy for both screening and no screening alternatives. However, the optimal decision for both screening and treatment is highly dependent on the utilities for adverse outcomes.^{7–9} The challenge is to demonstrate whether the optimal decision for screening correlates with the forecasted assessment of loss of sexual function or urinary control. Thus, in the specific case of prostate cancer screening and outcome assessment, we wish to determine the usefulness of forecasted assessment. We wish to determine whether forecasted assessment of an individual's feelings while in a future health state can be predictive of utilities (e.g. as elicited by the time-trade-off method) and also predictive of optimal decisions as determined by a decision-analytic model. Despite the changed recommendations for prostate cancer screening and treatment, this study question remains important because this forecasted assessment of anticipated difficulty adjusting to adverse consequences could be a major reason why men might avoid prostate screening and treatment (i.e. fear of impotence).

We conducted a secondary analysis of data from the Couples Prostate Cancer Project to address these unanswered questions. We sought to determine whether a man's forecasted assessment of possible health states was related to utility score and his reluctance to trade length of life for quality of life in the time-trade-off utility assessment (hereafter, called 'reluctant trading behaviour', that is, an unwillingness to trade length of life for improved quality of life) for different treatment outcomes. We also explored the multivariate relationships between the forecasted assessment and the optimal decision of whether or not to undergo screening for prostate cancer, using a previously validated decision-analytic model.^{7,9}

We conducted this analysis on two levels: (i) we considered the association between the

utility score and reluctant trading behaviour in a time-trade-off utility assessment with the forecasted assessment of potential sexual and urinary problems; and (ii) we considered the optimal decision of whether or not to screen for prostate cancer, using a previously validated decision-analytic model and the forecasted assessment of potential sexual or urinary problems. Thus, first we sought to validate the utilities for future preference using a forecasted assessment of sexual and urinary burden as caused by impotence and incontinence; then, we tested the predictive validity, also known as outcome validity, of our prostate cancer screening model. This form of validity predicts the degree to which the estimated outcomes of the model agree with the observed outcomes of actual practice.¹⁰ If these relationships can be demonstrated, then the response to a forecasted assessment of impotence and incontinence related to prostate cancer screening and treatment could serve as an aid for medical decision making.

Methods

Survey design

Participants in the Couples Prostate Cancer Project had been recruited at the time of a visit to one of three family medicine clinics in southeast Texas, USA: (i) The University of Texas Medical Branch at Galveston Family Practice Center, Galveston, (ii) Galveston County Coordinated Community Clinic, Texas City and (iii) St. Mary's Health Center, Galveston. The couples were patients at the family medicine clinic they visited; the men were between 45 and 70 years of age, without a personal history of prostate cancer, who had the ability to speak and understand English or Spanish. Consecutive patients meeting the study entry criteria were invited to participate in the study. Husbands and wives participated as couples and were paid \$100 for participating in a 1.5- to 2-h interview. Approval for the use of human subjects was granted by the Institutional Review Board of The University of

Texas Medical Branch at Galveston. Written informed consent was obtained from every participant. Primary data collection was performed from 1997 to 1998. Details of the study design can be found in an earlier companion paper.¹¹

Participants

Each participant completed a demographic and health questionnaire that included questions about current and potential future health states related to prostate cancer. Data from that questionnaire are the focus of this study. We analysed the four health states that concern sexual and urinary function: mild-to-moderate incontinence, severe incontinence, partial impotence and complete impotence. The partial impotence health state refers to the inability to always have erections when wanted, or having erections not always firm enough for sexual activity; complete impotence refers to a complete loss of ability to have an erection; mild-to-moderate incontinence refers to the inability to control the urine stream, resulting in leakage or dribbling of urine; and severe incontinence refers to the complete and constant loss of urine.

