Monitoring of health-related quality of life and symptoms in prostate cancer survivors: a randomized trial

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Background Routine symptom and health-related quality of life (HRQOL) assessments can engage patients, give provider feedback, and improve doctor/patient communication.

Objective We compared the impact of a technology-assisted symptom monitoring system versus usual care on HRQOL and doctor/patient communication in early-stage prostate cancer (PCa) survivors.

Methods Men (N = 94) were on average 62-years old, mostly African American (AA; 61.7%), and 10-19 months post-treatment. They were randomized to symptom monitoring plus feedback (SM+F; n = 49) or usual care (UC; n = 45). SM+F participants completed a 12-item telephone-assisted monitoring intervention. All participants completed a baseline and 2 follow-up interviews.

Results Among the SM+F participants, perceptions of the monitoring system were positive: 97.1% endorsed it as easy/very easy to use and 85% felt all patients could benefit from it. At baseline, men reported favorable general and cancer-specific HRQOL and doctor/patient communication, but poorer urinary and sexual function. Although there was no overall impact of the intervention, *post hoc* exploratory analyses indicated that among AA men, those who received SM+F improved relative to UC on doctor/patient communication ($P < .05$), general HRQOL ($P < .06$), and sexual function ($P < .05$).

Limitations Variability in survivor follow-up care, limited access to eligible participants, and minimal physician training in the use of reports likely decreased physician investment.

Conclusion Overall, PCa survivors were receptive to this monitoring system. Exploratory analyses suggest that this technology-assisted monitoring system may be of particular benefit to African American men. Additional studies with larger samples, more intervention time-points, and increased physician training are needed to strengthen the intervention's impact.

Research on symptom management and monitoring of health-related quality of life (HRQOL) among cancer patients has typically focused on the active treatment phase.[1-7] More recently, greater attention has been given to the psychosocial needs and follow-up care plans for survivors.[8] Several technology-assisted symptom/HRQOL monitoring systems with routine assessments have been shown to be easy to use,[1,3,5,9-16] readily accepted by patients,[3,9,11,14,15,17,18] helpful in communication between patients and providers,[3,9,11,13,15] and a means of overcoming numerous barriers to conducting routine assessments.[16,19-23] Real-time clinician feedback at the point-of-care appears to be a crucial component of these systems, giving patients and providers a systematic way of discussing symptoms and aspects of HRQOL that are often addressed only informally or not at all.

To date, 6 randomized controlled trials (RCTs) have assessed the impact of technology-assisted interventions among cancer patients.[6,23-27] There was significant variability across these studies, including differing sample sizes, number of intervention contacts, tumor site (eg, breast, lung, colon), outcomes assessed (eg, symptom distress, com-

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munication, and HRQOL), and types of technology used (eg, touch-screen computers, telephone systems). The methodological differences make it difficult to compare these studies, although a common thread was that patients found the systems easy to use and they generally perceived the systems as beneficial.[6,23-27]

Despite the positive response from participants, only 2 of the 6 RCTs demonstrated positive outcomes for the intervention over the control group.[23,25] In a study of 286 cancer patients and 28 oncologists, Velikova et al (2004) found that both the intervention and the attention-control groups had better HRQOL than the control group over a 6-month period.[23] Among the intervention patients, the HRQOL improvement was related to clear use of the HRQOL data by physicians, and to physician/patient discussion of pain and role function. A positive effect on emotional well-being was associated with feedback of the data to physicians. However, there were no significant differences between the intervention and attention-control groups.

The second RCT with positive findings assessed the symptom severity of 405 oncology clinic patients who reported having depression, pain, or both.[25] Kroenke et al (2010) demonstrated that centralized telephone-based symptom management coupled with an automated symptom monitoring system resulted in improved pain and depression scores compared to patients who received usual care. The intervention included repeated measurements of symptoms, accompanied by telecare management. Key components for the success of both studies appear to have been active provider participation and extensive provider training.

