Decision aids for localized prostate cancer in diverse minority men: Primary outcome results from a multicenter cancer care delivery trial (Alliance A191402CD)

Jon C. Tilburt, MD [1,2,3]; David Zahrieh, PhD [4]; Joel E. Pacyna, MA [1]; Daniel G. Petereit, MD[5]; Judith S. Kaur, MD[6]; Bruce D. Rapkin, PhD[7]; Robert L. Grubb, III, MD[8]; George J. Chang, MD[9]; Michael J. Morris, MD[10]; Evan Z. Kovac, MD[11]; Kara N. Babaian, MD[12]; Jeff A. Sloan, PhD[4]; Ethan M. Basch, MD [13]; Elizabeth S. Peil, MHA[4]; Amylou C. Dueck, PhD[14]; Paul J. Novotny, MS[4]; Electra D. Paskett, PhD[15]; Jan C. Buckner, MD[16]; Daniel D. Joyce, MD[17]; Victor M. Montori, MD[18]; Dominick L. Frosch, PhD[19]; Robert J. Volk, PhD [20]; and Simon P. Kim, MD[21]

BACKGROUND: Decision aids (DAs) can improve knowledge for prostate cancer treatment. However, the relative effects of DAs delivered within the clinical encounter and in more diverse patient populations are unknown. A multicenter cluster randomized controlled trial with a 2×2 factorial design was performed to test the effectiveness of within-visit and previsit DAs for localized prostate cancer, and minority men were oversampled. **METHODS:** The interventions were delivered in urology practices affiliated with the NCI Community Oncology Research Program Alliance Research Base. The primary outcome was prostate cancer knowledge (percent correct on a 12-item measure) assessed immediately after a urology consultation. **RESULTS:** Four sites administered the previsit DA (39 patients), 4 sites administered the within-visit DA (44 patients), 3 sites administered both previsit and within-visit DAs (25 patients), and 4 sites provided usual care (50 patients). The median percent correct in prostate cancer knowledge, based on the postvisit knowledge assessment after the intervention delivery, was as follows: 75% for the pre+within-visit DA study arm, 67% for the previsit DA only arm, 58% for the within-visit DA only arm, and 58% for the usual-care arm. Neither the previsit DA nor the within-visit DA had a significant impact on patient knowledge of prostate cancer treatments at the prespecified 2.5% significance level ($P = .132$ and $P = .977$, respectively). **CONCLUSIONS:** DAs for localized prostate cancer treatment provided at 2 different points in the care continuum in a trial that oversampled minority men did not confer measurable gains in prostate cancer knowledge. ***Cancer* 2022;128:1242-1251**.

KEYWORDS: decision aids, knowledge, prostate cancer, shared decision-making.

INTRODUCTION

Prostate cancer remains the most common noncutaneous malignancy in men with varying pathologic aggressiveness and outcomes. The clinical management of localized prostate cancer should include risk stratification derived from the prostate-specific antigen (PSA) level and Gleason score, incorporate life expectancy, and account for patients' quality of life, values, and preferences.[1] For instance, active surveillance may best serve patients with low-risk prostate cancer or a life expectancy less than 10 years, whereas healthier patients diagnosed with clinically aggressive prostate cancer typically require surgery or radiation therapy. However, each form of primary therapy (radiation therapy or surgery) has been shown to have similar survival benefits but different quality-of-life implications for urinary incontinence and erectile dysfunction.

Corresponding Author: Jon C. Tilburt, MD, Mayo Clinic, 13400 E Shea Blvd, Scottsdale, AZ 85259-5499 (tilburt.jon@mayo.edu).

[1]Biomedical Ethics Research Program, Mayo Clinic, Rochester, Minnesota; [2]Division of General Internal Medicine, Mayo Clinic, Scottsdale, Arizona; [3]Department of Quantitative Health Sciences, Mayo Clinic, Rochester, Minnesota; [4]Alliance Statistics and Data Center, Mayo Clinic, Rochester, Minnesota; [5]Rapid City Regional Cancer Care Institute, Monument Health, Rapid City, South Dakota; [6]Department of Hematology and Oncology, Mayo Clinic, Jacksonville, Florida; [7]Department of Epidemiology and Population Health, Division of Community Collaboration and Implementation Science, Albert Einstein College of Medicine, Bronx, New York; [8]Department of Urology, Medical University of South Carolina, Charleston, South Carolina; [9]Department of Colon and Rectal Surgery, The University of Texas MD Anderson Cancer Center, Houston, Texas; [10]Genitourinary Oncology Service, Memorial Sloan Kettering Cancer Center, New York, New York; [11]Department of Urology, Rutgers New Jersey Medical School, Newark, New Jersey; [12]Department of Surgery, Southern Illinois University, Springfield, Illinois; [13]Lineberger Comprehensive Cancer Center, University of North Carolina, Chapel Hill, North Carolina; [14]Alliance Statistics and Data Center, Mayo Clinic, Scottsdale, Arizona; [15]Ohio State University College of Medicine, The Ohio State University, Columbus, Ohio; [16]Department of Oncology, Mayo Clinic, Rochester, Minnesota; [17]Department of Urology, Mayo Clinic, Rochester, Minnesota; [18]Knowledge and Evaluation Research Unit, Mayo Clinic, Rochester, Minnesota; [19]Palo Alto Medical Foundation Research Institute, Palo Alto, California; [20]Division of Cancer Prevention and Population Sciences, Department of Health Services Research, The University of Texas MD Anderson Cancer Center, Houston, Texas; [21]Division of Urology, Anschutz Medical Center, University of Colorado, Aurora, Colorado

This study has been registered at ClinicalTrials.gov (NCT03103321).

We appreciate the constructive and critical feedback and support of our patient advisory board (Dick Vetter, Nate Sandman, and Jim Williams) throughout the trial and for their thoughtful comments in reviewing the data and an earlier draft of this article.

Additional supporting information may be found in the online version of this article.

