

Decision Aids for Benign Prostatic Hyperplasia and Prostate Cancer

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Treatment decisions for benign prostatic hyperplasia (BPH) and localized prostate cancer (PRCA) have long been recognized as being sensitive to the preferences of well-informed patients.^{1,2} In both conditions, no single treatment option has been conclusively shown to be superior, long-term outcome evidence is limited, alternative treatment options have varying benefit-risk profiles, and informed patients may choose to avoid any treatment whatsoever. The current BPH treatment decision is being framed between selecting transurethral resection of the prostate/minimally invasive surgery or no surgery and/or continuing pharmacotherapy. For PRCA, most men have a clinically localized cancer, and more than 90% of them attempt curative therapy with surgery or radiation,³ which can significantly impact quality of life.⁴ However, the optimal treatment for PRCA is uncertain, because no randomized trials have directly compared surgery with radiotherapy.⁵ Furthermore, many experts believe that localized, low-risk cancers are unlikely to progress, and that men with these cancers should consider active surveillance—deferring active treatment in favor of serial prostate-specific antigen (PSA) tests, digital rectal examinations, and prostate biopsies to monitor for signs of progression.^{6,7} Guidelines also recommend observation for men with higher-risk localized cancers who have limited life expectancy.^{6,8} Because there are significant trade-offs between the risks and benefits of alternative treatments for both BPH and PRCA, treatment decisions should be based on high-quality conversations between patients and healthcare providers, marked by shared decision making, and the final decision for choice of therapy should be in concert with the patient's stated goals and preferences.

Shared decision-making processes often incorporate patient decision aids (DAs), which are balanced sources of information about treatment options for a particular health condition.⁹ Numerous randomized trials have shown that use of well-designed DAs can facilitate shared decision mak-

ABSTRACT

Objectives

To examine the relationships among implementing decision aids (DAs) for benign prostatic hyperplasia (BPH) and prostate cancer (PRCA), and treatment rates and costs.

Study Design

A pre-post observational evaluation of a quality improvement initiative in a healthcare system in Washington state.

Methods

Men with BPH seen in urology clinics and all men diagnosed with localized PRCA were identified for an intervention period, in which urologists were instructed to order a DA for every patient with those conditions, and a historical control period. Outcomes were 6-month rates of surgery for BPH, any active treatment (hormone therapy, radiation, or surgery) for PRCA, and total healthcare costs.

Results

During the intervention, DAs were delivered to 22% of men with recent BPH drug treatment, 24% of men with untreated BPH, and 56% of men with PRCA. DA implementation was associated with a 32% lower rate of surgery among men with treated BPH (rate ratio [RR], 0.68; 95% CI, 0.49-0.94) and a nonsignificant 22% lower rate of surgery among men with previously untreated BPH (RR, 0.78; 95% CI, 0.50-1.22). For PRCA, DA implementation was associated with a 27% lower rate of active treatment (RR, 0.73; 95% CI, 0.57-0.93). We found no significant associations between DA implementation and costs of care for either condition.

Conclusions

Implementing patient DAs was associated with lower rates of elective surgery for previously treated BPH and active treatment for localized PRCA; however, implementation of these DAs was not associated with lower costs of care.

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ing, improve knowledge, increase patient participation, improve the match between patients' preferences and the interventions selected, and help achieve greater patient satisfaction.⁹ A 2011 Cochrane review identified 7 randomized trials of DAs for elective surgical procedures⁹; the pooled evidence suggested that patients receiving a DA were 25% less likely to undergo elective surgery. That Cochrane review included a 1992 study of a BPH DA.¹⁰ In that study, men who received the DA were no less likely to choose elective surgery, but they significantly increased their knowledge and were more satisfied with the decision making process. The Cochrane review also identified 2 randomized trials evaluating DAs for PRCA treatment⁹; however, their applicability is limited because 1 trial included only men with advanced cancers,¹¹ and neither presented the option of active surveillance.¹²

Professional societies emphasize the role of shared decision making in helping men make BPH and PRCA treatment decisions, but there is limited evidence of the effectiveness of integrating DAs into clinical practice to support shared decision making. Equally important, few studies have examined whether the widespread implementation of DAs in routine clinical practice can influence surgical rates or costs of care. This report summarizes the changes in surgical rates and costs observed in the first 18 months of implementing DAs for BPH and localized PRCA among urologists in a large integrated health system.