Utilities were elicited using the time-trade-off (TTO) method, which determined the point of indifference between a period of time in an altered health state and a shorter period of time in a state of perfect health. First, we determined the man's life expectancy (as found in U.S. life tables) based on his age. This became the 'anchor' for the time-trade-off method. For example, if the man's life expectancy was 20 years, we initially asked whether he preferred 1 year of perfect health to 20 years with severe incontinence. If the man preferred 20 years in a reduced health state, then we increased the number of years in perfect health by increments of one year, until the point of indifference was reached. For example, if the man determined that 17 years with perfect health were equivalent to 20 years with severe incontinence, then the utility score for severe incontinence was 17/20 or 0.85.

Research assistants conducted the face-to-face interviews with the participants. They used 'props' to better explain the health trade-offs. The time-trade-off utilities ranged from 0 to 1 on a continuous scale. Lower utility was associated with an undesirable health state as perceived by the participant. Details of the utility assessment procedure can be found in earlier publications.^{7,11,12}

The forecasted assessment was based on the Brief Male Sexual Function Inventory.¹³ The men were asked questions regarding the importance of their sexual function and anticipated adjustment to a loss of sexual and urinary function. These questions were based on the American Urological Association Symptom Problem Index 'bother' question.¹⁴ The assessment was recorded in the form of the following survey questions and responses:

1. How important is your sexual functioning to you? (very important vs. somewhat important/not important at all)
2. If you were to lose the ability to have an erection, what would that mean to you? (so bad I might never adjust to it vs. bad but I would adjust to it/minor adjustments)
3. If you were not able to control your bladder and needed to wear a pad or diaper, what would it mean to you? (might never adjust vs. bad but would adjust/minor adjustments)

Statistical analysis

Our primary objective was to examine the relationship between utilities and the answers to the survey questions about the 'forecasted assessment', that is, anticipated ability to adjust to problems in sexual and urinary function. Because all the utilities in the data were heavily distributed towards 1.0 and thus not normally distributed, we used the nonparametric Kruskal–Wallis test¹⁵ to evaluate the bivariate relationship between utility scores (0–1 on a continuous scale) and survey responses to sexual and urinary function questions (categorical variables). We tested the hypothesis that

the forecasted assessment of anticipated adjustment to problems with sexual function and the responses regarding anticipated adjustment to problems with urinary function would be related to utility scores and reluctant trading behaviour (as previously defined, reluctant trading behaviour is an unwillingness to trade length of life for improved quality of life in the time-trade-off utility assessment) for impotence or urinary incontinence and the optimal decision to screen for prostate cancer, respectively. The Kruskal–Wallis test determines the difference among the average ranks to assess whether they are likely to have come from samples drawn from the same population; it does not assess the relationship between the outcome and the predictor variable, adjusting for confounding effects. To examine the potential relationship between the reluctant trading behaviour and the individual forecasted assessment of the anticipated burden or potential adjustment to the impaired health states, we used multivariate logistic regression analysis. We believe that reluctance to trade length of life for improved quality of life can be a reasonable proxy for the time-trade-off utility score when analysing preferences. The outcome variable was coded '0' for the men who were willing to trade length of life for improved quality of life (defined as 'traders', with TTO score < 1.0) during the TTO utility assessment and '1' otherwise (defined as 'non-traders', TTO score = 1). We converted the continuous scale utilities into a dichotomous variable because of the failure in our initial attempts to perform transformations (e.g. squaring, logarithm) to obtain normality. The logistic regression model for impotence as an outcome variable included forecasted assessment variables – importance of sexual function and attitude towards a loss of the ability to have an erection – in addition to the control variables of race, work status, family history of prostate cancer, health status, family income, education and age. Similarly, for incontinence as a dependent variable, the model included only one forecasted assessment response variable – attitude towards having to wear an

incontinence pad – in addition to the same control variables used in the previous model. Thus, we tested the bivariate relationship between the utility score and forecasted assessment of urinary and sexual burden and the multivariate relationship between the reluctant trading behaviour and forecasted assessment.

As a secondary objective, we used the results from a previously validated decision-analytic model⁷ to examine the relationships between the forecasted assessment responses for the anticipated difficulty adjusting to a loss of sexual performance and the optimal decision regarding whether to undergo screening for prostate cancer. We incorporated the TTO utility data as input for the Markov decision-analytic model to determine recommendations for prostate cancer screening.