DOI: 10.1002/cncr.34062, **Received:** August 16, 2021; **Revised:** October 14, 2021; **Accepted:** November 3, 2021, **Published online** December 10, 2021 in Wiley Online Library (wileyonlinelibrary.com)

Complicating matters further, prostate cancer disproportionately affects Black or African American men and other minority populations in the United States, with higher rates of aggressive disease and poorer quality of care associated with more progression and greater mortality.[2-5] Moreover, Black or African American men typically report making treatment decisions with less knowledge and experience. It is also well known that poor patient-provider communication and mistrust are adverse mediators of known disparities in cancer care delivery.[6]

Shared decision-making can facilitate a more deliberate treatment decision for patients diagnosed with localized prostate cancer by aiding in patients' understanding of the competing risks and quality-of-life considerations for all management options and then applying those considerations to their own situation while incorporating the guidance of their cancer specialist.

Decision aids (DAs)—tools to promote shared decision-making—have been shown to improve patient knowledge, potentially reduce decisional conflict in prostate cancer treatment decisions, and thereby facilitate shared decision-making.[7,8] To date, trials have exclusively focused on DAs delivered and used by patients before treatment consultations and have not included sufficient numbers of minority men to ascertain whether observed DA effect sizes for improvement in knowledge are more broadly applicable for minority men facing a diagnosis of prostate cancer. In principle, improving patient knowledge about potential treatment consequences could help at least indirectly reduce the burden of prostate cancer treatments by calibrating expectations for some loss of bowel, bladder, and erectile function.[6] Determining whether DAs delivered within consultations work and whether DAs at all work in high-risk minority groups could help to reduce racial disparities in prostate cancer.

In this context, we sought to test whether DAs delivered before and/or within a consultation for localized prostate cancer could improve patients' immediate knowledge of prostate cancer risks and features and its treatment consequences as well as immediate decisional conflict. We hypothesized that previsit and within-visit DAs would each independently improve patient knowledge in a diverse population that intentionally oversampled minority men with localized prostate cancer facing an initial treatment decision.

MATERIALS AND METHODS

Our study (Alliance for Clinical Trials in Oncology A191402CD) was conceptualized in an investigator-initiated competitive grant application in response to a National Institute of Minority Health and Health Disparities announcement (RFA-MD-13-006). It was refined further in collaboration with the Health Disparities, Health Outcomes, Genitourinary, and Cancer Care Delivery Committees of the NCI Community Oncology Research Program (NCORP) Alliance Research Base.[9] An advisory board composed of community advocates knowledgeable about prostate cancer and including representation from minority populations was convened to advise investigators in trial planning, conduct, outreach, and reporting. Details of our protocol were previously published[10] and are briefly summarized next. This study was reviewed and approved by the National Cancer Institute (NCI) Cancer Prevention and Control Central Institutional Review Board.

Design

We used a cluster randomized trial with a 2×2 factorial design. With such a design, clinical practices were identified up front and randomized with equal allocation to 1 of 4 arms receiving both previsit and within-visit DAs, a previsit DA only, a within-visit DA only, or no DA (usual care; Fig. 1). The factorial design enabled efficient ascertainment of individual DA effects while also examining potential additive effects between the 2 DAs.

Population

We recruited 21 urology practices affiliated with NCI-funded NCORP sites that received funding to conduct cancer care delivery research, including several NCORP minority and underserved sites. We sought to approach individual patients with clinically localized prostate cancer within 4 months of their diagnosis at those practices who were facing an initial treatment decision. The inclusion criteria included an age $\geq$ 18 years, a positive prostate cancer biopsy within the previous 4 months (clinical T1-T3), a PSA test result $<$ 50 ng/mL, and an ability to read and comprehend English or access to translation/interpreter assistance. The exclusion criteria included known metastatic disease, a history of noncutaneous malignancy within the last 5 years, concurrent enrollment in another clinical trial for prostate cancer treatment, and impaired decision-making capacity (eg, dementia). Additionally, patients were recruited only if they were seeking an initial opinion about their diagnosis and had not yet had an initial consultation about prostate cancer treatment options. Because our underlying scientific question included a desire to understand the effects of DAs in minority men, particularly Black

