DR. DANIELA WITTMANN (Orcid ID : 0000-0002-9201-7269)

DR. AKANKSHA MEHTA (Orcid ID : 0000-0001-8226-7793)

DR. SHARON L BOBER (Orcid ID : 0000-0002-2793-2620)

DR. TED A SKOLARUS (Orcid ID : 0000-0002-5859-8151)

DR. DANIEL E SPRATT (Orcid ID : 0000-0002-5973-4741)

DR. CRAIG EVAN POLLACK (Orcid ID : 0000-0003-2464-6415)

Article type : Original Article

TrueNTH Sexual Recovery Intervention for Couples Coping with Prostate Cancer: Randomized Controlled Trial Results

Running title: Sexual Recovery after Prostate Cancer

Daniela Wittmann, PhD, MSW[1], Akanksha Mehta, MD[2], Sharon L. Bober, PhD[3], Ziwei Zhu, MS[1], Stephanie Daignault-Newton, MS[1], Rodney L. Dunn, MS[1], Thomas M. Braun, PhD[1], Caroline Carter, MPH[1], Ashley Duby, MS[1], Laurel L. Northouse, PhD[1], Bridget F. Koontz, MD[4], L. Michael Glodé, MD[5], Jan Brandon, BA[6], Rick Bangs, MBA[7], John McPhail, MA[7], Susan McPhail, MS[6], Lenore Arab, PhD[8], Kellie Paich, MPH[9], Ted A. Skolarus, MD, MPH[1, 13], Lawrence C. An, MD[1], Christian J. Nelson, PHD[10], Christopher S. Saigal, MD[8], Ronald C. Chen, MD, MPH[11], John P. Mulhall, MD[11], Sarah T. Hawley, PhD, MPH[1], Jason W. D. Hearn, MD[1], Daniel E. Spratt, MD[1] and Craig E. Pollack, MD, MHS[12]

1. University of Michigan, Ann Arbor, MI 2. Emory University, Atlanta, GA 3. Dana-Farber Cancer Institute, Boston, MA 4. Duke University, Durham, NC 5. University of Colorado, Aurora, CO 6. Partner advocate, Bethesda, MD, 7. Patient advocate, Bethesda, MD 8. University of California-Los Angeles, Los Angeles, CA 9. Movember Foundation, Los Angeles,

CA 10. Memorial Sloan Kettering, New York, NY 11. University of California-Los Angeles, Los Angeles, CA 12. Johns Hopkins University, Baltimore, MD 13. Veterans Affairs Ann Arbor Healthcare System, Ann Arbor, MI

Dr. Koontz is at East Carolina University, Dr. Chen is at University of Kansas, Dr. Spratt is at Cases Western University.

Corresponding Author:
Daniela Wittmann, PhD, MSW
Department of Urology
2800 Plymouth Road
Ann Arbor MI 48109-2800
734.615.2878
dwittman@med.umich.edu

Funding: This study was funded by the Movember Foundation.

Results from this study were presented at the 2019 American Urological Association and the Sexual Medicine Society of North America meetings.

Conflict of Interest:
Dr. Pollack reports stock ownership in Gilead Pharmaceuticals. He works on a temporary assignment at the Department of Housing and Urban Development (HUD). This report does not represent the views of HUD.

Dr. Skolarus receives UpToDate royalties for authorship on prostate cancer survivorship topic; he has NIH NCI grants R37CA222885 and R01CA242559.

Dr. Spratt receives personal fees from Blue Earth, AstraZeneca, and Janssen.

Dr. Koontz Dr. Koontz is a consultant for Rythera Therapeutics, has research funding from Janssen Scientific Affairs, Merck Pharmaceuticals, and Blue Earth Diagnostics, and is on Advisory Boards for Blue Earth Diagnostics and Myovant..

Dr. Glode consults for Janssen, Exelixis, Bayer and Seattle Genetics.

Dr. Mulhall is an advisor to Vault Health.

Author contributions:

	Conceptualization	Methodology	Analysis	Writing	Editing
Wittmann	✓	✓	✓	✓	✓
Mehta	✓	✓	✓	✓	✓
Bober	✓	✓	✓	✓	✓
Zhu		✓	✓	✓	✓
Braun		✓	✓		✓
Daignault-Newton		✓	✓	✓	✓
Dunn	✓	✓	✓	✓	✓
Carter	✓			✓	✓
Duby		✓	✓	✓	✓
Northouse	✓			✓	✓
Koontz	✓			✓	✓
Glode	✓			✓	✓
Brandon	✓				✓
Bangs	✓				✓
J. McPhail	✓				✓
S. McPhail	✓				✓
Arab	✓	✓			✓
Paich	✓			✓	✓
Skolarus	✓	✓	✓		✓
An	✓	✓	✓		✓
Nelson	✓	✓	✓		✓
Saigal	✓		✓	✓	✓
Chen	✓		✓	✓	✓
Mulhall	✓			✓	✓
Hawley		✓	✓	✓	✓
Hearn	✓		✓	✓	✓
Spratt	✓		✓	✓	✓
Pollack	✓	✓	✓	✓	✓

Acknowledgement: We would like to thank all the patients and partners who participated in the study and the study coordinators: Steven Thelen-Perry, MS[1], Joseph B. Huntley[12], Manotri Chaubal[12], Ella Anastasiades[2], Josemanuel Saucedo[8], Caraline Craig, MPH[10], and Becky Green, MSW[15].

The University of Michigan Rogel Cancer Center Shared Resource supports the Center for Health Communications Research through the National Institutes of Health's National Cancer Institute (Award # P30CA046592).

Lay summary

The study tested a web-based program supporting couples' sexual recovery of sexual intimacy after prostate cancer treatment. One hundred and forty-two couples were recruited and randomly assigned to the program (60) or to a control group (82). The program did not result in improving participants' satisfaction with sex life at 6-months after treatment, but couples in the intervention group engaged in sexual activity sooner after treatment than couples in the control group. Couples evaluated the program positively and would recommend it to others facing prostate cancer treatment.