This mathematical model allowed for the comparison of two potential screening strategies: (i) no screening, that is, treatment only after the development of symptoms and (ii) a one-time screening consisting of a digital rectal examination and a prostate-specific antigen (PSA) test. Using the actual ages of the men as a starting point for the Markov model, we determined the men's quality-adjusted life expectancy as measured in quality-adjusted life years if each strategy were to be implemented. The TTO scores for each participant were entered into the model to determine an individual optimal decision based on the maximization of quality-adjusted life expectancy. We used the results from the decision-analytic model to determine the optimal decision for prostate cancer screening for each participant, based on the sets of TTO scores as given by the 168 individuals. Additional details regarding the model can be found in the previously published companion paper.⁷

First, we examined the existence of a bivariate relationship between the optimal decision and individual forecasted assessment variables using a chi-square test. Then, we used multivariate logistic regression to determine the relationship between the patient's anticipated burden of impotence and incontinence and the optimal decision as determined by the decision-

analytic model. Here, we coded '1' when screening was determined to be the optimal decision from the model, and '0' when not screening was determined to be the optimal decision. Thus, we wish to show the potential multivariate relationships between the forecasted assessment responses that were identified as significant in the chi-square test and the optimal decisions from a preference-sensitive model. All statistical analyses were performed using SPSS version 20. Thus, the forecasted assessment becomes a form of validation of the prostate cancer screening model.

Results

Characteristics of participants

The study population of 168 men was diverse across racial/ethnic groups and education (see Table 1). Most of the men were in good to excellent health and had relatively high income status. Approximately 17% reported having a family member with prostate cancer. Nearly half reported having had a PSA test.

Sexual function and adjustment related to utilities for impotence

Table 2 displays the data collected from the men regarding their sexual function and the associated utilities. The reported value of importance of sexual function was significantly related to utility scores for impotence, with greater value of sexual function associated with lower utility scores for partial and complete impotence resulting from treatment. There was a significant relationship between the anticipated adjustment to a loss of sexual function and utility scores for impotence. Greater perceived difficulty adjusting to a loss of sexual function was significantly related to lower utility scores for partial and complete impotence.

The multivariate relationships are displayed in Table 3. Note that we performed this analysis on 161 participants; 7 participants did not provide values for some of the demographic

Table 1 Participant characteristics. (See also reference 7, Table 2)

Variable	Men <i>n</i> = 168
Age	
Mean	56.4
Range	(45 – 70)
Education (%)	
High school or less	64 (38)
Some college	58 (35)
College graduate or more	46 (27)
Family income (%)	
Less than \$20 000	63 (38)
\$20 000–\$70 000	78 (46)
More than \$70 000	24 (14)
Missing	3 (2)
Race/Ethnicity (%)	
White	110 (66)
Mexican American	24 (14)
African American	30 (18)
Other	4 (2)
Employed (%)	
Yes	78 (46)
No	90 (54)
Perceived health status (%)	
Excellent	23 (14)
Very good	50 (30)
Good	57 (34)
Fair	31 (18)
Poor	7 (4)
Relative with prostate cancer (%)	29 (17)

characteristics (most often, family income). None of the variables were significantly associated with the reluctant trading behaviour of the study respondents. Family income (more than \$69 999 and \$19 999–\$70 000 with reference to the baseline category, less than \$19 999) showed borderline association with the reluctant trading behaviour.