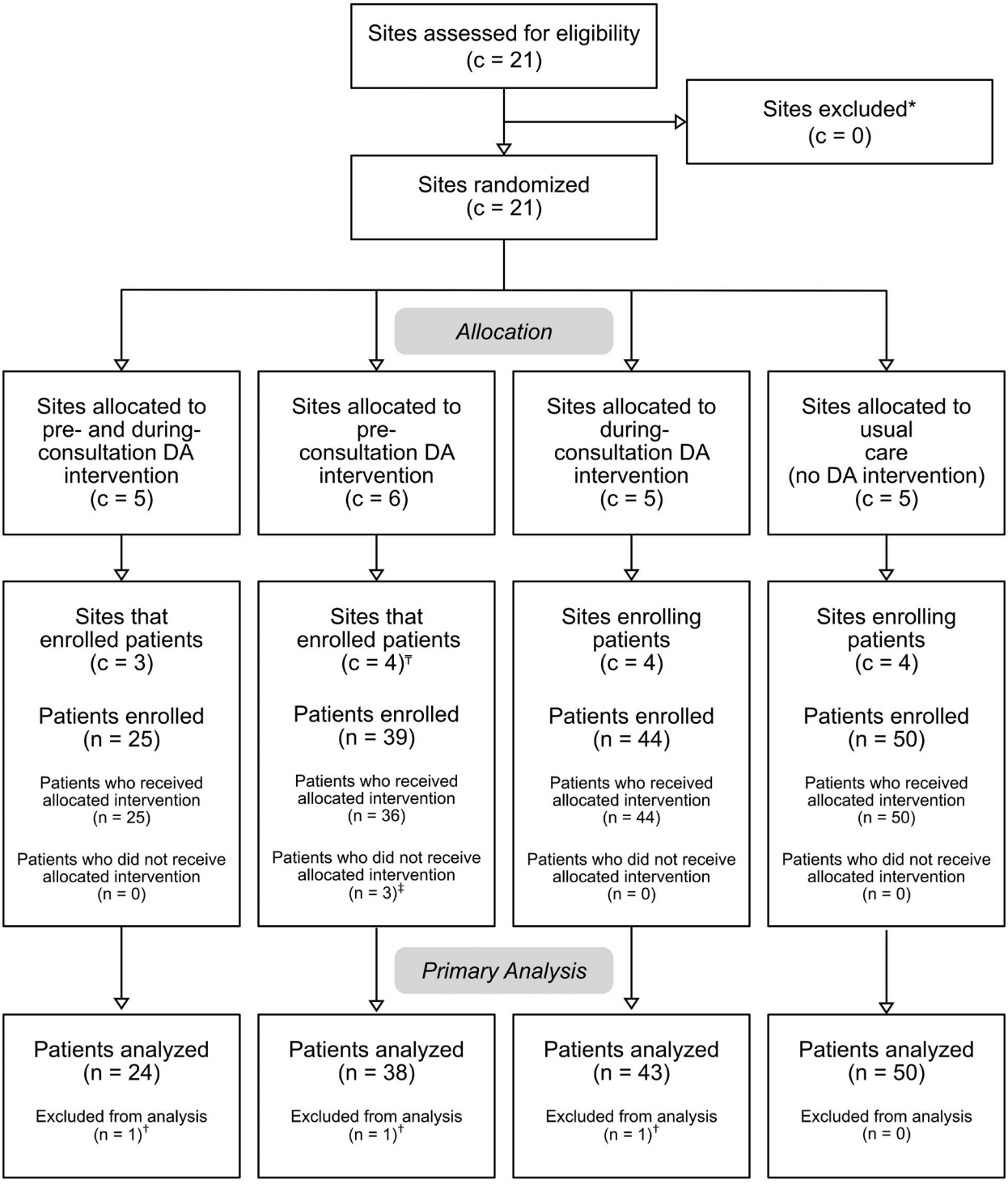

Figure 1. Site- and patient-level recruitment, randomization, and flow for cancer care delivery research: a 2×2 factorial, cluster randomized trial (Alliance A141902CD). *Reasons that a site did not meet the eligibility criteria were not captured as part of the protocol. ‡A replacement site for a nonaccruing site joined after study commencement. †Three patients received decision aids both before and during the consultation. †The patient did not complete the 12-item questionnaire about prostate cancer treatment knowledge. c indicates number of sites (clusters); DA, decision aid; n, number of patients.

or African American men, we set aside half of all trial slots for Black or African American men to ensure a prespecified effect size analysis in this subgroup while also hoping to attract a diverse overall demographic mix of participants.

Interventions

Prostate Cancer Choice (within-visit DA)

Prostate Cancer Choice is a within-visit DA designed to be deployed by clinicians during an office visit on a tablet or computer to support discussion with patients about treatment choices. After focus groups with patients and urologists, the DA was developed with the educational content to primarily serve as a prompt for guideline-concordant conversation with the clinician during the clinical encounter. It also provided individualized estimates of prostate cancer risk stratification (based on the pretreatment PSA levels, clinical T stage, and Gleason score) and life expectancy and queried current quality of life through a validated instrument.[11] Patients randomized to this arm also rated the importance of oncologic outcomes and quality of life. A summary page including prostate cancer risk stratification, life expectancy, existing quality of life, and values was then provided at the end of the consultation (http://prostatecancer.takethewind.com/web/index.php).

Knowing Your Options (previsit DA)

Knowing Your Options was designed to provide men with localized prostate cancer detailed information about their cancer and treatment options by using video, images, and risks communicated visually. The aid also prompts users to consider their values related to making a decision and includes a summary document available for printing. Underlying the design of the aid was a desire to promote deliberation by patients and emphasize that a decision need not be made quickly. It could be used before a conversation with a cancer specialist and after a clinical encounter to allow patients ample time to consider their treatment options. It was developed under a contract from the Agency for Healthcare Research and Quality (https://effectivehealthcare.ahrq.gov/products/decision-aids/prostate-cancer).

Both Prostate Cancer Choice and Knowing Your Options presented the same scientific evidence, each conformed to international standards for DA development,[12] and they were nonproprietary products that could be disseminated widely if demonstrated to be effective. Patients were approached to participate before a scheduled first consultation for initial prostate cancer management but after having received their diagnosis. Consenting participants received the intervention corresponding to their clinic's randomization assignment. To limit the possible effects of each DA on the diverse clinical practices, the protocol allowed each site to administer the DA without specific requirements of patient expectations or time estimates. Details of how the DAs were applied are described in detail elsewhere.[10]

Outcome Measures

Our primary outcome measure was a 1-time assessment of patient knowledge of prostate cancer risks, features, and implications for treatment assessed immediately after the index specialist consultation (Supporting Table 1). To assess knowledge, we devised, pilot-tested, and implemented a 12-item yes/no questionnaire. After deliberating with experts, to assess knowledge, we elected to avoid possible learning affects associated with a baseline plus repeat testing approach, a so-called difference-in-differences approach to outcome comparison. Instead, we used a 1-time assessment of individual knowledge assessed immediately after the index consultation by using the 12-item measure. The number of correct responses was converted into a proportion. Other secondary outcomes included clinical time (in minutes) for the consultation, decisional regret measured by the Decisional Regret Scale, and health-related quality of life measured by the Expanded Prostate Cancer Composite Index 26. The latter 2 secondary outcomes are not reported in this article because they are planned for a subsequent article devoted to 1-year outcomes.

Data Management and Analysis

This study was monitored twice annually by the Alliance Data and Safety Monitoring Board, a standing committee with members drawn from both within and outside the Alliance. Data collection was conducted centrally by the Alliance Statistics and Data Management Center (SDMC), and data quality was ensured by a review of the data by the Alliance SDMC and by the study chairperson according to Alliance policies. We implemented the analysis plan outlined in our previously published protocol; however, we provide a brief summary next.[10] The trial was registered with ClinicalTrials.gov in advance (NCT03103321).