METHODS

Context of Evaluation

This evaluation occurred in the context of implementing a systemwide quality improvement project at Group Health (GH), an integrated health system that provides care and insurance coverage for more than 600,000 Washington state residents. Greater detail on the execution of the quality improvement project has been published elsewhere and is briefly summarized here.^{13,14} The project goal was to integrate 12 high-quality video-based patient DAs (developed by the Informed Medical Decisions Foundation and Health Dialog) into standard clinical practice for 6 specialties: orthopedics, gynecology, neurosurgery, urology, general surgery, and cardiology. GH leadership encouraged providers to distribute these DAs to all patients with the health conditions, emphasizing the importance of improving patient knowledge and informed consent.^{9,13-15} All urology personnel were required to watch both DAs, attend multiple meetings explaining the purpose of the DA rollout, review care

processes related to delivering DAs, and review monthly DA distribution reports and surgery volumes over time.

Study Design

We conducted an observational evaluation of this quality improvement initiative with a pre-post design to assess whether rates of prostate procedures for BPH and PRCA and costs of care changed after implementing DAs. The evaluation plan and all study activities were reviewed and approved by the Group Health Human Subjects Research Committee (Institutional Review Board).

Clinical Setting

The GH urology service line includes 14 staff surgeons in 5 specialty clinical sites. Primary care providers can refer patients to urology for evaluation and treatment of BPH symptoms, and many patients also self-refer. Although GH does not currently recommend routine PSA screening, primary care providers can offer screening and refer patients to urology for elevated PSA tests, suspicious digital rectal examination findings, or other symptoms of cancer. PRCA is most often diagnosed at the time of prostate biopsy by a urologist.¹⁶ GH surgeons are salaried care providers; they do not receive surgical productivity incentives.

Population

Our study population included all patients with BPH (identified via the *International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] codes 600, 600.01, 600.2, 600.21, 600.9, and 600.91) who were aged 45 years or more¹⁷ and seen by a GH urologist in an outpatient clinic. We divided our BPH cohort into 2 groups: those who had received BPH pharmacotherapy (alpha-1 adrenergic blocker, a 5-alpha reductase inhibitor, or an anticholinergic medication) in the past year, and those who had not. For our PRCA analyses, we identified all patients from the Surveillance, Epidemiology, and End Results (SEER) cancer registry at GH who were newly diagnosed with localized PRCA (stage 1 or 2) during the study window. We extracted data on demographics, enrollment, diagnoses, procedures, and medical treatments from the GH electronic medical and administrative databases. We excluded patients who, in the 12 months before their index visit, had either a prostate procedure or diagnosis for PRCA in our SEER registry.

We divided the populations into two 18-month periods: the historical control period before DA implementation, from July 1, 2007, to December 31, 2008, and

the intervention period after implementation, from July 1, 2009, to December 31, 2010. All subjects had to be enrolled continuously in GH for 12 months before their index visit (their first visit with a GH urology provider during the control or intervention period). Our cohort included all patients who were potentially eligible to receive a DA during either period.

Decision Aids

The DAs used were video-based tools with accompanying written information in booklet format. The content of the decision aids is reviewed annually to ensure that the evidence presented is up-to-date, and the DAs discuss all common medical and surgical treatment options for BPH and PRCA in plain, balanced language. Decision aids were distributed primarily by mail in DVD format; clinical staff could order the DVD versions through the electronic health record. Patients could also view the DAs online on the secure website for members, and providers could embed a link to the online DA in the patient's after-visit summary.

Outcome Definitions: Surgical Procedures and Healthcare Costs

The primary outcomes of interest were: 1) a transurethral prostate procedure for BPH patients, or receipt of hormone therapy, radiation, or radical prostatectomy for PRCA patients, during the 6 months after the index visit or diagnosis date (identified by procedure codes); and 2) total healthcare costs in the 6 months after the index visit or diagnosis date. We defined total healthcare costs as the sum of costs (in 2009 dollars) of inpatient (including surgical costs), outpatient, pharmacy, radiology, laboratory, and ancillary services (ie, home healthcare, hospice, durable medical equipment). We defined healthcare use during this period as the number of inpatient hospitalizations, inpatient days, prescription drug fills, and primary and specialty care visits.

Analytic Methods: Rates of BPH Surgery and PRCA Active Treatment

We estimated adjusted rate ratios (RRs) and 95% confidence intervals of surgery and active treatment in the intervention (DA implementation) period relative to the control period. BPH and PRCA outcomes were analyzed separately, and the BPH cohort was stratified on prior treatment.

We used Poisson regression to compare 180-day rates and RRs for all treatment outcomes for both cohorts.¹⁸ For each separate analysis, the dependent variable was

whether a patient underwent treatment after his index visit/diagnosis date. Patients were followed from their index visit until surgery, disenrollment, death, or end of the 180-day follow-up period. Covariates included age at index date, body mass index, clinic location, number of prior urology visits, insurance type, and total prior-year costs (log scale). BPH models also included whether a patient underwent PSA testing in the prior year and whether BPH had been diagnosed before the index date. Additional variables in our PRCA analysis included the PSA value before cancer diagnosis (categorized as <4, 4-9, and 10+ ng/mL) and the biopsy Gleason score (categorized as 2-6, 7, and 8-10). Because we expected the effect of the decision aid to differ across PRCA risk groups, we conducted subgroup analyses examining the effect of the DA implementation among patients with low-risk PRCA (ie, those with Gleason <7 and PSA ≤10 ng/mL) and intermediate- to high-risk (Gleason ≥7 and/or PSA >10). Secondary analyses evaluated the impact of receiving a DA on the use of related surgical procedures.