Urinary function and adjustment related to utilities for urinary incontinence

The findings related to urinary function are given in Table 4. Greater perceived difficulty adjusting to a loss of bladder control was significantly related to lower utility scores for mild-to-moderate and severe incontinence among the men. None of the relationships between the reluctant trading behaviour for the

outcome of mild-to-moderate incontinence and the men's characteristics, plus forecasted assessment (i.e. attitude towards having to wear an incontinence pad), reached statistical significance in the multivariate analysis. However, statistically significant relationships were observed in the regression that had as the dependent variable the reluctant trading behaviour for the outcome of severe incontinence (Table 5). The variables that were statistically significant included family income, family medical history, and work status – characteristics of lower family income, a family history of prostate cancer and having employment each indicated the reluctant trading behaviour (shown by having a higher odds ratio) related to the outcome of severe incontinence. The response for the forecasted assessment, for example, what it would mean to have to wear an incontinence pad indicated a borderline significant ($P = 0.08$) relationship with the reluctant trading behaviour for the outcome of severe incontinence.

Optimal decision and qualitative responses

In our preliminary analysis using a chi-square test, only one forecasted assessment variable – the importance of sexual functioning – reached statistical significance (Table 6). The multivariate association between the optimal decision for screening based on the decision-analytic model and the forecasted assessments that were identified as significant in the chi-square test is displayed in Table 7. We then conducted logistic regression on this variable while controlling for study characteristics (i.e. age, race, family income, education, family history, health status, work status, and satisfaction with sex life). A statistically significant association was identified between the optimal decision and the importance of sexual functioning ($P = 0.01$). The odds of making the optimal decision to screen for prostate cancer for those who thought that sexual functioning was either somewhat important or not important was 2.99 times higher [95% confidence interval (CI), 1.28 to 6.95] than for those who thought

Table 2 Importance of sexual function and utility scores for two levels of potential impotence as possible outcomes of prostate cancer treatment

Forecasted assessments	No.	%	Partial impotence				Complete impotence			
			Mean (SD)	Median utility scores	Range	P-value*	Mean (SD)	Median utility scores	Range	P-value
How important is your sexual functioning to you?										
Very	97	58	0.83 (0.23)	0.91	0.04–1.00	0.05	0.72 (0.29)	0.85	0.04–1.00	0.01
Somewhat	63	38	0.86 (0.20)	0.94	0.06–1.00		0.81 (0.23)	0.86	0.04–1.00	
Not at all	8	5	0.91 (0.27)	1.00	0.25–1.00		0.91 (0.27)	1.00	0.25–1.00	
If you were to lose the ability to have an erection, what would that mean to you?										
Might never adjust	14	8	0.68 (0.28)	0.76	0.05–0.97	0.001	0.50 (0.37)	0.44	0.04–0.96	0.001
Bad, but would adjust	122	73	0.85 (0.22)	0.93	0.04–1.00		0.76 (0.26)	0.86	0.04–1.00	
Minor adjustment	32	19	0.90 (0.18)	1.00	0.25–1.00		0.87 (0.19)	0.94	0.25–1.00	

*P-value based on Kruskal–Wallis test.

Table 3 Multivariate association of participants' characteristics and forecasted assessment of complete and partial impotence with reluctance to trade length of life for quality of life

Participants' characteristics and qualitative responses	Partial impotence ¹		Complete impotence ²	
	Odds ratio	P-value	Odds ratio	P-value
Age (years)	1.018 (0.96, 1.07)	0.51	1.02 (0.97, 1.08)	0.36
Race (white vs. non-white)	1.019 (0.45, 2.35)	0.96	1.17 (0.49, 2.83)	0.71
Family income (reference: less than \$19 999)				
\$20 000–\$69 999	0.780 (0.32, 1.84)	0.57	0.42 (0.16, 1.11)	0.08
More than \$70 000	0.360 (0.09, 1.34)	0.12	0.25 (0.06, 1.08)	0.06
Education (not a high school graduate/high school graduate vs. some college/college graduate/post-college degree)	1.085 (0.45, 2.53)	0.85	1.64 (0.64, 4.17)	0.29
Family history of prostate cancer (no vs. yes)	1.439 (0.59, 3.48)	0.42	2.08 (0.82, 5.26)	0.12
Health status (excellent/very good vs. good/fair/poor)	1.026 (0.50, 2.07)	0.94	1.57 (0.73, 3.38)	0.24
Work status (not working vs. working)	1.478 (0.65, 3.32)	0.34	1.54 (0.64, 3.73)	0.33
Importance of sexual functioning (very important vs. somewhat important/not important at all)	1.486 (0.72, 3.05)	0.28	1.66 (0.77, 3.61)	0.19
Attitude towards a loss of ability to have an erection (so bad I might never adjust to it vs. bad but I would adjust to it/minor adjustments)	1.553 (0.62, 3.88)	0.34	1.44 (0.56, 3.72)	0.44