Across the RCTs that demonstrated negative results, a number of issues were identified, including high attrition rates and use of the same questionnaire for the intervention and the outcome measure,[24] the need for a longer data collection period,[26,28] and contamination between the study groups.[26]

Given the call for routine symptom/HRQOL monitoring for cancer survivors,[8] and the treatment-related side effects that accompany the long survival period following treatment for localized prostate cancer (PCa), we sought to expand this research to PCa survivors. PCa is a leading cause of morbidity for American men.[29] Approximately 90% of men diagnosed with PCa have early-stage disease and a 5-year survival rate of virtually 100%.[30] Most survivors report treatment-related side effects, particularly urinary, bowel, and sexual dysfunction. Although some symptoms resolve within 12 months of treatment completion, long-term treatment-related symptoms are common and have an adverse impact on disease-specific function and HRQOL.[31-33]

To our knowledge, only one study has used a technology-assisted monitoring system to collect HRQOL information from PCa patients.[5] Yet, no studies have been conducted with PCa survivors.

Based on our pilot study[34] that demonstrated the feasibility of this intervention, we conducted a randomized trial comparing a technology-assisted symptom monitoring system versus usual care on the HRQOL of PCa survivors. We adapted Kornblith's Vulnerability Model of Psychosocial Adaptation of Cancer Survivors (1998),[35] an automated symptom/HRQOL monitoring system on prostate cancer survivors' adaptation, to examine the direct and indirect effects of the intervention. We hypothesized that the intervention would improve general and disease-specific HRQOL; management of urinary, bowel, and sexual symptoms; and doctor/patient communication. Additionally, we conducted post hoc exploratory analyses to examine whether the intervention differentially impacted racial subgroups.

Methods

Participants

Eligibility criteria included early-stage PCa survivors who were 10-19 months post-treatment; a scheduled follow-up appointment with a urologist or radiation oncologist; the ability to read and understand English; and access to a telephone and the ability to manipulate a telephone keypad to complete the survey.

Procedure

This study was approved by the Georgetown/Medstar Oncology Institutional Review Board. Participants were recruited from urologists and radiation oncologists at 2 affiliated hospitals in the Washington, DC metropolitan area: Georgetown University Medical Center (GUMC) and Washington Hospital Center (WHC).

Invitation letters were mailed to eligible participants one month prior to their upcoming appointment. One week later, men were called by a research assistant (RA) to further describe the study; obtain verbal informed consent; conduct the baseline (T0) telephone interview; and randomize to either symptom monitoring plus feedback (SM+F) or usual care (UC). Randomization was conducted using the telephone-based system stored on a server at GUMC. Written consent was obtained via mail following completion of the T0.

Participants completed a total of 3 telephone interviews: baseline (T0), 2 months post-baseline (T1), and approximately 7 months post-baseline (T2). All 3 interviews were conducted by the RA and included the same HRQOL scales. The T2 also included an overall study evaluation.

- UC Group: UC participants saw their physicians as scheduled but did not use the monitoring system before each follow-up visit and no feedback was provided to physicians.
- SM+F Group: Participants in the SM+F intervention group received written and verbal (by telephone) instructions on how to use the technology-assisted monitoring system.

SM+F participants were instructed to call the automated system 3 business days prior to their next 2 follow-up visits with their physician. Reminder calls were made to those who did not call into the system on their own. Men were called every day for up to 3 days, until they either called into the system or had their appointment. For the monitoring intervention, the men completed the Prostate Cancer Subscale (PCS) of the Functional Assessment of Cancer Therapy-Prostate (FACT-P), a 12-item subscale that measures problems specific to prostate cancer. The PCS was used for the intervention so that the intervention itself would not overlap with the outcome measure. Internal consistency ranged from 0.65 to 0.69. Participants completed the PCS via telephone by responding to questions using their keypad. The responses were stored in a database from which individualized reports were generated. The RA delivered the reports to the physician approximately 24 hours prior to the scheduled follow-up visit. Participants completed a total of 2 monitoring interventions in approximately 7 months.