Precis

Couples coping with prostate cancer participated in a randomized controlled trial of a sexual recovery support program. While participants assigned to the intervention were not more satisfied with their sex life at 6-months post-treatment, they re-engaged in sexual activity earlier than the control group and found the program beneficial.

Abstract

Background: Despite significant sexual dysfunction and distress following localized prostate cancer treatment, patients typically receive only physiologic erectile dysfunction management. We performed a randomized controlled trial of an online intervention supporting couples' post-treatment recovery of sexual intimacy.

Methods: Patients treated with surgery, radiation or combined radiation and ADT with partners were recruited and randomized to an on-line intervention versus a control group. The intervention, tailored to treatment type and sexual orientation, comprised six modules addressing expectations for sexual and emotional sequelae of treatment, rehabilitation, and guidance towards sexual intimacy recovery. Couples, recruited from 6 sites nationally, completed validated measures at baseline, 3 and 6-months post-treatment. Primary outcome group differences were assessed with t-tests for individual outcomes.

Results: Among the 142 randomized couples, 105 patients (mostly surgery) and 87 partners completed the 6-month survey, reflecting challenges with recruitment and attrition. There were no differences between the intervention and control arms in the PROMIS Satisfaction with Sex Life 6 months post-treatment (primary outcome). Three months post-treatment, intervention group patients had higher sexual interest; patients and partners reported more engagement in penetrative and non-penetrative sexual activities than controls. Over

73% of intervention participants reported high or moderate satisfaction with module content; over 85% would recommend the intervention to other couples.

Conclusion: Online psychosexual support for couples can help couples connect and experience sexual pleasure early after treatment despite the patient's sexual dysfunction. Participants' high endorsement of the intervention reflects the importance of sexual health support to couples following prostate cancer treatment.

Key words: prostate cancer sexual dysfunction couples rehabilitation telemedicine

Total number:

1) Text pages, abstract, main text, references and figure legends: 13
2) Tables: 3
3) Figures: 2
4) Supporting files: 3

Introduction

Although most men with localized prostate cancer become long-term survivors,[1] treatment with surgery, radiation, or androgen deprivation therapy (ADT) frequently results in significant sexual side-effects that affect many men and their partners. Patient and partner distress about treatment-related sexual problems, including a decline in erectile function, negatively affects intimate relationships and quality of life.[2-4] [5, 6]. While patients and partners report a desire for information and guidance to help them cope with these side-effects, this information is often unavailable.[7-9] Support for sexual recovery remains a significant gap in prostate cancer survivorship care.

Experts in the field of sexual recovery after prostate cancer have advocated for the inclusion of partners and for support for couples' engagement in a process that is arduous, replete with feelings of loss and grief, when men and partners need to accept a new sexual paradigm and when men often need to use pre-erectile aids. [10, 11]. Additionally, the unique needs of gay and bisexual patients have been recognized [12, 13]. Existing interventions oriented towards couples' sexual recovery have not shown a significant effect on sexual function which generally remained in the dysfunctional range, underscoring the limited ability of psychosexual interventions to alter the biological impact of prostate cancer treatment on men's sexual function.[14, 15] However, psychosocial interventions have been shown to increase men's use of pro-erectile aids,[16, 17] increased knowledge about the sexual side-effects of treatment, improved partner acceptance of the idea that men can have a satisfying sex life despite erectile dysfunction, and increased the persistence of sexual activity even after ADT treatment.[18] The drawback of the reported interventions has been their administration by professionals or peers, with associated financial costs and need for highly trained personnel, which has limited their dissemination in clinical practice.

Online interventions have shown promise as an approach to increasing the implementation of evidence-based approaches to health education and symptom management for cancer survivors.[19-21] The use of an online platform can reduce barriers to specialized care, such as cost or distance, and may be particularly important in addressing sexual side-effects when patients and/or partners may be embarrassed and reluctant to seek in-person care.[15, 22]

The study goal was to test the impact of the TrueNTH Sexual Recovery Intervention, a tailored, interactive, web-based tool, on patients' and their partners' recovery of sexual intimacy after prostate cancer treatment, as compared to standard informational resources. We hypothesized that the online format, available in an easily available platform, would deliver specialty care with evidence-based content and promote couples' engagement in sexual recovery as well as satisfaction with their sex lives.

Methods

Study Design

The TrueNTH Sexual Recovery Intervention was developed and tested in a multi-site randomized controlled trial between May 2016 and May 2019 at the University of California-Los Angeles, Emory University, Memorial Sloan Kettering Cancer Center, Johns Hopkins University, the University of Michigan, and the University of North Carolina at Chapel Hill.[23] All sites obtained approval by their respective Institutional Review Boards. The study was registered at Clinicaltrials.gov, registration # NCT02702453 on March 3, 2016.

Study Sample

Eligibility criteria included patients diagnosed with localized prostate cancer aged 18 and older, partnered for at least 6 months, and their partners. Participants were required to speak English; each provided consent for participation in the study at least 2 weeks prior to starting prostate cancer treatment. Initially, men who received ADT were excluded; however, as many men undergoing radiation also received ADT, enrollment criteria were modified (03/2017) to include them.

Enrollment and randomization

Prior to study commencement, study ID numbers were randomized with 1:1 randomization, stratified by study sites, using a randomized block design with block sizes of 4. Couples were randomized as a dyad to the same arm. New patients were identified on clinic schedules when they were coming in to discuss treatment for prostate cancer. Initial interest was solicited by phone, consent was signed during the clinic visit. Consenting couples received their study IDs and a link to the study activities, based on their randomization. The Intervention IDs led couples to baseline assessments and to the TrueNTH Sexual Recovery Intervention. The Control IDs led couples to baseline assessments and to a link to the American Cancer Society's web page on Sexuality after Cancer.[24]