Analytic Methods: Costs and Utilization

We used regression models to compare total healthcare costs in the 6-month period following the index visit or diagnosis date before and after DA implementation. We used a generalized linear model with normally distributed errors to estimate the relationship between implementing DAs and the arithmetic mean of total costs. As a sensitivity analysis, we used a linear model with normally distributed errors for log-transformed costs to estimate the relationship between implementing DAs and geometric mean costs. For both models, we used robust standard error estimation to account for deviations from model-based assumptions of common variance (homoscedasticity).

All analyses were conducted using SAS software, version 9.2 (Cary, North Carolina).

RESULTS

Benign Prostatic Hyperplasia Cohorts

Patient characteristics were similar for both control and intervention cohorts (Table 1), including age, clinic visits, PSA testing, prescription medications, and comorbidity. However, among men with previously untreated BPH, the intervention group was slightly younger than the control group, had slightly higher frequencies of prior BPH diagnosis, and had higher Charlson Comorbidity Index (CCI) scores.

Prostate Cancer Cohorts

The characteristics of PRCA men were similar in both cohorts, including age, body mass index (BMI), and urology visits (Table 2). Before diagnosis, about a quarter of the men had a PSA value ≥ 10 ng/mL, though more than half had low-grade Gleason scores. Few men had CCI scores of 3 or more.

Receipt of Decision Aids

Decision aids were delivered (by mail or online) to 258 (24%) eligible patients without any treatment for BPH in the previous year, 179 (22%) eligible patients with recent treatment for BPH, and 117 (56%) eligible patients with localized PRCA.

Impact of Decision Aid Implementation on Rates of Procedures

In the BPH cohort, the effects of implementing DAs differed according to whether the patient had received pharmacotherapy in the year before the index date (Table 3). The untreated BPH group had 0.03 procedures per 180 person-days in the intervention group and 0.04 procedures per 180 person-days in the control group, an adjusted relative rate (intervention/control) for surgery of 0.78 (95% CI, 0.50-1.22; $P = .27$). However, in the previously treated BPH group, the procedure rate was 0.07 per 180 person-days in the intervention group and 0.10 per 180 person-days in the control group, an adjusted relative rate for surgery of 0.68 (95% CI, 0.49-0.94; $P = .02$).

In the PRCA cohorts (Table 3), the adjusted rate of undergoing any treatment for PRCA was 0.69 per 180 person-days in the intervention group and 0.94 per 180 person-days in the control group, an adjusted relative risk of 0.73 (95% CI, 0.57-0.93; $P = .01$). Among the subgroup of men with low-risk cancers (PSA ≤ 10 ng/mL and Gleason < 7), the intervention and control groups had comparable rates of active treatment (adjusted RR, 0.80; 95% CI, 0.50-1.29; $P = .35$), although among the subgroup of men with intermediate- to high-risk cancers, the intervention group had a lower rate of receiving any treatment (adjusted RR, 0.64; 95% CI, 0.48-0.85; $P = .002$).

Impact of Decision Aid Implementation on Total Healthcare Use and Care Costs

In our multivariable adjusted models, we observed no significant difference in arithmetic mean total healthcare cost in the intervention versus control period for previously treated and previously untreated BPH patients (Table 4). We also observed no significant difference in

total healthcare costs for PRCA patients in the intervention versus control periods. Similar findings were found for geometric mean costs (data not presented). Additionally, mean costs were similar across the intervention and control cohorts for men with low-risk PRCA. eAppendix Tables 1 and 2 (available at www.ajmc.com) show the unadjusted costs of care and healthcare use in the 180 days following the index urology visit for our intervention and control groups.

Secondary Analyses

Secondary analyses evaluated the impact of receiving a DA on the use of related surgical procedures. Among previously untreated BPH patients, receiving a DA was associated with a nonsignificantly higher 180-day rate of transurethral prostate procedures (RR, 1.69; 95% CI, 0.85-3.37; $P = .13$). However, among previously treated BPH patients, receiving a DA was associated with a significantly higher 180-day rate of transurethral prostate procedures (RR, 2.80; 95% CI, 1.62-4.85; $P = .0002$). Similarly, for patients with localized PRCA, receiving the DA was associated with a nonsignificantly higher 180-day rate of initiating any treatment (RR, 1.23; 95% CI, 0.64-2.39; $P = .53$).