Description of the monitoring system

The Prostate Cancer Monitoring System (PCMS) is a telephone/computer-based monitoring system adapted from the Advanced Lung Cancer Management Program (ALCaMP) Study.[36] ALCaMP was designed to reduce barriers to the routine use of standardized symptom/HRQOL assessments for patients with advanced lung cancer.

Symptom alerts and report. The report format was based on input from several urologists who participated in the pilot study.[34] Symptom alerts (the word 'alert' printed beside the patient response) were generated when a patient's endorsement of a symptom was a 4 or 5 on a 5-point scale, regardless of whether it had changed from the previous assessment. An alert was also generated if the response worsened by 2 or more points from the previous assessment. All items were scored such that higher scores corresponded to more of a particular symptom.

Measures

Demographic and clinical information. Self-reported patient information was assessed at T0 and included age, race/ethnicity, education, marital status, employment status, income, treatment, and comorbidities.

General HRQOL. The SF-12[37] is a 12-item generic measure of HRQOL composed of 2 subscales, the Mental Component Summary (MCS) and the Physical Component Summary (PCS). It has been widely used among medical patients and the general population. The 2-week test-retest reliability for the MCS was 0.76 and 0.89 for the PCS.[37,38] Higher scores indicate better general HRQOL.[38] The SF-12 was administered at T0, T1, and T2.

Cancer-specific HRQOL. The Functional Assessment of Cancer Therapy – General (FACT-G)[39] is a 27-item questionnaire divided into 4 HRQOL domains: Physical Well-Being (PWB), Social Well-Being (SWB), Emotional Well-Being (EWB), and Functional Well-Being (FWB). The FACT-G is a well-validated and widely used cancer-specific questionnaire. The total score ranges from 0 to 108, with a higher score indicating better quality of life. The FACT-G was administered at T0, TI and T2.

Prostate cancer–specific HRQOL. The UCLA Prostate Cancer Index (UCLA-PCI)[40] is a 20-item measure of function and bother in urinary, bowel, and sexual domains for men treated for PCa. Higher scores indicate better functioning. The UCLA PCI was also administered at T0, T1, and T2.

Doctor/patient communication. The Primary Care Assessment Survey (PCAS) is a measure originally designed for the primary care setting, although it has also been used in the oncology setting.[41] We included 2 of the 11 subscales: communication (6 items) and interpersonal treatment (5 items). The 6-point response scale included categories from 'Very poor' to 'Excellent'. Scores ranged from 0-100 points, with higher scores indicating more favorable ratings.[42] Overall satisfaction with care by the doctor was measured by one item with responses ranging from poor "0" to excellent "10". The PCAS was also administered at T0, T1, and T2.

Post-visit ratings (PVR). Patients and physicians rated their perceptions about how well symptoms/HRQOL issues were addressed. Patients and physicians rated activities that were performed during the clinic visit, including referrals to other healthcare providers (eg, psychiatry, physical therapy) and prescriptions and/or other activities performed in response to patient-reported concerns. PVRs were administered after each physician visit. Patient data for both groups was above 80% following each visit while physician data was approximately 60% for patients in both groups. These discrepancies made it difficult to make comparisons between patients and physicians and thus these data are not discussed further.

Patient/physician study evaluation. At the T2 assessment, SM+F participants completed a 10-item questionnaire to evaluate the utility and acceptability of the monitoring system and their study participation. UC participants completed a 7-item questionnaire to evaluate their study participation. At the end of the study, physicians completed a 10-item questionnaire to evaluate the impact of study participation on their communication with patients and their satisfaction with the care they provided.

Data analysis. Intent-to-treat analyses included all patients who were randomized in the study (N = 94). We present comparisons on the outcomes at T2 (ie, following the opportunity for completion of both interventions). We conducted descriptive statistics, t-tests, and chi-square statistics to determine whether there were any baseline group differences on demographic, clinical, or outcome variables. Multivariate analyses included repeated measures ANCOVAs to compare SM+F and UC participants on the primary outcomes. We also conducted per-protocol analyses, limited to the 83% in the SM+F group who had completed both monitoring interventions. Finally, we conducted post hoc exploratory repeated measures ANCOVAs with race as a factor to examine whether the intervention had a differential impact within racial subgroups. All multivariate analyses were adjusted for age and education due to significant univariate associations between these variables and the outcome variables. We used the Statistical Package for the Social Sciences (SPSS) versions 19 and 20 to conduct the analyses.