The TrueNTH Sexual Recovery Intervention

The Intervention design was based on a conceptual model of sexual recovery after prostate cancer, expert feedback, patient and partner focus groups, and usability testing.[23, 25] The conceptual model

incorporated a biopsychosocial model of sexuality and grief and mourning as key elements in the process towards sexual recovery.[26] The content of the intervention was tailored to participants' treatment type (surgery/radiation) and sexual orientation (female/male partner). The Intervention's 6 modules are accessed over a 7-month period. Each comprises an introductory video of a patient, couple, or sex therapist, education content relevant to the stage of recovery, and suggested activities for the couple to engage in to maintain emotional and sexual connection. Between modules, couples received emails with strategies for concerns expressed during the activity. Module topics included: 1) preparation for treatment-related sexual side-effects and emotional impact, 2) overview of sexual aids for patients and partners, 3) preparation for sexual encounters, 4) strategies for expanding sexual repertoire, 5) incorporation of the new sexual paradigm into daily life, and 6) guidance for speaking to healthcare providers about sexual concerns. The TrueNTH Sexual Recovery Intervention was developed following established processes and user-centered approaches by the Center for Health Communications Research at the University of Michigan.[27]

Outcome measures

Outcome measures are detailed in Appendix Table A. and in our published protocol.[23] The primary pre-specified outcome was the Patient Reported Outcome Measure Information System (PROMIS) Global Satisfaction with Sex Life,[28] to which the patient and the partner responded at baseline and 6 months after beginning prostate cancer treatment. We hypothesized that Global Satisfaction with Sex Life at 6 months would decline for both groups, but would be higher for couples in the intervention arm. Three-month assessments were not collected to reduce response burden during a time of intensive intervention content transmission. We also did not hypothesize shorter term differences.

Secondary outcomes included PROMIS assessments of Sexual Interest, Sexual Activity, and Use of Sexual Aids;[28] prostate cancer-specific quality of life, measured by the Expanded Prostate Cancer Index Composite (EPIC-26);[29] and female sexual function, assessed by the Female Sexual Function Index (FSFI-female partners).[30] Secondary outcomes were assessed at baseline, 3 and 6-months post-treatment. The intermediate 3-month time-point was added for the secondary outcomes because of couples' potential to engage in non-penetrative sexual activities and use sexual aids for penetration, regardless of sexual function and current feelings of loss. Based on existing literature on sexual function outcomes at 3 months, we did not expect a difference between the intervention and control arms in participants' sexual function. At the same time, we hypothesized that patients and partners in the intervention arm would have more sexual interest, accept the use sexual aids more easily, and be more sexually active.

Patients and partners in the intervention arm evaluated their satisfaction with module content after each module, responding on a 5-point Likert scale to statements about whether the module was helpful, should be changed, or was confusing. Participants rated overall satisfaction with the intervention at the end of the intervention. They were also asked whether the intervention helped them cope with the side-effects, manage sex life, was helpful overall, and was worth recommending to others.

Statistical Design

A planned accrual of 142 patient-partner dyads was based upon an anticipated average adjusted score of the primary outcome of 50 in intervention and 45 in the control group, with a standard deviation of 10,[31] 80% power, 5% significance level, and 10% loss to follow-up.

Data Analysis

Analysis was performed on data from participants who completed at least one of the two (3/6 month) surveys. Differences in baseline demographics and disease characteristics were compared between patients in the intervention and control arms using the Wilcoxon rank-sum test for continuous variables and Chi-squared test for categorical variables. The primary outcome, Global Satisfaction with Sex Life, was reported using means and 95% confidence intervals at baseline and 6-months by arm and compared using Student's t-test. Continuous outcomes including Sexual Interest, EPIC Sexual Domain, and FSFI Sexual function were presented with means and 95% confidence intervals and compared between study arms at baseline, 3-months, and 6-months using ANCOVA models. The models at 3-months and 6-months included an adjustment for baseline score. Treatment arm differences in increase of sexual activity or sexual aids from baseline were tested with chi-squared tests. Intervention use by module and user assessment by role and module are described using frequencies and proportions. Statistical analysis was completed using SAS 9.4 (SAS Institute, Inc) at the 5% significance level.

Results

Accrual

Across sites, 510 couples were approached (Figure 1). There were 288 (56%) couples who declined to participate; 222 (44%) couples were randomized (100 couples to the intervention arm (I) and 122 couples to the control arm (C)). The difference in the size of the intervention and control arm cohorts was an artifact of the initial consenting process at one of the institutions: patients were consented early in their oncologic treatment; some later chose active surveillance or sought treatment at a different institution, thus becoming ineligible to participate. The imbalance between the arms was not discovered early enough to attempt correction. Baseline surveys were completed by patient and partner within 2 weeks prior to treatment in 62 (62%) couples in the intervention arm and 80 (66%) couples in the control arm. Only participants who completed the baseline surveys were eligible to progress in the study. At 3-months, 107 (I=41, C=66) patients and 86 (I=30, C=56) partners completed the surveys. At 6 months, 105 (I=39, C=66) patients and 87 (I=32, C=55) partners completed the surveys.

Patient Characteristics

There were no significant differences in demographic or clinical characteristics between study arms participants at baseline (Table 1). Across study arms, median patient age was 61, 20% were non-White, 65% completed college. Nearly 2/3 (65%) had Gleason 7 disease, 85% received surgery, 11% received radiation, and 4% received combined radiation and hormonal therapy. Couples had been in their relationship 31 years on average; 4% were in same-sex partnerships. Partners' median age was 59, 21% were non-White, 65% had

completed college. For the 3-month follow-up, the only difference between participants in the intervention versus control arms was educational status; there were no baseline differences between study arms among couples who completed the 6-month survey.

Primary Endpoint: Global Satisfaction with Sex Life in prostate cancer patients and in their partners (GSSL).

Table 2 indicates that, as expected, there were no significant differences in Global Satisfaction with Sex Life (GSSL) scores at baseline between the intervention and control arms (means: 62 vs 60, p=0.3). The GSSL scores at the 6-month follow-up were not significantly different between the intervention and control arms (means: 53 vs 51, p=0.4 after controlling for baseline). Similarly, partner GSSL scores at the 6-month follow-up, a secondary outcome, were not significantly different between the intervention and control arms (means: 53 vs 55, p=0.5 after controlling for baseline).