We assumed that most patients would correctly answer 50% of the 12 knowledge questions (standard deviation [SD], 12%). We hypothesized that patients receiving any DA (either the previsit or within-visit DA) would have a 1-point difference in the knowledge

score, or 8% greater knowledge, in comparison with those receiving usual care. The targeted accrual goal was calculated as 172 participants from all 20 sites. In the study design, we assumed an intracluster correlation coefficient (ICC) of 0.10 to account for clustering of patient outcomes by site on the basis of prior literature. Complete details of our power analysis are described elsewhere.[10]

For the primary analysis, we used a linear mixed effects model to examine the effects of each DA on postvisit patient knowledge. Race/ethnicity (non-Hispanic White or other), age (years), clinical stage (T1, T2, or T3), PSA (ng/mL), and Gleason grade group (≤6, 7 [3 + 4], 7 [4 + 3], or 8-10) were included in the model. To control the type 1 error rate at 5% across the 2 simultaneous comparisons for testing the study's primary hypotheses, the statistical significance for each comparison (previsit vs no previsit DA and within-visit vs no within-visit DA) was assessed at the 2.5% significance level. We report the parameter estimates for each effect, including the respective standard error, 2-sided 97.5% confidence interval (CI), and nominal *P* value. Additionally, we report the estimated ICC. Although the study was not prospectively powered to detect an interaction effect, for a supportive analysis, we evaluated any potential for synergy between the interventions by estimating an interaction effect in the linear mixed effects model. Furthermore, we repeated the primary analysis within the racial/ethnic subgroup comprising any race/ethnicity other than non-Hispanic White. *P* values are 2-sided. Statistical analyses were conducted with SAS version 9.4 by the Alliance SDMC.

RESULTS

Characteristics of the Participating Sites and Patient-Participants

Among the initial 21 sites randomized, 7 did not enroll any patients, and 14 enrolled a total of 147 patients. A replacement site for a nonaccruing site joined after study commencement and accrued an additional 11 patients. In total, 15 sites accrued 158 patients between November 2017 and June 2019, although their distribution was asymmetric (Fig. 1). Three sites in the combined pre+within-visit DA arm accrued 25 participants, 4 sites in the previsit-only DA arm accrued 39 patients, 4 sites in the within-visit DA arm accrued 44 patients, and 4 sites in the usual-care arm accrued 50 patients.

Patient demographic and clinical characteristics were clinically balanced across the arms (Table 1). The mean age was 63.5 years (SD, 7.7 years). Eighty-five (53.8%) were Black or African American. The median consultation time was 39.5 minutes (range, 13.0-250.0 minutes). Three (1.9%) did not complete the 12-item knowledge questionnaire, and 7 (4.5%) left partial answers; omitted items were assumed to be incorrect. The primary analysis was based on 155 patients for whom at least partial outcomes were collected. The same 155 patients also completed the Decisional Conflict Scale (DCS).

Primary Outcome—Knowledge

Descriptive results according to the 2×2 factorial design of our cluster randomized trial for our primary outcome of knowledge are tabulated in Table 2; furthermore, the distributions of the knowledge scores are visually shown as box plots in Figure 2 for each of the 4 factorial cells of the trial. The mean proportion correct within the group of patients who received the previsit DA (n = 62) was 0.67 (SD, 0.164; median, 0.67), whereas within the group that did not receive the previsit DA (n = 93), the mean percent correct was 0.57 (SD, 0.204; median, 0.58). The mean proportion correct within the group of patients who received the within-visit DA (n = 67) was 0.62 (SD, 0.174; median, 0.67), whereas within the group that did not receive the within-visit DA (n = 88), the mean proportion correct was 0.60 (SD, 0.209; median, 0.67). Results from the primary analysis are shown in Table 3. In comparison with each intervention's respective control, after we controlled for race/ethnicity, age, clinical stage, PSA, and Gleason grade group and allowed for between-site variability, the mean differences in postvisit knowledge were 0.094 (97.5% CI, –0.055 to 0.242) and 0.002 (97.5% CI, –0.147 to 0.150) for the previsit DA and the within-visit DA, respectively. Neither DA intervention effect achieved statistical significance at the prespecified 2.5% level ($P = .132$ and $P = .977$, respectively). As a supportive analysis, we evaluated any potential for synergy between the interventions by estimating an interaction effect. The coefficient associated with the interaction term was close to zero (0.005; 95% CI, –0.265 to 0.274); this provided a lack of evidence of any potential interaction effect.

In the primary analysis, the estimated ICC was high (0.23). For a post hoc analysis, we investigated what was driving such a high ICC. Figure 3 shows a vertical bar graph of the average knowledge score within each site grouped according to the factorial cells of the trial. The average knowledge score calculated for each site ranged from 0.31 to 0.76, which was the range within the

TABLE 1. Baseline Characteristics of 158 Patients at 15 Participating Practices by Study Arm

	Both Decision Aids (n = 25 at 3 Centers)	Previsit Decision Aid (n = 39 at 4 Centers)	Within-Visit Decision Aid (n = 44 at 4 Centers)	Usual Care (n = 50 at 4 Centers)	Total (n = 158)
Age, y					
No.	25	39	44	50	158
Mean (SD)	62.5 (7.33)	63.1 (8.09)	64.6 (7.46)	63.4 (7.87)	63.5 (7.69)
Median	65.0	64.0	64.5	62.5	63.0
Range	41.0-72.0	40.0-83.0	50.0-86.0	50.0-88.0	40.0-88.0
Race, No. (%)					
White	13 (52.0)	16 (41.0)	10 (22.7)	20 (40.0)	59 (37.3)
Black or African American	12 (48.0)	19 (48.7)	28 (63.6)	26 (52.0)	85 (53.8)
Asian	0 (0.0)	1 (2.6)	1 (2.3)	3 (6.0)	5 (3.2)
American Indian/Alaska Native	0 (0.0)	0 (0.0)	1 (2.3)	0 (0.0)	1 (0.6)
Not reported or available	0 (0.0)	0 (0.0)	2 (4.5)	1 (2.0)	3 (1.9)
Unknown: patient unsure	0 (0.0)	3 (7.7)	2 (4.5)	0 (0.0)	5 (3.2)
Ethnicity, No. (%)					
Hispanic	0 (0.0)	1 (2.6)	2 (4.5)	0 (0.0)	3 (1.9)
Non-Hispanic	25 (100.0)	37 (94.9)	38 (86.4)	47 (94.0)	147 (93.0)
Not reported	0 (0.0)	0 (0.0)	2 (4.5)	2 (4.0)	4 (2.5)
Unknown	0 (0.0)	1 (2.6)	2 (4.5)	1 (2.0)	4 (2.5)
Race/ethnicity, No. (%)					
Non-Hispanic White	13 (52.0)	15 (38.5)	7 (15.9)	17 (34.0)	52 (32.9)
Other	12 (48.0)	24 (61.5)	37 (84.1)	33 (66.0)	106 (67.1)
Clinical T stage, No. (%)					
T1	15 (60.0)	31 (79.5)	36 (81.8)	34 (68.0)	116 (73.4)
T2	10 (40.0)	6 (15.4)	8 (18.2)	14 (28.0)	38 (24.1)
T3	0 (0.0)	2 (5.1)	0 (0.0)	2 (4.0)	4 (2.5)
Gleason grade group, No. (%)					
≤6	8 (32.0)	19 (48.7)	17 (38.6)	17 (34.0)	61 (38.6)
7 (3 + 4)	9 (36.0)	14 (35.9)	13 (29.5)	12 (24.0)	48 (30.4)
7 (4 + 3)	3 (12.0)	3 (7.7)	6 (13.6)	9 (18.0)	21 (13.3)
8	2 (8.0)	3 (7.7)	4 (9.1)	8 (16.0)	17 (10.8)
9-10	3 (12.0)	0 (0.0)	4 (9.1)	4 (8.0)	11 (7.0)
PSA, ng/mL					
No.	25	39	44	50	158
Mean (SD)	7.7 (6.17)	9.9 (6.18)	10.8 (8.43)	12.2 (10.41)	10.5 (8.40)
Median	5.0	8.0	7.5	8.0	7.0
Range	3.0-34.0	4.0-33.0	1.0-44.0	1.0-47.0	1.0-47.0
Consultation time, min					
No.	25	39	32	50	146
Mean (SD)	29.2 (9.23)	43.2 (29.42)	56.7 (20.23)	59.0 (54.37)	49.1 (38.10)
Median	27.0	38.0	52.5	39.0	39.5
Range	17.0-48.0	13.0-150.0	20.0-116.0	13.0-250.0	13.0-250.0