¹Variable represents reluctance to trade length of life in utility assessment to avoid partial impotence; Hosmer and Lemeshow goodness-of-fit statistics: parameter estimates = 7.17, P-value = 0.51; Cox and Snell R^2 = 0.04; Nagelkerke R^2 = 0.06.²Variable represents reluctance to trade length of life in utility assessment to avoid complete impotence; Hosmer and Lemeshow goodness-of-fit statistics: parameter estimates = 6.77, P-value = 0.56; Cox and Snell R^2 = 0.06; Nagelkerke R^2 = 0.09.

sexual functioning was very important. Another statistically significant association ($P = 0.04$) with an odds ratio of 0.34 was identified between the optimal decision to screen for prostate cancer and one of the income groups (\$20 000–\$69 999) with reference to the baseline category (less than \$19 999). This

means that the odds ratio of making the optimal decision to screen for prostate cancer was 0.34 times higher for those in the income group \$20 000–\$69 999 than for those with income less than \$19 999. The remainder of the variables in the multivariate analysis did not reach statistical significance.

Table 4 Importance of the participant's urinary function for two levels of potential incontinence as possible outcomes of prostate cancer treatment

			Mild-to-moderate incontinence				Severe incontinence			
				Median utility scores	Range	P-value		Median utility scores	Range	P-value
Forecasted assessment	No.	%	Mean (SD)				Mean (SD)			
If you were not able to control your bladder and needed to wear a pad or diaper, what would it mean to you?										
Might never adjust	23	14	0.71 (0.30)	0.81	0.05–1.00	0.01	0.56 (0.29)	0.64	0.04–1.00	0.03
Bad, but would adjust	123	73	0.84 (0.18)	0.91	0.25–1.00		0.71 (0.25)	0.74	0.06–1.00	
Minor adjustment	22	13	0.93 (0.10)	0.98	0.65–1.00		0.76 (0.22)	0.81	0.32–1.00	

SD, standard deviation.

Table 5 Multivariate association of participants' characteristics and forecasted assessment of mild-to-moderate and severe incontinence with reluctance to trade length of life for quality of life

Participants' characteristics and qualitative responses	Mild-to-moderate incontinence ¹		Severe incontinence ²	
	Odds ratio (95% confidence interval)	P-value	Odds ratio (95% confidence interval)	P-value
Age (years)	0.99 (0.94, 1.05)	0.95	1.01 (0.95, 1.08)	0.59
Race (reference: white vs. non-white)	0.88 (0.36, 2.10)	0.77	1.00 (0.34, 2.94)	0.99
Husband's family income (reference: less than \$19 999)		0.30		
\$20 000–\$69 999	0.48 (0.19, 2.15)	0.12	0.26 (0.08, 0.87)	0.03
More than \$70 000	0.57 (0.15, 2.16)	0.41	0.11 (0.01, 0.70)	0.01
Education (not a high school graduate/high school graduate vs. some college/college graduate/post-college degree)	0.69 (0.28, 1.73)	0.44	1.16 (0.37, 3.68)	0.79
Family history of prostate cancer (no vs. yes)	1.81 (0.73, 4.48)	0.19	2.85 (0.96, 8.45)	0.05
Health status (good/fair/poor vs. excellent/very good)	1.69 (0.80, 3.57)	0.16	2.20 (0.85, 5.68)	0.10
Work status (not working vs. working)	1.29 (0.55, 3.02)	0.54	2.90 (0.99, 8.50)	0.05
Attitude towards having to wear a pad (might never adjust vs. bad but would adjust/minor adjustments)	1.74 (0.55, 5.49)	0.34	6.47 (0.76, 54.4)	0.08