Results

Participation and retention rates

We contacted 142 men with early-stage PCa (Figure 1). Ten men were ineligible (eg, non-English speakers, disconnected phone numbers, cognitive impairment). Of the 132 eligible men, 94 (71%) agreed to participate in the study (SM+F group [n = 49] vs UC group [n = 45]). Retention rates are presented in Figure 1. T2 retention rates are based on the number of eligible participants at T0 who had a final follow-up appointment. Reasons for study dropout at T1 and T2 included: not comfortable talking about PCa, unreachable, too busy, confidentiality issues, too ill, and moved out of the country.

Demographic characteristics are shown in Table 1. Participants were a mean age of 62-years, and over one-half were African American (AA; 61.7%), married (78.7%), had a college/advanced degree (50.0%), were working full-time (60.6%), and had an annual household income over $100,000 (57.4%). Approximately 44% had 2 or more comorbid illnesses and the majority had had a radical prostatectomy (RP). There were no significant differences between the groups on any demographic or clinical variables at T0.

Participants' evaluation of the study

At the T2 interview, all participants completed an evaluation of their participation experience. Among the SM+F participants, the majority (97.1%) endorsed that it was easy or very easy to use the monitoring system and 85% endorsed that all patients would benefit from an automated monitoring system to routinely assess their symptoms/HRQOL. When asked how often they would like to complete a symptom assessment, 62% reported before each visit, 14% every other month, 5% monthly, and 19% never. Finally, 65% of SM+F participants said an automated symptom monitoring system would be 'quite a bit' or 'very useful' for general patient care following treatment.

Approximately 88% of all participants indicated that the interview questions asked were important, 84% reported that the questions were not too personal, and 83% reported that the surveys were *not* too long to complete. When asked about their preference for mode of completing a survey, 66% endorsed the computer/internet while 16% endorsed the telephone, 13% endorsed no preference and 6% preferred in-person surveys.

Process variables. At T1, 92% of the SM+F participants completed the intervention, and at T2 85% completed the intervention. Overall, 96% were exposed to at least one and 83% were exposed to both interventions.

Comparison of SM+F and UC groups on study outcomes. At baseline, patients reported very favorable levels of general HRQOL (SF-12), cancer-specific HRQOL (FACT-G), bowel functioning (UCLA-PCI), and doctor/patient communication (PCAS). Only the sexual and urinary functioning scores suggested a low level of disease-specific functioning (ULCA-PCI). None of the measures differed significantly between groups at baseline (Table 2). We conducted intent-to-treat repeated measures ANCOVA analyses to assess the impact of the intervention. Contrary to our hypotheses, the multivariate analyses revealed no significant group by time interactions on any of the outcomes at T2 (all Ps $> .10$). We also found no significant group differences when we limited the analyses to those who were exposed to the intervention.

Moderator analyses. To assess whether the intervention had a differential impact within racial subgroups (AA/White), we conducted post hoc exploratory repeated measures ANCOVAs that included race as a factor with education and age as covariates. On the sexual function subscale, there was a group by time by race interaction ($F(1, 59) = 4.15$; $P = .05$), revealing that AA men in the SM+F group improved more than White men in the SM+F group and also more than AA men in the UC arm (Figure 2). On the overall subscale of the PCAS, there was a significant group by time by race interaction ($F(1, 61) = 6.28$; $P = .02$),