DISCUSSION

DAs are designed to deliver unbiased, comprehensive information about the risks and benefits of all available treatment options and to help clarify patient preferences and align them with the final treatment choice. Healthcare systems, policy makers, and payers alike are looking for system-level interventions to improve the quality of care in the United States. Underuse, overuse, and misuse of healthcare procedures are often cited as areas of opportunity for improving quality, and it has been hypothesized that using patient DAs might help ensure that rates of care reflect the preferences of well-informed patients, rather than provider-driven preferences or incentives. In addition, it has been suggested that DAs might also reduce the costs of care from the payer and purchaser perspective¹⁹; however, little empirical evidence exists to support this theory.²⁰

Our observational study is the largest to date of patient DA implementation in the context of quality improvement for elective surgical care.^{13,14,21} We found that implementing DAs for BPH in a large, multi-site urology group practice setting was associated with a significant 32% lower rate of transurethral prostate procedures among men who had previously received pharmacologi-

cal treatment for BPH and a nonsignificant 22% lower rate among men who had not received previous pharmacological treatment for BPH. Furthermore, we found that implementing DAs for localized PRCA was associated with a significant 27% reduction in actively treating PRCA. Surprisingly, the greatest reduction in active treatment was seen among men with a Gleason ≥ 7 and/or PSA > 10 ng/mL. Treatment patterns might change with longer-term follow-up, but a more likely explanation is that our available data led to some misclassification of the risk groups. We used only Gleason and PSA to classify risk because we lacked detailed data on clinical stage or biopsy results. This may have prevented us from accurately classifying some low-risk men according to guidelines for active surveillance.⁷

Our results for BPH and PRCA are supportive of prior randomized studies, which suggest that receiving DAs may lower use of elective surgery, at least in the short term.⁹ Our findings also suggest that the overall DA implementation strategy—which required all urology personnel to watch both DAs, attend multiple meetings explaining the purpose of the DA rollout, review care processes related to delivering DAs, and review monthly DA distribution reports and surgery volumes over time—was responsible for the changes in rates of treatment initiation that we observed, rather than any direct influence of DAs on patient decisions. Notably, implementing DAs was not associated with changes in healthcare costs in these populations. The lack of association with cost savings should not undermine the notion of implementing DAs to support decision making for urologic conditions. The primary motivating factors for implementing DAs should be improving the quality of decision making, not reducing costs.²⁰

Limitations

Our analysis is based on observational data and is subject to potential biases and limitations of the study design. Our BPH cohort definitions may misclassify some patients, because providers may indiscriminately use the BPH ICD-9-CM code as an indicator for any male lower urinary tract symptoms that may be resulting from other pathologies such as urethral stricture or overactive bladder. However, any misclassification of these conditions is unlikely to be unequally distributed across our intervention and control populations, and is therefore unlikely to influence our study results. Furthermore, we were unable to classify BPH patients according to the severity of their BPH symptoms, because those clinical symptom data were not available to us; therefore, we used prior

medical treatment of BPH as one way of stratifying our cohort into groups with higher and lower BPH symptom severity/acuity.

We did not have data on quality of life in this study, and we are unable to assess whether the quality of life of the patients who chose against early intervention was improved or perhaps diminished as a result of their decisions. Patients in the intervention and control periods had similar characteristics at the time of the index exam, and we adjusted for many clinical factors related to treatment decisions (eg, age, BMI, disease severity [including SEER stage, Gleason score, and PSA for PRCA patients], and comorbidity). However, unmeasured factors may have affected our findings, including changes to the economy, secular changes in attitude towards prostate treatment, and other concurrent changes in GH policy or structure influencing care patterns. For prostate cancer, interest in active surveillance has been growing in the past decade, and this trend may have impacted our results. Given the limitations of our study design, our intervention should be replicated in other settings to confirm these findings.

DA delivery was suboptimal in the first 18 months of implementation, with only a quarter of BPH patients and half of PRCA patients receiving a DA. In our published qualitative research, urology providers expressed several early reservations about DA implementation—including concerns about the accuracy of the DA content—which may have resulted in the low rates of DA delivery.¹³ Other commonly mentioned barriers to DA implementation include the perception among clinicians that they already practice good shared decision making; that their patients don't want or can't cope with the information; and that they lack the time, incentive, and organizational support to do it.²² In secondary analysis, patients with treated BPH who received a DA were significantly more likely to undergo a transurethral procedure. We think it unlikely that receiving a DA increased rates of intervention; we think, rather, that clinicians were selectively ordering DAs only for patients considered to be surgical candidates. Importantly, our intervention involved both the DAs and the broader quality-improvement effort that motivated urology providers to use these tools in clinical practice. Because DA implementation and system changes co-occurred, we cannot disentangle the effect of DAs from the effect of direct intervention on providers through education and active monitoring.