Secondary Outcomes

Sexual activity at follow-up assessments (both 3- and 6-months) were compared to baseline and reported for patients and partners by treatment arm. At 3-months, 68% of patients in the intervention arm reported an increase in at least 1 non-penetrative activity, compared to 53% of patients in the control arm (p=0.07) (Figure 2 and Supplemental Table 1). Certain non-penetrative activities (e.g., hugging, kissing) as well as vaginal intercourse were more present in the intervention arm compared to controls (all p<0.05).

The intervention was also associated with more sexual activity reported by partners, with 73% in the intervention arm vs 60% in the control arm reporting a 3-month increase of at least 1 non-penetrative sexual activity as compared to baseline (p=0.037). Significantly higher activities reported by partners in the intervention group included kissing, touching someone's chest and having your chest touched. Vaginal penetration was reported more often by intervention arm partners (13%) versus control (5%), though this difference was not statistically significant (p=0.16). The 6-month comparisons are more modest and not statistically significant.

No statistical differences were found for sexual interest between the intervention and control arms for either patients or partners (Table 3), in male sexual function (EPIC sexual domain) or female sexual function (FSFI) at 3- and 6-months. However, intervention arm partners' FSFI scores at 3-months were higher than those of the controls.

Participant Evaluation of the Intervention

Over 73% of patients and partners in the intervention arm reported high or moderate overall satisfaction with the intervention and over 89% of patients and partners stated that they would recommend it to others. Participants also found individual modules related to the sexual recovery process useful. The first module was accessed by 90% of participants, declining to 54% for the final module. Modules were reported to be 'Found Helpful' by 65-82% of patients and 65-82% of partners, with a similar range reporting 'Would Recommend'. A minority of users (0% - 19%) reported that the modules 'Felt Confusing'.

Discussion

Sexual health support after prostate cancer treatment remains a significant gap in survivorship care. The goal of our TrueNTH Sexual Recovery Intervention was to address this gap by providing patients and their partners with tailored support along the trajectory of their recovery from the sexual side-effects of prostate cancer treatment.

The study did not find significant differences between the intervention and control group in the primary outcome—the Global Satisfaction with Sex Life scale. Our hypothesis that the intervention would mitigate the decline in satisfaction with sex life in the intervention group at 6-months may been overly optimistic as at 6-months post-treatment, couples are still adjusting to troubling treatment-related sexual changes and may not feel much satisfaction with their sex lives.

Nonetheless, we did find that intervention couples, compared to controls, expanded their sexual repertoire to non-penetrative activities (e.g., hugging, kissing) and engaged in intercourse (likely using sexual aids) more often early in the recovery. Findings from our secondary outcomes suggest that the intervention may have had the most impact at 3-months, when the intervention group engaged earlier in both penetrative and non-penetrative sexual activities. We interpret this as couples' uptake of the intervention's guidance to accept treatment-related changes in sexual function, increase non-penetrative sexual interactions, focus on pleasure, and incorporate the use of pro-erectile aids. These results corroborate previous research that found that couples find comfort in showing affection and sexual expression following a cancer diagnosis,[32] and that including partners can increase men's uptake of pro-erectile aids.[16] It is also possible that the intervention's encouragement to recognize patients' feelings of loss and helping them come to terms with sexual dysfunction diminished their ambivalence about sexual aids, similarly present in Nelson et al.'s RCT of a patient-only directed intervention.[33]

Our findings about the female partners' higher level of post-treatment sexual function in the intervention arm, while not significant at 0.05 level, parallels research by Shindel et al. who emphasized the association between higher female sexual function and prostate cancer patients' sexual outcomes.[34] This finding, along with partners' higher level of sexual activity also parallel findings by Northouse et al., showing the significant benefit partners derive from supportive couple interventions.[35] These findings also support our previous emphasis on partners' equal stake in the sexual recovery process [36] and signal that partners' support and sexual needs should be addressed

This study had many strengths, including its theory-driven on-line intervention modules, designed with a user-centered approach and tailored for patients receiving different treatments and by sexual orientation, able to be disseminated to couples without professional resources. The majority of patients and partners reported that the modules were helpful and said they would recommend them to others. Another strength of this study was use of a randomized clinical trial to test the intervention outcomes across multiple sites in the U.S.

The study has several important limitations. First, there are notable sample characteristics limitations. Despite our best efforts, our sample was relatively homogeneous in terms of race, treatment type and sexual orientation, thereby limiting the study's generalizability.

Second, recruitment of men treated with radiation (with or without ADT) was low and a separate study testing the intervention with this population would be needed to assure relevance. Further, a relatively high proportion of participants had a prostate cancer with pathological stage T3/T4. Preoccupation with the severity of the disease may have diminished couples' motivation to stay engaged in sexual recovery or with the intervention.

Third, there was a 46% attrition for the 6-months follow-up, reducing the study power to detect statistically significant differences between study arms and limiting the generalizability of our findings. Hence, our findings must be viewed with caution. This level of attrition is consistent with a recent review of online support programs by Kang et al. (2018), who reported up to 42% attrition in four sexual health support programs and up to 52% attrition in general lifestyle online programs. Online intervention requires self-motivation and independence from encouragement of a clinician. Methodologies for maintaining adherence need to be further investigated. It is notable that even a study that had in-person interventions with little attrition, was not able to demonstrate a sustained impact on the majority of outcomes after 5 years.[17]

Fourth, our choice of the primary outcome may be a limitation as well. Based on earlier negative rehabilitation studies, experts proposed measuring satisfaction with sex life as a more viable primary outcome: couples could have a satisfying sex life while using sexual aids [37]. It is also likely that couples and individuals within them vary in what they want from sexual health support; focusing on a 'one-size-fits-all' primary outcome may obscure significant benefits [25].

Fifth, recruiting couples versus individuals poses an extra challenge to engagement. Participants who completed the 6-month follow-up may have been more motivated or otherwise different than those who did not thereby limiting the generalizability of our findings. Second, the 6-month follow-up period may have limited our ability to observe the long-term impact of the intervention on the trajectory of sexual recovery, particularly in the context of the effects of different treatments on erectile function. It may be important to screen couples prospectively to identify individual needs, assess motivation for engagement, then tailor components of the intervention accordingly. Since patients' and partners' needs and motivation may change over time, a mixed methods implementation science approach to the study of the intervention's effectiveness may be more relevant as it allows for making modifications as new findings emerge.