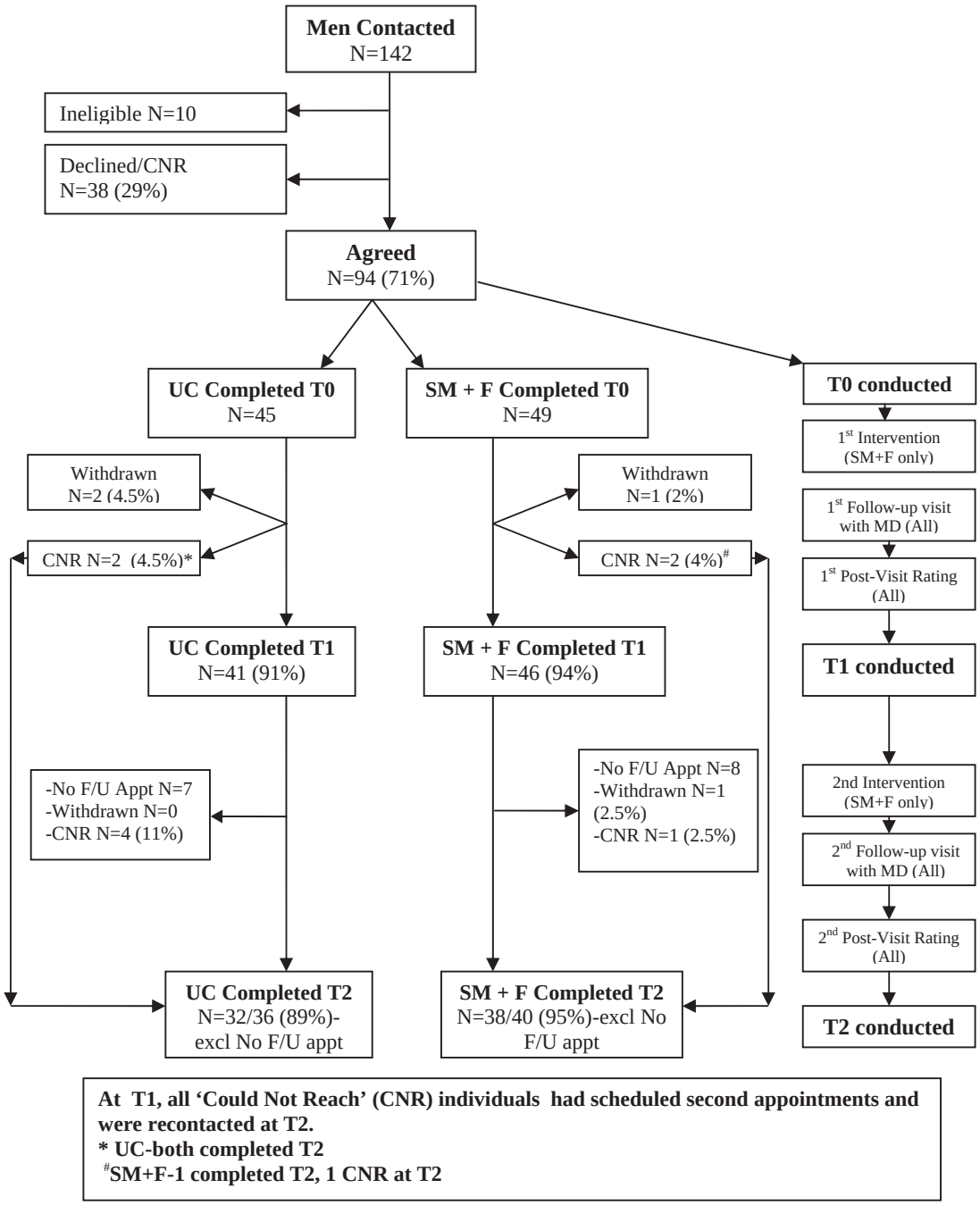


FIGURE 1 PCMS study flowchart.

indicating that White men in the UC group improved while those in the SM+F group declined. The reverse was true for AA men: those in the SM+F group improved while those in the UC group declined (Figure 3). Finally, for the MCS analysis, there was a marginally significant group by time by race interaction ($F(1, 61) = 3.73$; $P = .06$), which revealed that White men in both the UC and SM+F groups declined, while AA men in the UC group declined but those in the SM+F group improved (Figure 4). Across all 3 figures, AA men in the SM+F intervention improved compared to AA men in the UC group. Among White men, the SM+F intervention resulted in an improvement over the UC group only on the sexual function outcome. The interactions with