Further investigation is necessary to understand how the differences between types of medical practices influence the uptake and effectiveness of DAs. GH is an

integrated health plan and care delivery system that salaries its urology providers. GH surgeons do not have the same monetary incentives for performing surgery as their colleagues in fee-for-service settings. Other experts have noted that implementing DAs in fee-for-service settings may be more challenging, especially if it reduces surgical procedure volume.²³⁻²⁵ Finally, the study does not address whether patients who received mailed DAs actually viewed them. Nor does it address whether the conversations between patients and providers changed as result of implementing these DAs.

CONCLUSIONS

The prevalence of BPH and PRCA is increasing in the aging US population. Implementing video-based DAs for BPH and localized PRCA in a large, multi-site urology group practice setting was associated with lower rates of elective surgery for previously treated BPH and of active treatment for localized PRCA. More research is needed to better understand whether large-scale implementation of these tools can improve the quality of patients' decisions, their quality of life, and their satisfaction with care, and if they can help mitigate the risks and costs of surgical intervention over the long term.

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Authorship Information: Concept and design (DA, CC, MH, EW); acquisition of data (DA, CC, MAL, TRR, EW); analysis and interpretation of data (DA, DKM, RDW); drafting of the manuscript (DA, CC, RH); critical revision of the manuscript for important intellectual content (DA, MH, RH, MAL, DKM, EW); statistical analysis (DA, RDW); provision of study materials or patients (DA); obtaining funding (DA, EW); administrative, technical, or logistic support (DA, CC, MH, TRR, EW); and supervision (DA, MAL, TRR).

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Take-Away Points

The goals of this study were to examine the relationships between implementing decision aids for benign prostatic hyperplasia and prostate cancer on rates of treatment and healthcare costs.

- A multimodal strategy for implementing patient decision aids was associated with significantly lower rates of elective surgery for men with medically treated benign prostatic hyperplasia and lower rates of active treatment for localized prostate cancer.
- Decision aid implementation was not associated with cost savings in these populations.
- More research is needed to understand whether these tools can improve long-term patient satisfaction with decision making and quality of life.

Table 1. Baseline Descriptive Statistics for Previously Treated and Untreated Patients With Benign Prostatic Hyperplasia (BPH), by Control (July 2007 to December 2008) and Intervention Groups (July 2009 to December 2010)

	No Prior Medical BPH Treatment						Prior Medical BPH Treatment ^a					
	Control N = 1036			Intervention N = 1069			Control N = 873			Intervention N = 800		
	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median
Year of Index Visit:												
n (%)												
2007	381	(36.8%)					387	(44.3%)				
2008	655	(63.2%)					486	(55.7%)				
2009				372	(38.4%)					355	(44.4%)	
2010				697	(65.2%)					445	(55.6%)	
Age in years at diagnosis	68.9	(10.5)	68.0	68.4	(9.9)	67.0	71.2	(10.1)	71.0	71.6	(10.2)	71.0
Age group, in years:												
n (%)												
45-54	89	(8.6%)		81	(7.6%)		43	(4.9%)		33	(4.1%)	
55-64	314	(30.3%)		329	(30.8%)		223	(25.5%)		192	(24.0%)	
65-74	301	(29.1%)		359	(33.6%)		255	(29.2%)		253	(31.6%)	
75-84	246	(23.7%)		232	(21.7%)		255	(29.2%)		226	(28.3%)	
85+	86	(8.3%)		68	(6.4%)		97	(11.1%)		96	(12.0%)	
BMI	27.8	(4.9)	27.0	27.8	(5.0)	27.0	27.7	(5.0)	27.0	28.3	(5.0)	27.8
BPH diagnosis in the preceding year: n (%)	346	(33.4%)		383	(35.8%)		531	(60.8%)		488	(61.0%)	
Number of urology visits in past year: n (%)												
0	986	(95.2%)		1012	(94.7%)		721	(82.6%)		646	(80.8%)	
1	40	(3.9%)		47	(4.4%)		96	(11.0%)		113	(14.1%)	
2+	10	(1.0%)		10	(0.9%)		56	(6.4%)		41	(5.1%)	
Proportion with a PSA in the prior year: n (%)	668	(64.5%)		604	(56.5%)		479	(54.9%)		409	(51.1%)	
PSA level: n (%)												
<4	387	(57.9%)		357	(59.1%)		316	(66.0%)		235	(57.5%)	
4-9	229	(34.3%)		198	(32.8%)		131	(27.3%)		139	(34.0%)	
≥10	52	(7.8%)		49	(8.1%)		32	(6.7%)		35	(8.6%)	
Ultrasound: n (%)	17	(1.6%)		17	(1.6%)		12	(1.4%)		16	(2.0%)	
Biopsy: n (%)	24	(2.3%)		32	(3.0%)		30	(3.4%)		30	(3.8%)	
Alpha-1: n (%)							793	(90.8%)		697	(85.9%)	
5-alpha: n (%)							96	(11.0%)		170	(21.3%)	
Anticholinergics: n (%)							98	(11.2%)		86	(10.8%)	
Charlson Comorbidity Index score 3+: n (%)	107	(10.3%)		155	(14.5%)		142	(16.3%)		157	(19.6%)	
Prior costs (index date, 2009 dollars):												
Total Costs ^b	10,523	(17,967)	4499	11,903	(23,273)	4808	15,520	(25,327)	6461	13,815	(28,650)	6632
Inpatient	2505	(9945)	0.0	2791	(13,210)	0.0	4485	(15,790)	0.0	3656	(20,667)	0.0
Outpatient	8018	(11,240)	4402	9112	(14,876)	4760	11,035	(13,529)	6286	10,158	(12,098)	6336
Primary care	1149	(2315)	816	1291	(2177)	864	1325	(1171)	1001	1372	(1191)	1035
Specialty care	3329	(4016)	1893	3644	(4659)	2057	4473	(5376)	2612	4333	(6024)	2648
Outpatient urology	710	(1097)	354	612	(833)	368	797	(1052)	407	753	(997)	422
Pharmacy	1233	(2918)	500	1409	(4863)	493	1729	(3012)	958	1606	(2340)	951