Clinical implications

Although the study did not yield expected improvements in patients' and their partners' satisfaction with their sex life at 6-month follow up, this randomized controlled trial of the TrueNTH Sexual Recovery Intervention was linked with improvements in a range of other important sexual outcomes, most specifically for patients treated with surgery and their partners. The intervention was also reported as helpful by patients and

partners who participated in it. The integration of the TrueNTH Sexual Recovery Intervention into usual care can become a valuable adjunct to oncologic treatment so that patients and partners who are comfortable using an online program can access support for their sexual recovery.

References

1. Miller KD, Nogueira L, Mariotto AB, et al. Cancer treatment and survivorship statistics, 2019. *CA: a cancer journal for clinicians*. Sep 2019;69(5):363-385. doi:10.3322/caac.21565
2. Sanders S, Pedro LW, Bantum EO, Galbraith ME. Couples surviving prostate cancer: Long-term intimacy needs and concerns following treatment. *Clinical journal of oncology nursing*. Aug 2006;10(4):503-8.
3. Walker LM, Wassersug RJ, Robinson JW. Psychosocial perspectives on sexual recovery after prostate cancer treatment. *Nature reviews Urology*. Mar 2015;12(3):167-176. doi:10.1038/nrurol.2015.29
4. Gomella LG. Contemporary use of hormonal therapy in prostate cancer: managing complications and addressing quality-of-life issues. *BJU international*. Jan 2007;99 Suppl 1:25-9; discussion 30.
5. Resnick MJ, Koyama T, Fan KH, et al. Long-term functional outcomes after treatment for localized prostate cancer. *New England Journal of Medicine*. Jan 31 2013;368(5):436-45. doi:10.1056/NEJMoa1209978
6. Avulova S, Zhao Z, Lee D, et al. The Effect of Nerve Sparing Status on Sexual and Urinary Function: 3-Year Results from the CEASAR Study. *The Journal of urology*. May 2018;199(5):1202-1209. doi:10.1016/j.juro.2017.12.037
7. Maliski SL, Connor S, Fink A, Litwin MS. Information desired and acquired by men with prostate cancer: data from ethnic focus groups. *Health Educ Behav*. Jun 2006;33(3):393-409.
8. Schover LR, Fouladi RT, Warneke CL, et al. Seeking help for erectile dysfunction after treatment for prostate cancer. *Archives of sexual behavior*. Oct 2004;33(5):443-54.
9. Bernat JK, Skolarus TA, Hawley ST, Haggstrom DA, Darwish-Yassine M, Wittmann DA. Negative information-seeking experiences of long-term prostate cancer survivors. *Journal of cancer survivorship : research and practice*. Dec 2016;10(6):1089-1095. doi:10.1007/s11764-016-0552-5
10. Walker LM. Psychosocial contributors to atients' and partners' postprostate cancer sexual recovery: 10 evidence-based and practical considerations. *International journal of impotence research*. 2021;33:464-472.
11. Nguyen DD, Berlin A, Matthew AG, Perlis N, Elterman DS. Sexual function and rehabilitation after radiation therapy for prostate cancer: a review. *International journal of impotence research*. May 2021;33(4):410-417. doi:10.1038/s41443-020-00389-1
12. Rosser BR, Capistrant B, Torres B, et al. The Effects of Radical Prostatectomy on Gay and Bisexual Men's Mental Health, Sexual Identity and Relationships: Qualitative Results from the Restore Study. *Sexual and relationship therapy : journal of the British Association for Sexual and Relationship Therapy*. 2016;31(4):446-461. doi:10.1080/14681994.2016.1228871
13. Ussher JM, Perz J, Rose D, Dowsett G, Latini D. Threat to Gay Identity and Sexual Relationships: The Consequences of Prostate Cancer Treatment for Gay and Bisexual Men. In: Ussher JM, Rosser BR, eds. *Gay*

and Bisexual Men Living with Prostate Cancer from diagnosis to recovery. Harrington Press; 2019:38-53:chap 2.
14. Canada AL, Neese LE, Sui D, Schover LR. Pilot intervention to enhance sexual rehabilitation for couples after treatment for localized prostate carcinoma. *Cancer*. Dec 15 2005;104(12):2689-700.
15. Schover LR, Canada AL, Yuan Y, et al. A randomized trial of internet-based versus traditional sexual counseling for couples after localized prostate cancer treatment. *Cancer*. Sep 26 2012;118(2):500-9. doi:10.1002/cncr.26308
16. Chambers SK, Occhipinti S, Schover L, et al. A randomised controlled trial of a couples-based sexuality intervention for men with localised prostate cancer and their female partners. *Psycho-oncology*. Jul 2015;24(7):748-56. doi:10.1002/pon.3726
17. Chambers SK, Occhipinti S, Stiller A, et al. Five-year outcomes from a randomised controlled trial of a couples-based intervention for men with localised prostate cancer. *Psycho-oncology*. Apr 2019;28(4):775-783. doi:10.1002/pon.5019
18. Wittmann D., Koontz BF. Evidence Supporting Couple-Based Interventions for the Recovery of Sexual Intimacy After Prostate Cancer Treatment. *Current Sexual Health Reports*. 2017;9(1):32-41. doi:10.1007/s11930-017-0095-4
19. Berry DL, Halpenny B, Wolpin S, et al. Development and evaluation of the personal patient profile-prostate (P3P), a Web-based decision support system for men newly diagnosed with localized prostate cancer. *Journal of medical Internet research*. Dec 17 2010;12(4):e67. doi:10.2196/jmir.1576
20. Northouse L, Schafenacker A, Barr KL, et al. A Tailored Web-Based Psychoeducational Intervention for Cancer Patients and Their Family Caregivers. *Cancer nursing*. Jun 18 2014;37(5):321-30. doi:10.1097/ncc.0000000000000159
21. Skolarus TA, Metreger T, Wittmann D, et al. Self-Management in Long-Term Prostate Cancer Survivors: A Randomized, Controlled Trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. May 20 2019;37(15):1326-1335. doi:10.1200/jco.18.01770
22. Matthew AG, Trachtenberg LJ, Yang ZG, et al. An online Sexual Health and Rehabilitation eClinic (TrueNTH SHAReClinic) for prostate cancer patients: a feasibility study. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*. Aug 31 2021;doi:10.1007/s00520-021-06510-4
23. Wittmann D, Mehta A, Northouse L, et al. TrueNTH sexual recovery study protocol: a multi-institutional collaborative approach to developing and testing a web-based intervention for couples coping with the side-effects of prostate cancer treatment in a randomized controlled trial. *BMC cancer*. Oct 02 2017;17(1):664. doi:10.1186/s12885-017-3652-3
24. ACS. Sexuality for the man with cancer. Accessed 3/1/2014, http://www.cancer.org/treatment/treatmentsandsideeffects/physicalsideeffects/sexualsideeffectsinmen/sexualityfortheman/sexuality-for-the-man-with-cancer-toc