TABLE 1 Sample characteristics/clinical information

Sample characteristics	SM+F (N = 49)	UC (N = 45)	Total (N = 94)
Age (years) (Mean, SD)	61.9 (7.0)	62.0 (8.1)	62.0 (7.5)
Missing	1		1
Age N (%)			
48-60 years	24 (50.0)	21 (46.7)	45 (48.4)
61-78 years	24 (50.0)	24 (53.3)	48 (51.6)
Missing	1		1
Race N (%)			
White	16 (32.7)	17 (37.8)	33 (35.1)
African American	31 (63.3)	27 (60.0)	58 (61.7)
Other	1 (2.0)	1 (2.2)	2 (2.1)
Refused	1 (2.0)	0	1 (1.1)
Marital status N (%)			
Married/com. relationship	39 (79.6)	35 (77.8)	74 (78.7)
Not married	10 (20.4)	10 (22.2)	20 (21.3)
Education N (%)			
High school or less	24 (49.0)	23 (51.1)	47 (50.0)
College/advanced degree	25 (51.0)	22 (48.9)	47 (50.0)
Household income N (%)			
≤ $100,000	18 (36.7)	21 (46.7)	39 (41.5)
≥ $100,000	31 (63.3)	23 (51.1)	54 (57.4)
Missing		1	1
Employment status N (%)			
Full time	31 (63.3)	26 (57.8)	57 (60.6)
Retired/parttime/else	18 (36.7)	19 (42.2)	37 (39.4)
Clinical information	**SM+F (N = 49)**	**UC (N = 45)**	**Total (N = 94)**
Comorbidities N (%)			
0 illnesses	14 (28.6)	10 (22.2)	24 (25.5)
1 illnesses	13 (26.5)	16 (35.6)	29 (30.9)
2+ illnesses	22 (44.9)	19 (42.2)	41 (43.6)
Type of treatment N (%)			
RP only	31 (63.2)	27 (60.0)	58 (61.7)
RT only (Inc.1 RP+RT)	7 (14.3)	9 (20.0)	16 (17.0)
ADT + other	9 (18.4)	7 (15.6)	16 (17.0)
Watchful waiting	2 (4.1)	2 (4.4)	4 (4.3)
Site N (%)			
GUMC	27 (52.9)	24 (47.1)	51 (54.3)
WHC	22 (51.2)	21 (48.9)	43 (45.7)

Abbreviations: ADT, androgen deprivation therapy; GUMC, Georgetown Univeristy Medical Center; RP, radical prostatectomy; RT, radiation therapy; SM+F, symptom monitoring plus feedback; UC, usual care; WHC, Washington Hospital Center.
No statistically significant differences were found between the 2 groups.

race were nonsignificant for the remaining outcome >measures (FACT-G total score, all FACT-G subscale scores, the PCS of the SF-12, urinary function and bowel function of the UCLA PCI, and the Communication and Interpersonal subscales of the PCAS).

Discussion

The objective of this RCT was to compare the impact of a technology-assisted monitoring system versus usual care on HRQOL and doctor/patient communication in PCa survivors. Our hypotheses regarding overall group differ-