(continued)

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Table 1. Baseline Descriptive Statistics for Previously Treated and Untreated Patients With Benign Prostatic Hyperplasia (BPH), by Control (July 2007 to December 2008) and Intervention Groups (July 2009 to December 2010) (continued)

	No Prior Medical BPH Treatment						Prior Medical BPH Treatment					
	Control N = 1036			Intervention N = 1069			Control N = 873			Intervention N = 800		
	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median
Prior year healthcare use												
Primary care visits	5.65	(5.6)	4.0	5.97	(6.1)	5.0	7.05	(6.3)	5.0	6.90	(5.8)	5.0
Specialty care visits	0.19	(0.7)	0.0	0.15	(0.6)	0.0	0.32	(1.0)	0.0	0.27	(0.9)	0.0
Prescription drug fills	30.69	(34.9)	20.0	28.52	(31.0)	20.0	46.77	(41.1)	33.0	44.97	(38.2)	33.0
Inpatient days	0.89	(3.0)	0.0	0.91	(3.1)	0.0	1.67	(4.7)	0.0	1.38	(5.5)	0.0
Admit counts	0.20	(0.5)	0.0	0.21	(0.6)	0.0	0.34	(0.8)	0.0	0.25	(0.6)	0.0
Insurance type: n (%)												
Medicare	629	(60.7%)		668	(62.5%)		610	(69.9%)		577	(72.1%)	
Medicaid	0	(0.0%)		1	(0.1%)		0	(0.0%)		0	(0.0%)	
Commercial	363	(35.0%)		351	(32.8%)		245	(28.1%)		209	(26.1%)	
Private pay	44	(4.2%)		49	(4.6%)		18	(2.1%)		14	(1.8%)	
Basic health	0	(0.0%)		0	(0.0%)		0	(0.0%)		0	(0.0%)	
Other	0	(0.0%)		0	(0.0%)		0	(0.0%)		0	(0.0%)	
Location of urology visit: n (%)												
Seattle	404	(39.0%)		334	(31.2%)		285	(32.6%)		227	(28.4%)	
Bellevue	186	(18.0%)		180	(16.8%)		159	(18.2%)		156	(19.5%)	
Olympia	136	(13.1%)		154	(14.4%)		134	(15.3%)		118	(14.8%)	
Tacoma	256	(24.7%)		325	(30.4%)		246	(28.2%)		253	(31.6%)	
Everett	54	(5.2%)		76	(7.1%)		49	(5.6%)		46	(5.8%)	

BMI indicates body mass index; PSA, prostate-specific antigen.

^aPrior treatment refers specifically to receipt of BPH treatment in the year prior to the index date.

^bTotal is the sum of inpatient + outpatient.