Abbreviations: PSA, prostate-specific antigen; SD, standard deviation.

usual-care arm and was consistent with the large SD observed within the usual-care arm reported in Table 2. The primary analysis was repeated with site GA020 excluded from the analysis. The ICC was substantially reduced (0.08) and was consistent with the assumed ICC applied in the study design (0.10); however, with site GA020 excluded, the effect of the previsit DA became attenuated, and the conclusions remained unchanged.

The primary analysis was repeated within the racial/ethnic subgroup comprising any race/ethnicity other than non-Hispanic White (n = 104). The previsit and within-visit intervention effects were similar in magnitude to the overall results, with neither intervention effect achieving statistical significance at any reasonable level (data not shown).

DISCUSSION

This study, the first NCI-sponsored cancer care delivery research trial, originating from the NCORP Alliance Research Base, a cluster randomized trial with a 2×2 factorial design conducted in urology practices in a community oncology research base, investigated the effects of DAs delivered at 2 different points in the care trajectory on patient knowledge and successfully oversampled minority men. Neither the DA delivered before the visit nor the DA delivered within the visit significantly improved patient-reported knowledge according to a postvisit, 12-item, disease-specific knowledge questionnaire after adjustments for site and patient differences.

Despite its null results, this study advances the science and literature of shared decision-making for localized

TABLE 2. Descriptive Results for the Primary Outcome of Knowledge Within Each Factorial Cell of the 2×2 Factorial Trial and According to the Receipt of the Previsit and Within-Visit Decision Aids Among the 155 Patient-Participants at 15 Sites

	Within-Visit Decision Aid		
	Yes	No	Total
Previsit Decision Aid			
Yes			
No.	24	38	62
Mean (SD)	0.69 (0.165)	0.65 (0.164)	0.67 (0.164)
Median	0.75	0.67	0.67
Range	0.08-0.83	0.08-0.92	0.08-0.92
No			
No.	43	50	93
Mean (SD)	0.58 (0.167)	0.56 (0.232)	0.57 (0.204)
Median	0.58	0.58	0.58
Range	0.17-0.92	0.00-0.92	0.00-0.92
Total			
No.	67	88	
Mean (SD)	0.62 (0.174)	0.60 (0.209)	
Median	0.67	0.67	
Range	0.08-0.92	0.00-0.92	

Abbreviation: SD, standard deviation.
This table is based on the 155 participants who completed (or partially completed) the 12-item questionnaire for the primary outcome of knowledge.

prostate cancer in several ways. First, this study helps in describing the effects of DAs for minority men with localized prostate cancer. It also begins to address the optimal timing of DA delivery in the clinical setting. Regarding the former, our study shows that it is feasible to enroll large proportions of minority patients in practice-based cancer care delivery trials. To date, this is one of the largest DA trials (>150 patients), and using a clustered randomized trial design and enrolling a majority of Black or African American men (54%) with newly diagnosed with prostate cancer, it is arguably the most diverse study of its kind, although it still was somewhat underaccrued. Our design was aimed at addressing implementation modes of delivery and comparing them and thereby at least nudging the field from efficacy toward pragmatic effectiveness and an implementation mindset. That neither the previsit modes nor the in-visit mode had a demonstrable effect on prostate cancer knowledge does not negate these other contributions.

In explaining the null effects, several explanations come to mind. It is at least plausible that the prostate cancer knowledge questionnaire lacked the sensitivity to detect a difference. Moreover, one could argue that knowledge as an outcome measure is flawed; in fact, most randomized clinical trials in a recent meta-analysis showed little or no increase in knowledge, and none included enough Black or African American men to surmise their effect in that population. At the time the study was planned, it was the best outcome available.

The optimal timing of DA delivery remains an important unanswered question. To date, the timing of DA delivery in the pre- or in-visit clinical setting for prostate cancer treatment decisions has not been critically examined. To our knowledge, all published studies have examined previsit DAs. Our null and somewhat underpowered data do not settle that question, and it is one that deserves future investigation. Moreover, in this respect, heterogeneity of use in DA implementation—a question beyond effectiveness related to implementation—applies equally to both DA modes that we tested.