¹Variable represents reluctance to trade length of life in utility assessment to avoid mild-to-moderate incontinence; Hosmer and Lemeshow goodness-of-fit statistics: parameter estimates = 6.08, P-value = 0.64; Cox and Snell R^2 = 0.04; Nagelkerke R^2 = 0.06.²Variable represents reluctance to trade length of life in utility assessment to avoid severe incontinence; Hosmer and Lemeshow goodness-of-fit statistics: parameter estimates = 5.86, P-value = 0.66; Cox and Snell R^2 = 0.10; Nagelkerke R^2 = 0.16.

Discussion

This study attempted to predict how men value length of life versus improved quality of life based on their anticipated sexual and urinary function for possible outcomes of prostate cancer screening and treatment and how anticipated sexual burden from impotence relates to the optimal decision of whether to undergo screening for prostate cancer. Some studies have observed that patients value quantity of life so highly that they are reluctant to trade any time for improved quality of life following prostate cancer treatment.^{16–18} In our study, the median

utility score for the participants experiencing impotence most of the time, participants giving no value to their sexual function and participants willing to make minor adjustments if they were to lose their ability to have an erection was 1.0, implying that these respondents would not trade any longevity to improve these functions.

Based on the initial analysis, we found that the value of sexual function for men is strongly related to their utility scores for impotence. We also found that the man's anticipated difficulty adjusting to the inability to have an erection and an anticipated loss of bladder control were strongly related to his utility scores for future

Table 6 Bivariate association of forecasted assessment with optimal decision for prostate cancer screening as determined by decision-analytic model

Qualitative responses	Optimal decision	
	Pearson chi-square value	P-value*
Importance of sexual functioning	3.90	0.05
Attitude towards loss of ability to have an erection	2.81	0.09
Attitude towards having to wear an incontinence pad	1.45	0.22

*P-value based on chi-square test.

impotence and urinary incontinence, respectively. Therefore, we conclude that the anticipated difficulty adjusting to impotence and incontinence is highly related to preferences. This finding is important because it shows that questions regarding anticipated adjustment may be used as an appropriate proxy for utilities for making clinical decisions about prostate cancer screening and treatment. This finding also validates the function of utilities as the utilities represent the strength of preferences for one outcome relative to the others.

In our more specified analysis, we found that men who had a family history of prostate cancer or were employed were more likely to show reluctant trading behaviour for the outcome of severe incontinence compared to those who did not have such a family history or were unemployed. With borderline significance, the men who responded 'bad, but would adjust' or 'minor adjustments' when asked what it would mean to them to have to wear a pad, were more likely to show reluctant trading behaviour (i.e. have smaller severe incontinence utility scores). Men with low family income appeared to place a higher value on length of life for severe incontinence utility.

In addition, as a secondary objective, this study attempted to demonstrate the relationship between the optimal decision of whether to undergo screening for prostate cancer as determined by a decision-analytic model based on a man's anticipated change in sexual and urinary functions. In our more specified analyses attempting to predict the association between the optimal decision and the utilities by controlling for the participants' characteristics, we saw some statistically significant relationships

Table 7 Multivariate association of participants' characteristics and qualitative responses with optimal decision for prostate cancer screening as determined by decision-analytic model

Participants' characteristics and qualitative responses	Optimal decision	
	Odds ratio (95% confidence interval) ¹	P-value
Age (years)	0.99 (0.94, 1.06)	0.85
Race (white vs. non-white)	2.23 (0.84, 5.93)	0.10
Family income (reference: Less than \$19 999)		
\$20 000–\$69 999	0.34 (0.13, 0.95)	0.04
More than \$70 000	0.44 (0.09, 2.01)	0.29
Education (not a high school graduate/high school graduate vs. some college/college graduate/post-college degree)	1.06 (0.41, 2.73)	0.89
Family history of prostate cancer (no vs. yes)	0.77 (0.25, 2.31)	0.64
Health status (excellent/very good vs. good/fair/poor)	0.86 (0.37, 1.99)	0.73
Work status (not working vs. working)	1.06 (0.41, 2.74)	0.89
Satisfaction with sex life (reference: very dissatisfied)		
Neutral	0.60 (0.18, 2.01)	0.41
Most satisfied/very satisfied	2.34 (0.89, 6.15)	0.08
Importance of sexual functioning (very important vs. somewhat important/not important at all)	2.99 (1.28, 6.95)	0.01