TABLE 2 Primary outcome measure means by randomization group across time

Timepoint →	T0		T2	
Group → Outcomes ↓	SM+F (38)	UC (32)	SM+F (38)	UC (32)
FACT-G	**M (SD)**	**M (SD)**	**M (SD)**	**M (SD)**
Total score	93.3 (7.6)	94.2 (12.1)	92.5 (12.3)	94.8 (11.3)
Physical well-being	26.0 (2.1)	25.6 (2.3)	25.5 (3.6)	25.9 (2.6)
Social well-being	21.6 (3.7)	22.4 (4.6)	21.8 (4.4)	23.1 (3.2)
Emotional well-being	21.7 (2.3)	21.7 (3.0)	21.6 (2.5)	21.7 (3.1)
Functional well-being	24.0 (3.2)	24.6 (4.3)	23.6 (4.6)	24.1 (4.4)
SF-12				
Mental component subscale	56.5 (4.0)	56.0 (5.4)	55.1 (7.8)	53.8 (7.8)
Physical component subscale	51.1 (6.5)	50.7 (7.3)	50.5 (8.1)	53.8 (5.1)
UCLA-PCI				
Urinary function	59.2 (13.7)	60.8 (12.3)	60.2 (14.4)	60.8 (13.7)
Bowel function	89.4 (13.2)	91.9 (8.6)	88.5 (14.3)	90.5 (14.7)
Sexual function	33.9 (25.7)	39.9 (26.1)	45.3 (29.6)	45.5 (30.6)
Missing	1	1	1	1
PCAS				
Communication	85.4 (15.9)	83.6 (17.3)	86.7 (12.9)	84.8 (16.5)
Interpersonal	82.4 (17.6)	85.0 (15.2)	82.9 (16.8)	84.1 (18.0)
Overall	82.6 (10.6)	82.5 (12.2)	83.7 (8.8)	84.4 (9.5)

Abbreviations: FACT-G, Functional Assessment of Cancer Therapy-General; PCAS, Primary Care Assessment Survey; SM+F, symptom monitoring plus feedback; UC, usual care; UCLA-PCI, UCLA Prostate Cancer Index.

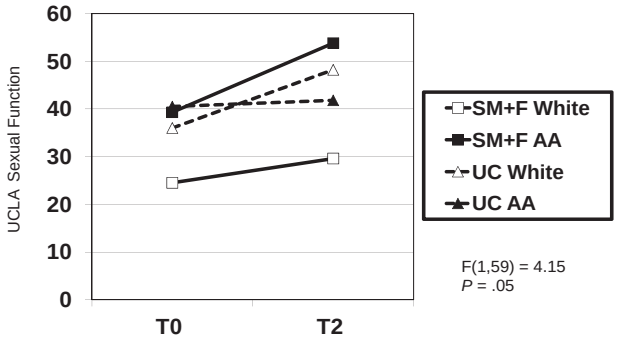


FIGURE 2 Exploratory analyses regarding intervention's impact within racial subgroups. UCLA sexual function. Abbreviations: SM+F White, symptom monitoring + feedback White; SM+F AA, symptom monitoring + feedback African American; UC White, usual care White; UC AA, usual care African American.

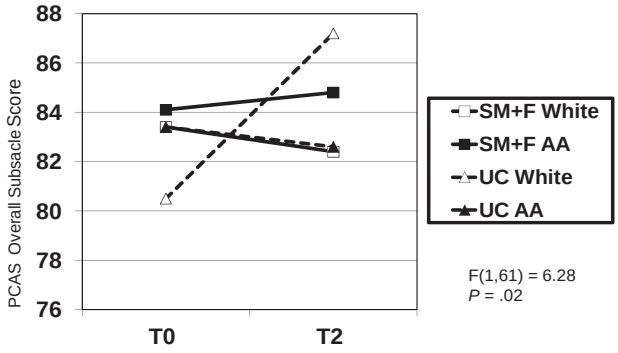
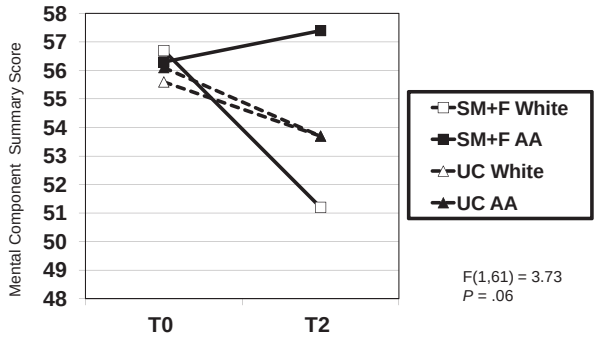