Testing 2 DAs delivered at different times with respect to the clinical encounter and incorporating a large number of underrepresented Black or African American men, who are at higher risk for worse oncologic and functional outcomes than other racial groups, create a valuable baseline for similar comparisons of DA modes for future studies. DAs used in the previsit and within-visit settings did not demonstrate a difference across arms in patient knowledge as measured by a postvisit, disease-specific, 12-item questionnaire. These findings should be viewed in light of the notable variation in the effect of DA usage and outcome measurement and the mixed effects that they have on prostate cancer knowledge and other outcomes.[13-20] A recent systematic review and meta-analysis of DAs for treatment decisions in localized prostate cancer found no changes in patient knowledge in prostate cancer along with high heterogeneity across sites.[21] Most of the data on the impact of DAs on patient knowledge about prostate cancer treatments come from only 2 trials: a small clinical trial showing a large effect (n = 61)[13] and a larger clinical trial reporting marginal gains in patient knowledge (n = 182).[22] A similar systematic review and meta-analysis of DAs for prostate cancer screening, which had a large number of trials included and less heterogeneity, recently found at best modest impacts on patient knowledge as well.[23] In both cases, DA trials assessing the impact on knowledge in treatment decisions for prostate cancer reported limited participation by Black or African American men. In this respect, our findings showing no demonstrable improvement in knowledge are not surprising, and they also prompt whether future studies should be using this measure at all.

This study has important limitations. First, several sites did not accrue patients, whereas others accrued excess patients; this led to overall asymmetric accrual and

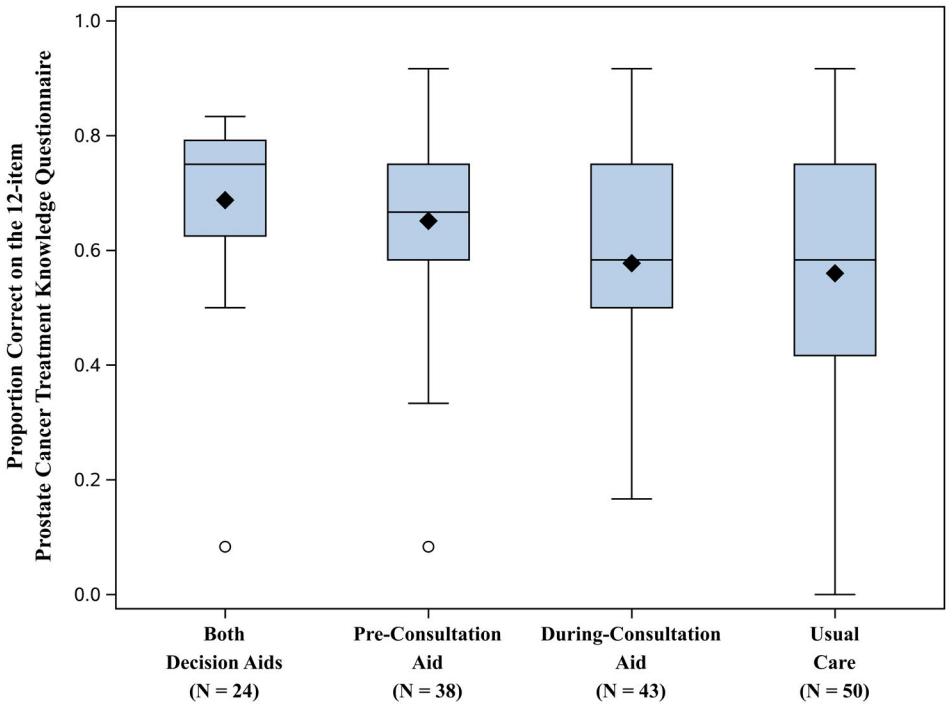

Figure 2. Distribution of knowledge scores by study arm among 155 patient-participants at 15 sites who completed (or partially completed) the 12-item questionnaire.

TABLE 3. Differences in Knowledge Scores Between Each Intervention and Its Respective Control

Knowledge of Prostate Cancer Treatment	Previsit Decision Aid (n = 62)	No Previsit Decision Aid (n = 93)	Within-Visit Decision Aid (n = 67)	No Within-Visit Decision Aid (n = 88)
Adjusted mean	0.684	0.590	0.638	0.636
SE	0.045	0.039	0.045	0.039
Adjusted difference	0.094		0.002	
97.5% CI	–0.055 to 0.242		–0.147 to 0.150	
P	.132		.977	

Abbreviations: CI, confidence interval; SE, standard error.

Results were obtained from a mixed effects regression model, which contained a fixed intercept, a fixed effect for having received the preconsultation decision aid (main effect), a fixed effect for having received the during-consultation decision aid (main effect), and a random, site-specific intercept to allow patients within the same site to be correlated as well as the following explanatory variables: race/ethnicity (non-Hispanic White or other), age (years) at the baseline, baseline clinical stage (T1, T2, or T3), baseline prostate-specific antigen level (ng/mL), and baseline Gleason score (≤6 [reference], 7 [3 + 4], 7 [4 + 3], or 8-10). Both comparisons are for the intervention versus its respective control. Positive differences represent a favorable outcome (increased knowledge) for the relevant intervention. To control the type 1 error rate at 0.05 across the 2 simultaneous comparisons for testing the study's primary hypotheses, the confidence coefficient applied to each of the 2-sided CIs was (1 – [0.05/2]) × 100%. However, we report the actual (unadjusted) *P* value; the threshold for determining statistical significance would be 0.05/2 = 0.025 (a Bonferroni correction). The estimated intracluster correlation was 0.23. The interaction between the interventions was investigated as a supportive analysis and was found not to be significant at any reasonable level of significance (interaction coefficient, 0.005; 95% CI, –0.265 to 0.274; *P* = .971).

perhaps contributed to the higher than expected intersite heterogeneity. The ICC gauged the site-to-site heterogeneity in patient knowledge scores, and the high ICC led to less precise estimates of the intervention effects. Because the ICC in the completed trial data was considerably higher than the value allowed for at the design stage, the trial was likely underpowered to identify a clinically important effect for each DA intervention. This degree of variability is rare and may justify further investigation beyond the scope of this report. It is also possible that the highest accruing sites in the control arm were especially motivated and effective at patient education at the baseline, and this creates a challenge in ascertaining differences in knowledge outcomes from the interventions. This, when added to the diminished sample size (usable data on 155 of 172 target patients), leaves plenty of room for null results. Moreover, because we did not gather fidelity-to-intervention data, we do not know if the