Table 2. Baseline Descriptive Statistics for Localized Prostate Cancer Cohorts, by Control and Intervention Group

	Localized Prostate Cancer Cohorts					
	Control N = 208			Intervention N = 210		
	mean	(SD)	median	mean	(SD)	median
Year of Index Visit: n (%)						
2007	90	(43.3%)				
2008	118	(56.7%)				
2009				71	(33.8%)	
2010				139	(66.2%)	
Age at diagnosis	67.1	(7.7)	67.0	67.4	(7.6)	67.0
Age group, in years: n (%)						
45-54	8	(3.8%)		7	(3.3%)	
55-64	68	(32.7%)		69	(32.9%)	
65-74	94	(45.2%)		95	(45.2%)	
75-84	38	(18.3%)		39	(18.6%)	
BMI	28.3	(4.7)	27.8	28.3	(4.1)	27.7
Number of urology visits in past year: n (%)						
0	15	(7.2%)		16	(7.6%)	
1	140	(67.3%)		148	(70.5%)	
2+	53	(25.5%)		46	(21.9%)	
PSA level: n (%)						
<4	19	(9.5%)		22	(10.8%)	
4-9	127	(63.2%)		128	(63.1%)	
≥10	55	(27.4%)		53	(26.1%)	
Gleason score: n (%)						
2-6 (low-grade)	100	(49.3%)		120	(57.7%)	
7 (intermediate-grade)	56	(27.6%)		65	(31.3%)	
8-10 (high-grade)	47	(23.2%)		23	(11.1%)	
Low-risk cancer^a: n (%)	39	(45.9%)		57	(49.1%)	
Charlson Comorbidity Index score 3+, n (%)	16	(7.7%)		19	(9.0%)	
Prior year costs (2009 dollars):						
Total ^b	10,499	(15,791)	5250	9302	(13,760)	5326
Inpatient	1822	(7960)	0.0	1335	(6491)	0.0
Outpatient	8677	(10,182)	5250	7967	(8439)	5188
Primary care	1129	(2765)	747	891	(673)	733
Specialty care	4554	(4177)	3140	3893	(4430)	2593
Outpatient urology care	2353	(2292)	1758	1735	(1801)	1339
Pharmacy	864	(1549)	450	1059	(2640)	376
Prior year healthcare use						
Primary care visits	4.87	(4.2)	4.0	4.32	(3.8)	3.0
Specialty care visits	0.09	(0.4)	0.0	0.04	(0.2)	0.0
Prescription drug fills	29.07	(34.3)	19.0	24.50	(23.9)	17.0
Inpatient days	0.58	(2.1)	0.0	0.47	(2.3)	0.0
Admit counts	0.14	(0.5)	0.0	0.11	(0.4)	0.0
Insurance type: n (%)						
Medicare	127	(61.1%)		132	(62.9%)	
Medicaid	0	(0.0%)		1	(0.1%)	
Commercial	74	(35.6%)		70	(33.3%)	
Private pay	7	(3.4%)		8	(3.8%)	
Location of urology visit: n (%)						
Seattle	81	(38.9%)		58	(27.6%)	
Bellevue	62	(29.8%)		55	(26.2%)	
Olympia	14	(6.7%)		18	(8.6%)	
Tacoma	51	(24.5%)		79	(37.6%)	

BMI indicates body mass index; PSA, prostate-specific antigen.

^aLow-risk, Gleason <7 and PSA ≤10.

^bTotal is the sum of inpatient + outpatient.

Table 3. Multivariable Adjusted 180-Day Rates of Transurethral Procedures for BPH and Any Treatment for Prostate Cancer^a

	Procedure Rate (per 180 person-days)	95% CI	Relative Rate	95% CI	P
BPH^a					
No prior medical treatment^b					
Control	0.044	0.03-0.06			
Intervention	0.034	0.02-0.05	0.78	0.50-1.22	.2678
Prior medical treatment					
Control	0.102	0.08-0.13			
Intervention	0.069	0.05-0.09	0.68	0.49-0.94	.0185
Prostate cancer^c					
Control	0.94	0.79-1.12			
Intervention	0.69	0.57-0.83	0.73	0.57-0.93	.0111

BPH indicates benign prostatic hyperplasia.

^aAdjusted for age, body mass index, prevalent case, prior urology visits, prior PSA measurement, insurance type, clinic location, and total prior costs (log scale).

^bPrior treatment refers specifically to receipt of BPH treatment in the year prior to the index date.

^cAdjusted for age, body mass index, prior urology visits, prostate-specific antigen value, Gleason score, insurance type, clinic location, and total prior costs (log scale).

Table 4. Adjusted Relative Mean “Post Index” Costs for Patients With BPH and Localized Prostate Cancer

	Post Index Costs (Mean)	95% CI	Relative Mean Costs	95% CI	P
BPH cohorts^a					
No prior medical treatment^b					
Control	7661.8	6709.2-8614.5			
Intervention	8092.7	7008.4-9176.9	1.06	0.86-1.25	.5718
Prior medical treatment					
Control	8746.3	7471.4-10,021.2			
Intervention	7412.0	6423.6-8400.4	0.85	0.68-1.01	.0718
Prostate cancer cohort^c					
Control	18,855.5	16,338.5-21,372.4			
Intervention	16,887.4	14,558.6-19,216.3	0.90	0.72-1.07	.2511

BPH indicates benign prostatic hyperplasia.