FIGURE 3 Exploratory analyses regarding intervention's impact within racial subgroups. PCAS overall subscale. Abbreviations: SM+F White, symptom monitoring + feedback White; SM+F AA, symptom monitoring + feedback African American; UC White, usual care White; UC AA, usual care African American.

ences were unconfirmed, potentially due to the very high baseline scores on the majority of our outcome measures, which made it difficult to demonstrate change over time. However, post hoc exploratory analyses suggested that the intervention benefited AA men in the SM+F group compared to AA men in the UC group while the SM+F intervention did not have the same beneficial impact among White men. Although these findings will need replication, this technology-assisted monitoring system may have provided AA men with a tool that highlights their symptom/HRQOL issues and helps them communicate with their physicians.

Despite the fact that this was a negative study with respect to HRQOL outcomes, this study makes several important contributions to the literature on symptom/



Note. These are adjusted means (adjusting for age, education and the baseline measure of the outcome).

FIGURE 4 Exploratory analyses regarding intervention's impact within racial subgroups. MCS12. Abbreviations: SM+F White, symptom monitoring + feedback White; SM+F AA, symptom monitoring + feedback African American; UC White, usual care White; UC AA, usual care African American.

HRQOL monitoring, particularly about the process issues. First, this study is, to our knowledge, the first RCT examining the impact of a monitoring system focused on symptoms/HRQOL in cancer survivors, with a focus on PCa survivors. This research addressed survivorship issues, specifically in PCa survivors who are known to experience significant side-effects following treatment. We expected that this system would be particularly useful for men as they tend to report fewer symptoms/problems compared to women[43-45] and may be more likely to express their concerns in a less direct manner. Because this system was successfully adapted from advanced lung cancer patients to PCa survivors, it may be used with patients along the trajectory of cancer care to evaluate HRQOL and other important outcomes such as doctor/patient communication. Finally, our results suggest that this type of system may be of particular benefit to AA men. However, additional studies are needed to confirm these findings.

Study limitations included the significant variability in follow-up care for PCa survivors. For example, men who received RP tended to see their urologist only every 6 months while men who had combination therapy may have alternated between their radiation oncologist and their urologist every 3 months. This difference in follow-up visits may have posed an unanticipated problem for recruitment of eligible participants for this study. Second, because eligibility was tied to a follow-up visit for men approximately one year post-completion of treatment, many men may have already stopped regular follow-up with these specialists by that time. Primary care physicians may provide an additional avenue for recruitment of PCa survivors.

An important design consideration was the concern regarding contamination between groups because physicians treated patients in both groups. In subsequent studies, randomization by site will be necessary to address this concern. In the present study, we met with each physician prior to the start of the study to provide a study overview and to show them a sample report that they would be given prior to each SM+F participant clinic visit. In retrospect, we recognize that increased physician training in the use of these types of reports may have engendered greater investment from physicians as evidenced by Velikova.[23] Future studies must train and incentivize physicians to complete study ratings so that comparisons between patient and physician data can be analyzed. Physicians must also understand the importance of completing the study evaluations so that they can share what worked and what did not regarding the information gained about problems experienced by their patients. A final study design consideration was the number of interventions. In the present study, participants completed 2 interventions. Other studies had more than 2 interventions, which have been identified by researchers as a potential factor that may impact the results.[27] If a study such as this were started just after the completion of treatment, having additional interventions may result in a greater impact over time.

Future directions

Additional research is needed to continue to assess the use of technology-assisted systems for the routine symptom and HRQOL assessment for cancer patients and survivors. Needed improvements to this type of research include larger sample sizes, more intervention points, more physician training, and randomization by site. Finally, further efforts to explore the impact of such interventions on doctor/patient communication need to be examined as little research in this area has been conducted. Automated monitoring for cancer patients and survivors is an important area of research that could have significant clinical impact by allowing patients and survivors to have a more active role in their follow-up care. Determining cost-effective methods for using these types of systems is also needed to improve the long-term outcomes of cancer survivors.

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