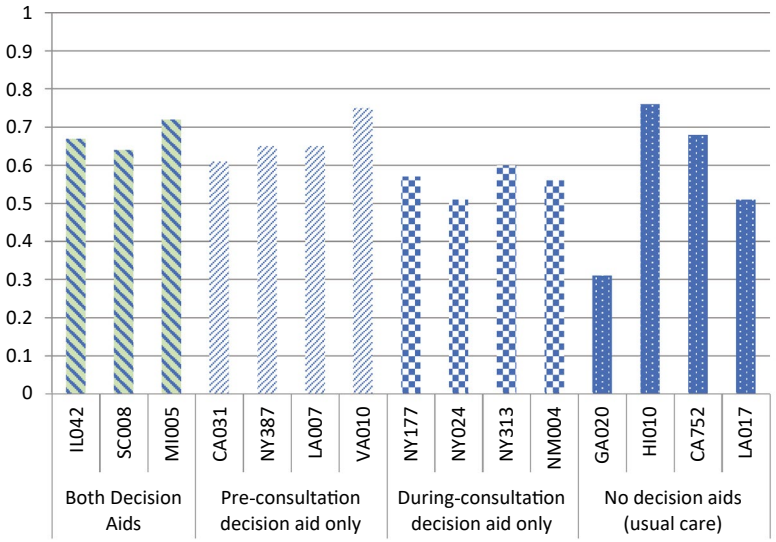

Figure 3. Average knowledge scores (proportions correct) for each site and according to the factorial cells of the trial.

interventions, particularly the within-visit intervention, were used as intended. Absent these data, our inferences about the potential inefficacy of that DA mode are further hampered. In addition, how we measured the knowledge outcome, though deliberate, may have exposed us to site-to-site heterogeneity in baseline education efforts and other vigorous patient engagement strategies. Second, another limitation is that, had we chosen a "change in knowledge" as our outcome (a so-called difference-in-differences approach), we may, in hindsight, have been able to account for baseline differences across sites in our cluster randomized design. Third, we acknowledge that the cluster randomization study design resulted in some imbalances by race and clinical characteristics of prostate cancer for risk stratification (PSA, T stage, and Gleason score) across sites. It is plausible that these imbalances may have contributed to the lack of differences in our primary outcome, although our measure assessed general prostate cancer treatment knowledge rather than knowledge specific to details about prostate cancer risk stratification. Fourth, it is likely that additional patient-level factors that were not collected, in particular health literacy, would have modified the knowledge outcome measure. Lastly, several other key outcome measures, such as decisional conflict, patient satisfaction with the decision, and patient utilities and concordance with values and treatment decisions, are often used in shared decision-making trials. Because of the constraints of study sites and patient burden with data collection, we recognize that our findings may have been constrained in demonstrating effectiveness with these other outcome measures. Although the DCS represented an ancillary outcome measure in this study, we focused this study on the primary outcome of patient knowledge because we recognized that there were no differences in the DCS for each arm of the DAs across sites in comparison with controls.

These results, when considered along with recent systematic reviews, demonstrate the necessity of better measures for prostate cancer treatment decision support. They also raise broader questions of how best to support patients with newly diagnosed prostate cancer. Particularly among the disproportionate number from minority Black or African American communities affected by prostate cancer, patients need sustainable system-level support for their treatment decisions in the predicament that this disease presents.

FUNDING SUPPORT

Research reported in this publication was supported by the National Cancer Institute of the National Institutes of Health under award numbers UG1CA189823 (Alliance for Clinical Trials in Oncology NCI Community Oncology Research Program grant); UG1CA189848, UG1CA233270, UG1CA233290, UG1CA233329, UG1CA233331, UG1CA233373, UG1CA232760, and R01 MD008934 (Jon C. Tilburt, Joel E. Pacyna, Judith S. Kaur, and Simon P. Kim); and U10CA180820, UG1CA189830, and UG1CA189854 (ECOG-ACRIN). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health (https://acknowledgments.alliancefound.org).

CONFLICT OF INTEREST DISCLOSURES

Daniel G. Petereit reports grant support from the Bristol-Myers Squibb Foundation, the Irving A. Hansen Foundation, the Ralph Lauren Pink Pony Foundation, and the National Institutes of Health (1R01CA240080-01); consulting fees from Boston Scientific; payments or honoraria from Boston Scientific, the University of California San Francisco, the Mayo Clinic, and

the University of Pennsylvania; legal consultancy for brachytherapy cases; and a leadership role with the American Brachytherapy Society. George J. Chang reports consulting fees from Medicaroid and participation on boards for J&J and 11 Health. Ethan M. Basch reports consulting fees from AstraZeneca, Carevive Systems, Navigating Cancer, and Sivan Healthcare. Michael J. Morris is an uncompensated consultant for Bayer, Novartis, Advanced Accelerator Applications, Janssen, and Lantheus; is a compensated consultant for ORIC, Curium, Athenex, the National Comprehensive Cancer Network, and Exelixis; reports participation on boards for Curium, Athenex, Exelixis, AstraZeneca, and Amgen; and receives institutional funding for clinical trials from Bayer, Endocyte, Progenics, Corcept, Roche/Genentech, Celgene/Bristol-Myers Squibb, and Janssen. None of his disclosures are related to this work. Electra D. Paskett is a multiple principal investigator on a grant to her institution from the Merck Foundation and on another grant from Pfizer, and she also receives grant funding to her institution from the Breast Cancer Research Foundation. None of her disclosures are related to this work. Victor M. Montori reports that he works at the Knowledge and Evaluation Research Unit of the Mayo Clinic and conducts research into shared decision-making; often, shared decision-making tools are produced that are placed in the public domain and are free to use and that produce no income to the research unit or to him personally. Dominick L. Frosch reports consulting fees paid to his former employer (Sutter Health) by the Mayo Clinic/National Institutes of Health. The other authors made no disclosures.