^aAdjusted for age, BMI, prevalent case, prior urology visits, prior PSA measurement, insurance type, clinic location, and total prior costs (log scale).

^bPrior treatment refers specifically to receipt of BPH treatment in the year prior to the index date.

^cAdjusted for age, BMI, prior urology visits, PSA value, Gleason score, insurance type, clinic location, and total prior costs (log scale).

eAppendix Table 1. Six-Month “Post Index” Unadjusted Healthcare Use and Costs of Care for Patients With BPH

	No Prior Medical BPH Treatment						Prior Medical BPH Treatment ^a					
	Control N = 1036			Intervention N = 1069			Control N = 873			Intervention N = 800		
	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median	mean	(SD)	median
Post costs (2009 dollars):												
Total ^b	7107	(14,930)	2282	7947	(19,022)	2429	9770	(20,935)	3303	8409	(13,631)	3836
Inpatient	1636	(9260)	0.0	1795	(9728)	0.0	2756	(11,780)	0.0	1913	(8058)	0.0
Outpatient	5472	(9000)	2275	6151	(11,614)	2429	7014	(12,051)	3168	6496	(7989)	3734
Primary care	581	(1115)	306	575	(862)	328	680	(960)	383	653	(838)	416
Specialty care	2413	(4272)	977	2477	(4956)	1026	2831	(4305)	1335	2645	(3338)	1545
Urology surgery	456	(1137)	0.0	380	(925)	0.0	691	(1484)	0.0	591	(1288)	0.0
Pharmacy	721	(1651)	321	851	(2584)	282	1006	(1854)	510	891	(1566)	458
Primary care visits	3.0	(3.6)	2.0	2.9	(3.6)	2.0	3.3	(3.6)	2.0	3.3	(3.7)	2.0
Specialty care visits	0.1	(0.6)	0.0	0.1	(1.4)	0.0	0.2	(0.9)	0.0	0.2	(0.7)	0.0
Prescription drug fills	18.1	(19.2)	12.0	14.9	(15.5)	11.0	24.5	(21.3)	18.0	20.7	(17.3)	15.0
Inpatient days	0.6	(2.4)	0.0	0.7	(3.2)	0.0	1.2	(4.6)	0.0	0.9	(3.3)	0.0
Admit counts	0.1	(0.4)	0.0	0.1	(0.5)	0.0	0.2	(0.6)	0.0	0.2	(0.5)	0.0
Total transurethral procedures: n (%)	48	(4.6%)		39	(3.6%)		106	(12.1%)		68	(8.5%)	

BPH indicates benign prostatic hyperplasia.

^aPrior treatment refers specifically to receipt of BPH treatment in the year prior to the index date.

^bTotal is the sum of inpatient + outpatient.

eAppendix Table 2. Six-Month “Post Index” Unadjusted Healthcare Use and Costs of Care for Patients With Early Stage Prostate Cancer (PRCA)

	Early Stage PRCA Cohorts					
	Control N = 208			Intervention N = 210		
	mean	(SD)	median	mean	(SD)	median
Costs (2009 dollars):						
Total ^b	19,414	(20,022)	15,323	16,526.7	(16,210)	10,397
Inpatient	2827	(7001)	0	2991.7	(6827)	0
Outpatient	16,587	(17,418)	11,524	13,535.0	(14,458)	9425
Primary care	1131	(1749)	492	586.5	(876)	290
Specialty care	9809	(10,313)	7902	7238.1	(8238)	4994
Outpatient urology care	2501	(3147)	903	1978.1	(2665)	738
Pharmacy	553	(763)	289	649.2	(1456)	319
Healthcare use						
Primary care visits	3.1	(3.3)	2.0	2.2	(2.2)	2.0
Specialty care visits	0.1	(0.3)	0.0	0.0	(0.2)	0.0
Prescription drug fills	18.3	(21.9)	11.0	13.0	(11.6)	10.5
Inpatient days	1.0	(2.2)	0.0	0.7	(1.4)	0.0
Admit counts	0.3	(0.6)	0.0	0.2	(0.4)	0.0
Post index treatments received: n (%)						
No PRCA treatment received	83	(39.9%)		101	(48.1%)	
Any PRCA treatment received	125	(60.1%)		109	(51.9%)	
PRCA treatments received ^a						
<i>Androgen deprivation therapy</i>	22	(17.6%)		2	(1.8%)	
<i>External beam radiation</i>	23	(18.4%)		25	(22.9%)	
<i>Brachytherapy</i>	73	(58.4%)		66	(59.6%)	
<i>Surgery</i>	44	(38.4%)		43	(39.5%)	

^aTreatment categories are not mutually exclusive; patients could have received more than 1 treatment in the 6-month follow-up period.

^bTotal is the sum of inpatient + outpatient.