25. Mehta A, Pollack C, E, , Gillespie T, et al. What patients and partners want in interventions that support sexual recovery after prostate cancer treatment. *Sexual medicine*. 2019;7:184-191.
26. Wittmann D, Carolan M, Given B, et al. What couples say about their recovery of sexual intimacy after prostatectomy: toward the development of a conceptual model of couples' sexual recovery after surgery for prostate cancer. *The journal of sexual medicine*. Feb 2015;12(2):494-504. doi:10.1111/jsm.12732
27. Center for Health Communications Research. https://chcr.umich.edu/
28. Carle AC, Riley W, Hays RD, Cella D. Confirmatory Factor Analysis of the Patient Reported Outcomes Measurement Information System (PROMIS) Adult Domain Framework Using Item Response Theory Scores. *Medical care*. Oct 2015;53(10):894-900. doi:10.1097/mlr.0000000000000413
29. Wei JT, Dunn RL, Litwin MS, Sandler HM, Sanda MG. Development and validation of the expanded prostate cancer index composite (EPIC) for comprehensive assessment of health-related quality of life in men with prostate cancer. *Urology*. Dec 20 2000;56(6):899-905.
30. Rosen R, Brown C, Heiman J, et al. The Female Sexual Function Index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. *Journal of sex & marital therapy*. Apr-Jun 2000;26(2):191-208.
31. Flynn KE, Lin L, Cyranowski JM, et al. Development of the NIH PROMIS ® Sexual Function and Satisfaction measures in patients with cancer. *Journal of Sexual Medicine*. 2013;10(Suppl 1):43-52.
32. Leiber L, Plumb MM, Gerstenzang ML, Holland J. The communication of affection between cancer patients and their spouses. *Psychosomatic medicine*. Nov-Dec 1976;38(6):379-89. doi:10.1097/00006842-197611000-00003
33. Nelson CJ, Saracino RM, Napolitano S, Pessin H, Narus JB, Mulhall JP. Acceptance and Commitment Therapy to Increase Adherence to Penile Injection Therapy-Based Rehabilitation After Radical Prostatectomy: Pilot Randomized Controlled Trial. *The journal of sexual medicine*. Sep 2019;16(9):1398-1408. doi:10.1016/j.jsxm.2019.05.013
34. Shindel A, Quayle S, Yan Y, Husain A, Naughton C. Sexual dysfunction in female partners of men who have undergone radical prostatectomy correlates with sexual dysfunction of the male partner. *The journal of sexual medicine*. Nov 2005;2(6):833-41; discussion 841.
35. Northouse LL, Mood DW, Schafenacker A, et al. Randomized clinical trial of a family intervention for prostate cancer patients and their spouses. *Cancer*. Dec 15 2007;110(12):2809-18. doi:10.1002/cncr.23114
36. Wittmann D, Carolan M, Given B, et al. Exploring the role of the partner in couples' sexual recovery after surgery for prostate cancer. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*. Sep 2014;22(9):2509-15. doi:10.1007/s00520-014-2244-x
37. Wittmann D, Skolarus TA, Montie JE. Are We Targeting the Right Outcome for Sexual Health After Prostate Cancer Treatment? *European urology*. Jun 6 2015;doi:10.1016/j.eururo.2015.05.044

Table legends

Table 1. Participant Characteristics

Table 2. Global Satisfaction with Sex Life (PROMIS) Association between arms at 6 months

Supplemental Table 1. Sexual Activity and Aids (PROMIS)

Figure Legends

Figure 1. Consort Diagram

Figure 2. Sexual Activity

Patient frequency of reported increase in activity at 3months and 6months compared to baseline for patients and partners. Fig a and b include proportion reporting an increase in at least 1 non-penetrative activity. Fig c and d report the mean number of non-penetrative activities with reported increase. Fig e and f report frequency of reported increase of vaginal intercourse. P-values are displayed for comparison between arms.

Table 1. Participant Characteristics

	Prostate Cancer Patient			Partner		
	Intervention	**Control**	**P value**	**Intervention**	**Control**	**P value**
N	**62**	**80**	**-**	**62**	**80**	**-**
Age Median(IQR)	62 (56-65)	61 (57-67)	0.4	60 (53-64)	59 (53-63)	0.6
BMI Median(IQR)	27 (25-31)	27 (25-30)	0.7	26 (22-32)	25 (22-27)	0.3
	%	%		%	%	
Gender						
Female	0%	0%	-	95%	96%	0.8
Male	100%	100%		5%	4%	
Race						
White/Caucasian	84%	75%		86%	74%	
Black/African-American	13%	16%	0.5	11%	11%	0.1
Hispanic/Latino	2%	4%		3%	5%	
Other	2%	6%		0%	10%	
Co-morbidities						
None	55%	60%	0.5	71%	65%	0.5
1 or more	45%	40%		29%	35%	
Employment Status						
Full-Time	53%	58%	0.5	44%	38%	0.8
Part-Time	10%	5%		18%	19%	
Not Working for pay	37%	38%		39%	44%	
Education			0.4			0.3
Less than High School	0%	0%		3%	0%	