Hosmer and Lemeshow goodness-of-fit statistics: parameter estimates = 7.345; P-value = 0.50; Cox and Snell R^2 = 0.12; Nagelkerke R^2 = 0.18.

¹Odds of the optimal decision of whether to screen for prostate cancer.

between the optimal decision and participants' characteristics. Specifically, men with low family income and those who gave somewhat or no importance to their sexual functioning were more likely to undergo screening, as determined by the decision-analytic model. We believe that the relationship between the importance of sexual functioning and the optimal decision to screen for prostate cancer holds true because of the preference-sensitive nature of the decision (and the decision-analytic model).

Little has been published in the literature regarding the effect of these characteristics of participants and their qualitative responses regarding utilities. Similar to our findings, Shimizu *et al.*¹⁹ reported that age and sexual function were unrelated to TTO utilities. Saigal *et al.*²⁰ also reported that baseline urinary, sexual and bowel function did not correlate well with the respective utilities for potential incontinence, impotence or radiation prostatitis. Saigal *et al.* found a statistically significant relationship between perceived health status and TTO score. The authors concluded that the men who perceived that they had better general health appeared to place higher value on the quantity of life, whereas those who were already suffering from poor general health placed a higher value on the quality of life.²⁰ We found a similar borderline association between perceived health status and the severe incontinence utility. However, the associations between perceived health status and the utilities of other health states (i.e. partial impotence, complete impotence and mild-to-moderate incontinence) were not statistically significant. It is established in the literature that men with family histories of prostate cancer are more likely to participate in screening.^{21,22} The predictions made from our decision model corroborated this finding. Men with a family history of prostate cancer are less likely to trade quality of life for length of life.

In our analysis, we consistently found that income is a significant predictor of the utilities for complete impotence and severe incontinence as potential consequences of prostate cancer treatment and the optimal decision of whether to screen. Men with low incomes are

less likely to trade length of life for improved quality of life as possible outcomes of prostate cancer treatment and are more likely to undergo screening. This finding is relatively new as none of the studies have explored the effect of family income on potential consequences of prostate cancer treatment and the optimal decision that predicts whether men would undergo screening for prostate cancer.

We recognize the limitations of our study. The data were obtained from participants at three primary care clinics in southeast Texas, USA. The sample was small and the majority of the men were white. Therefore, the utilities and responses to questions regarding perceived burdens from the men in the sample may not be representative of men throughout the United States (or the world). While some relationships were in the expected direction, the low sample size may have led to insufficient statistical power to detect the effects. A third limitation is our use of single items, rather than scales, to assess the burden of adverse consequences. Scales would have allowed for more precision. A fourth limitation is that of reproducibility in that the properties of some of the independent measures are unknown. A fifth limitation is that the current controversy about prostate cancer screening is based on the practice of repeated screening, rather than one-time screening as presented in this paper. The use of data collected in 1997–1998 is a potential limitation of this study; however, we believe this methodological study retains its relevance regarding the relationship between utilities and descriptive characterizations of how men feel about outcomes of impotence and incontinence. We found that the utility scores elicited by the time-trade-off method for impotence and urinary incontinence are strongly related to the forecasted assessments to these adverse health states. We also found that the optimal decision to screen for prostate cancer correlates with these forecasted assessments. We expect that questions regarding such assessments may be used as an appropriate proxy for utilities for making clinical decisions about prostate cancer screening and treatment.

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Conflict of interest

No conflicts of interest have been declared.

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