AUTHOR CONTRIBUTIONS

Jon C. Tilburt: Conceptualization, formal analysis, funding acquisition, project administration, supervision, and writing–original draft. **David Zahrieh:** Formal analysis and writing–review and editing. **Joel E. Pacyna:** Project administration and writing–review and editing. **Daniel G. Petereit:** Methodology and writing–review and editing. **Judith S. Kaur:** Methodology and writing–review and editing. **Bruce D. Rapkin:** Writing–review and editing. **Robert L. Grubb III:** Writing–review and editing. **George J. Chang:** Methodology and writing–review and editing. **Michael J. Morris:** Methodology and writing–review and editing. **Evan Z. Kovac:** Writing–review and editing. **Kara N. Babaian:** Writing–review and editing. **Jeff A. Sloan:** Methodology and writing–review and editing. **Ethan M. Basch:** Methodology and writing–review and editing. **Elizabeth S. Peil:** Formal analysis, writing–review and editing. **Amylou C. Dueck:** Formal analysis and writing–review and editing. **Paul J. Novotny:** Methodology and writing–review and editing. **Electra D. Paskett:** Methodology and writing–review and editing. **Jan C. Buckner:** Writing–review and editing. **Daniel D. Joyce:** Writing–review and editing. **Victor M. Montori:** Methodology and writing–review and editing. **Dominick L. Frosch:** Methodology and writing–review and editing. **Robert J. Volk:** Methodology and writing–review and editing. **Simon P. Kim:** Funding acquisition, methodology, and writing–review and editing.

REFERENCES

1. Mohler JL, Antonarakis ES, Armstrong AJ, et al. Prostate cancer, version 2.2019, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw*. 2019;17:479-505.
2. Bach PB, Schrag D, Brawley OW, Galaznik A, Yakren S, Begg CB. Survival of Blacks and Whites after a cancer diagnosis. *JAMA*. 2002;287:2106-2113.
3. Cohen JH, Schoenbach VJ, Kaufman JS, et al. Racial differences in clinical progression among Medicare recipients after treatment for localized prostate cancer (United States). *Cancer Causes Control*. 2006;17:803-811.
4. Du XL, Fang S, Coker AL, et al. Racial disparity and socioeconomic status in association with survival in older men with local/regional stage prostate carcinoma: findings from a large community-based cohort. *Cancer*. 2006;106:1276-1285.
5. Godley PA, Schenck AP, Amamoo MA, et al. Racial differences in mortality among Medicare recipients after treatment for localized prostate cancer. *J Natl Cancer Inst*. 2003;95:1702-1710.
6. Prostate Cancer Patient Education Project (PCFEP): prostate cancer symptom management in low-literacy men (cancer disparities) part 1. what-when-how. Accessed February 10, 2021. http://what-when-how.com/cancer-disparities/prostate-cancer-patient-education-project-pcfep-prostate-cancer-symptom-management-in-low-literacy-men-cancer-disparities-part-1/
7. Linder SK, Swank PR, Vernon SW, Mullen PD, Morgan RO, Volk RJ. Validity of a low literacy version of the Decisional Conflict Scale. *Patient Educ Couns*. 2011;85:521-524.
8. Stacey D, Legare F, Lewis K, et al. Decision aids for people facing health treatment or screening decisions. *Cochrane Database Syst Rev*. 2017;4:CD001431.
9. NCI Community Oncology Research Program (NCORP) Cancer Care Delivery Research (CCDR). National Cancer Institute. Published 2017. Accessed September 15, 2017. https://healthcaredelivery.cancer.gov/ccdr/
10. Pacyna JE, Kim S, Yost K, et al. The comparative effectiveness of decision aids in diverse populations with early stage prostate cancer: a study protocol for a cluster-randomized controlled trial in the NCI Community Oncology Research Program (NCORP), Alliance A191402CD. *BMC Cancer*. 2018;18:788.
11. Szymanski KM, Wei JT, Dunn RL, Sanda MG. Development and validation of an abbreviated version of the Expanded Prostate Cancer Index Composite instrument for measuring health-related quality of life among prostate cancer survivors. *Urology*. 2010;76:1245-1250.
12. International Patient Decision Aid Standards (IPDAS) Collaboration. Accessed April 29, 2020. http://ipdas.ohri.ca/
13. Chabrera C, Zabalegui A, Bonet M, et al. A decision aid to support informed choices for patients recently diagnosed with prostate cancer: a randomized controlled trial. *Cancer Nurs*. 2015;38:E42-E50.
14. Formica MK, Wason S, Seigne JD, Stewart TM. Impact of a decision aid on newly diagnosed prostate cancer patients' understanding of the rationale for active surveillance. *Patient Educ Couns*. 2017;100:812-817.
15. Holmes-Rovner M, Stableford S, Fagerlin A, et al. Evidence-based patient choice: a prostate cancer decision aid in plain language. *BMC Med Inform Decis Mak*. 2005;5:16.
16. Isebaert S, Van Audenhove C, Haustermans K, et al. Evaluating a decision aid for patients with localized prostate cancer in clinical practice. *Urol Int*. 2008;81:383-388.
17. Kim SP, Knight SJ, Tomori C, et al. Health literacy and shared decision making for prostate cancer patients with low socioeconomic status. *Cancer Invest*. 2001;19:684-691.
18. McGregor S. Information on video format can help patients with localised prostate cancer to be partners in decision making. *Patient Educ Couns*. 2003;49:279-283.
19. Myers RE, Leader AE, Censits JH, et al. Decision support and shared decision making about active surveillance versus active treatment among men diagnosed with low-risk prostate cancer: a pilot study. *J Cancer Educ*. 2018;33:180-185.
20. Onel E, Hamond C, Wasson JH, et al. Assessment of the feasibility and impact of shared decision making in prostate cancer. *Urology*. 1998;51:63-66.
21. Violette PD, Agoritsas T, Alexander P, et al. Decision aids for localized prostate cancer treatment choice: systematic review and meta-analysis. *CA Cancer J Clin*. 2015;65:239-251.
22. Mishel MH, Germino BB, Lin L, et al. Managing uncertainty about treatment decision making in early stage prostate cancer: a randomized clinical trial. *Patient Educ Couns*. 2009;77:349-359.
23. Ilic D, Jammal W, Chiarelli P, et al. Assessing the effectiveness of decision aids for decision making in prostate cancer testing: a systematic review. *Psychooncology*. 2015;24:1303-1315.