High School Graduate	31%	38%		27%	31%	
College Graduate	69%	63%		69%	69%	
Income						
Less than $50,000	6%	6%		8%	8%	
$50,000 - $89,999	21%	19%	1.0	18%	23%	0.8
$90,000 or more	68%	70%		68%	65%	
I don't know	5%	5%		6%	4%	
Primary Treatment						
Surgery	90%	81%	0.1	-	-	-
Radiation (RT)	10%	13%				
Radiation + ADT	0%	6%				
Received Additional Treatment	6%	4%	0.5	-	-	-
Clinical T Stage						
T1, T2	85%	86%	0.7	-	-	-
T3, T4	3%	1%				
Unknown	11%	13%				
Pathological T Stage						
T1, T2	70%	59%	0.4	-	-	-
T3, T4	29%	40%				
Unknown	2%	2%				
Clinical Gleason Score						
6	16%	21%	0.2	-	-	-
7	73%	59%				
8 – 10	11%	20%				
Pathological Gleason Score			0.3	-	-	-
6	7%	9%				

7 8-10	87% 6%	77% 14%				
PSA at diagnosis Median(IQR)	5.5 (4.2-7.3)	6.3 (4.6-9.1)	0.2			

Table 2. Global Satisfaction with Sex Life (PROMIS) Association between arms at 6 months

		Baseline (actual value)		Month 6 (actual value)		Model estimate: arm effect at 6 months controlling for baseline	Treatment Arm P value
		N	Mean (95% CI)	N	Mean (95% CI)	Parameter estimate (95% CI)	
Prostate Cancer Patient	Intervention	31	62 (59, 64)	31	53 (51, 55)	1.3 (-1.6, 4.2)	0.4
	Control	51	60 (57, 62)	51	51 (49, 53)		
Partner	Intervention	30	58 (55 , 61)	30	53 (50 , 56)	-1.3 (-4.7, 2.2)	0.5
	Control	41	60 (57 , 63)	41	55 (52 , 57)		

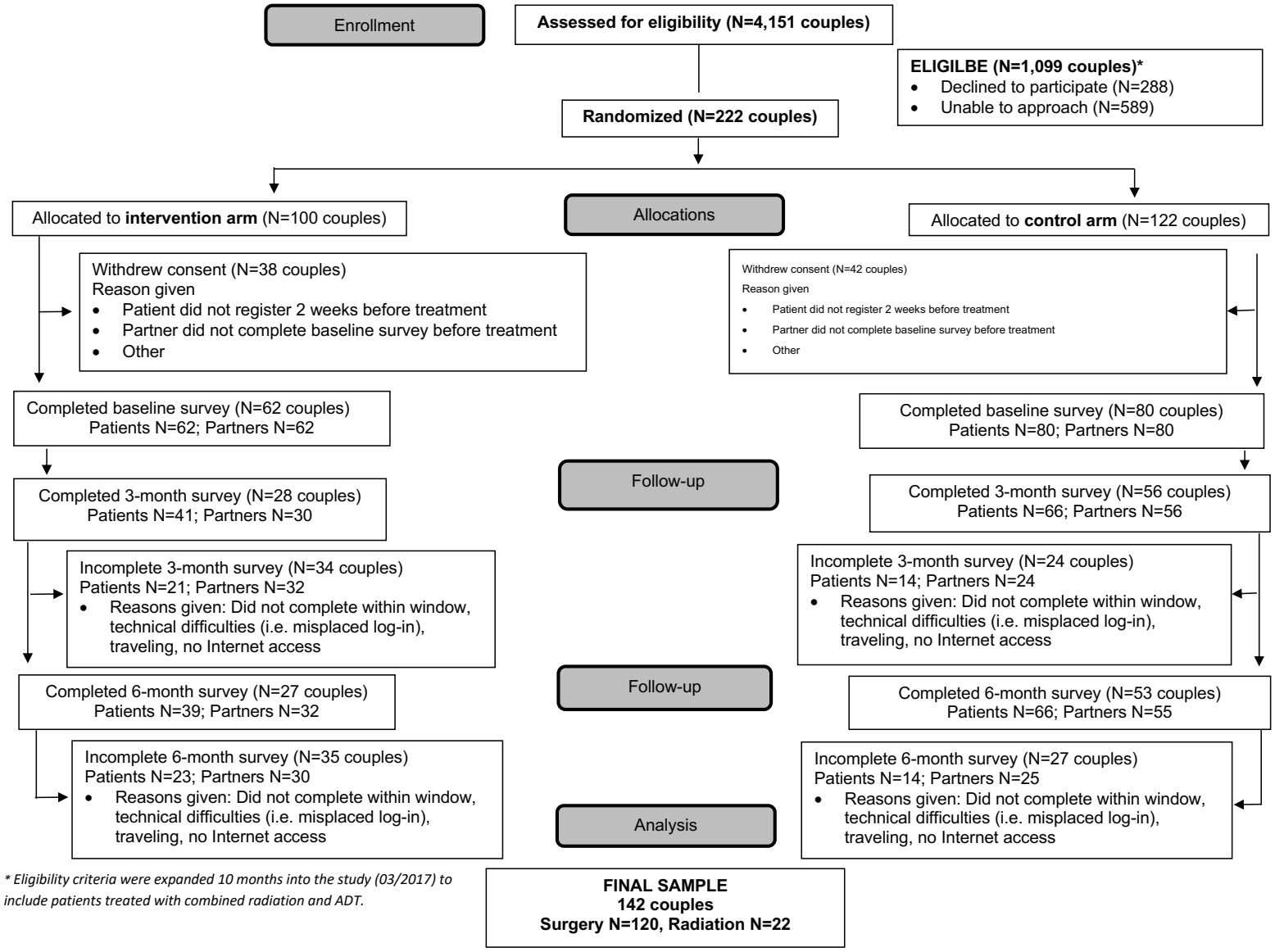
Table 3. Sexual Interest (PROMIS) and Sexual Function (EPIC for Patients and FSFI for Partners)

		Baseline	**Month 3**	**Month 6**	**Estimated arm effect (Month 3 from Baseline)**		**Estimated arm effect (Month 6 from Baseline)**	
		Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Parameter Estimate (95% CI)	Between Arm P value	Parameter Estimate (95% CI)	Between Arm P value
Prostate	**N**	I=47, C=72	I=41, C=66	I=39, C=66	I=41, C=66		I=39, C=66	

Cancer Patient								
Sexual interest (PROMIS)	Intervention	60 (58, 62)	56 (54, 59)	56 (53, 59)	2.3(-0.8, 5.4)	0.15	1.9 (-1.3, 5.1)	0.2
	Control	58 (57, 62)	53 (51, 55)	53 (52, 55)				
Sexual Domain (EPIC)	Intervention	80 (73, 87)	36 (27, 45)	41 (32, 51)	1.9 (-10, 14)	0.8	-4.5 (-15, 6.3)	0.4
	Control	79 (72, 85)	33 (26, 40)	42 (35, 49)				
Partner	**N**	I=37 C=67	I=30, C=60	I=32, C=55	I=30, C=60		I=32, C=55	
Sexual interest (PROMIS)	Intervention	53 (50, 55)	50 (47 , 53)	52 (50 , 54)	0.06 (-2.8, 2.9)	1.0	0.9 (-1.6, 3.4)	0.5
	Control	53 (51, 55)	51 (49, 53)	51 (49 , 53)				
Sexual function (FSFI)	Intervention	24 (22, 26)	22 (19, 24)	21 (19, 24)	2.5(-0.3, 5.4)	0.09	2.1 (-0.8, 5.0)	0.2
	Control	22 (20, 24)	18 (16, 20)	18 (15, 20)				

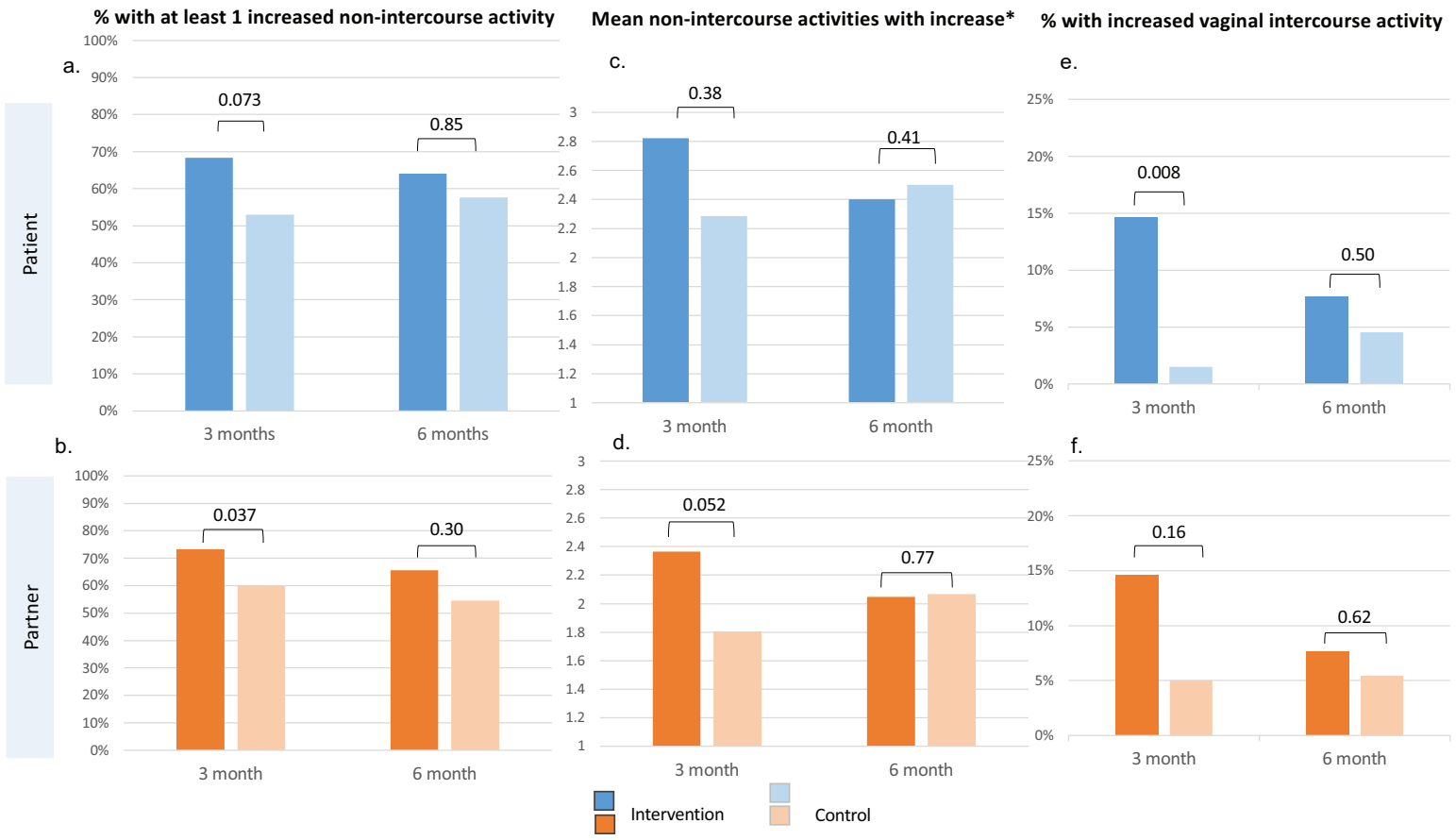
*I=Intervention C=Control

It forTrueNTH Sexual Recovery Consort Diagram



** Eligibility criteria were expanded 10 months into the study (03/2017) to include patients treated with combined radiation and ADT.*

cncr_34076_f1.eps



cncr_34076_f2.eps