

An Examination of Treatment Patterns and Costs of Care Among Patients With Benign Prostatic Hyperplasia

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Abstract

Objective: To examine utilization and costs of care for benign prostatic hyperplasia (BPH)-related services in a large cohort of commercially insured persons.

Methods: Pharmacy and medical claims data were obtained from 61 US healthcare plans. Men aged ≥ 45 years who were newly diagnosed with BPH between January 2000 and March 2001 were identified. Each patient was followed for 12 months after diagnosis; utilization and costs were calculated for common procedures and disease-related events. Costs were estimated based on health plan payments. Univariate statistics were provided for relevant measures.

Results: A total of 77 040 patients were selected (mean age, 58.1 years). Thirty-six percent of patients had 1 or more urologist visits in the year after diagnosis. Two thirds of patients had a prostate-specific antigen test, whereas 7% had a prostate biopsy. A total of 14 392 patients (18.7%) received an alpha blocker during follow-up; 1860 patients (2.4%) received a 5-alpha reductase inhibitor. Approximately 2% of patients had a surgical procedure (either invasive or minimally invasive); transurethral prostatectomy costs averaged approximately \$5600, consisting of mean (standard deviation) costs of \$794 (\$470) for the procedure and \$4810 (\$8487) in associated inpatient costs. Re-treatment was common (18.7%) among patients with a surgical procedure, at a mean cost of \$1888 (\$1636).

Conclusion: Most patients newly diagnosed with BPH appear to undergo watchful waiting in the year after diagnosis. Although rates of surgical intervention and adverse events at 1 year are low, these events are costly. Strategies to prevent or delay the need for surgery, such as regular examinations, testing, and use of pharmacotherapy where indicated, may further reduce the need for surgical intervention.

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Benign prostatic hyperplasia (BPH) is a noncancerous prostate enlargement which can lead to bothersome lower urinary tract symptoms (LUTS). It has been estimated that more than 50% of men older than 50 years of age and approximately 90% of men older than 80 years of age have BPH.¹⁻³ There are several treatment options available for this condition, including watchful waiting, pharmacotherapy, phytotherapy (ie, use of medicinal plants and herbs), and surgical intervention.⁴

Watchful waiting is recommended for patients without bothersome LUTS and typically involves patient education, lifestyle changes (eg, reductions in fluid intake, avoidance of caffeine or alcohol), and periodic monitoring.⁴ These examinations are critical to rule out further complications of BPH progression as well as the development of prostate cancer. Patients whose symptomatology affects activities of daily living may receive pharmacotherapy, typically with 5-alpha reductase inhibitors or alpha blockers. Early treatment, particularly for patients receiving 5-alpha reductase inhibitors, may slow the rate of BPH progression and prevent or delay the need for surgical interventions and/or the incidence of complications.^{5,6}

In 1993, BPH-related medical expenses were estimated to exceed \$4 billion annually in the United States; other estimates that have taken into consideration the aging of the population and increasing use of medical and surgical intervention have suggested

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that these expenses may currently be much higher—estimates as high as \$26 billion annually have been reported.⁷ Future treatment costs are likely to rise as the prevalence of BPH in the United States increases as a result of the aging population. In the United States, approximately 36.5 million men are between the ages of 50 and 89. By the year 2020, the number of men in this age range is expected to increase to 52.5 million.⁸

Despite awareness of the prevalence of BPH, patterns of care, and overall economic burden, detailed examinations of the resources consumed and their corresponding cost has only been performed in countries other than the United States.^{9,10} A study was therefore conducted to assess levels of medical resource utilization and costs after BPH diagnosis in the United States based on information from a large, national health-care claims database.

METHODS

Data Source

Data were obtained from the PharMetrics Patient-Centric Database and spanned the period from July 1999 to June 2002. At the time of this study, the database contained fully adjudicated claims from 61 health plans across the United States. Inpatient and outpatient diagnoses (in *International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]* format) and procedures (in *Current Procedural Terminology, Fourth Revision [CPT-4]*, *ICD-9-CM*, and Healthcare Common Procedure Coding System [HCPCS] formats) as well as standard and mail order prescription records are included in the data set. Reimbursed payments and charged amounts are available for all services rendered as well as dates of service for all claims. Additional data elements include demographic variables (eg, age, sex, geographic region), health plan type (ie, health maintenance organization [HMO], preferred provider organization [PPO], point-of-service [POS], indemnity, other), payer type (eg, commercial, Medicare Risk, managed Medicaid), provider specialty, and start and stop dates

for plan enrollment. All patients who met the sample selection criteria specified below were included in the analyses.

Sample Selection

Men with at least 1 medical claim with a listed diagnosis of BPH (*ICD-9-CM* 600.xx) were initially selected for inclusion in the study sample. An index date for each patient was established based on the first occurrence of a diagnosis. The study sample was restricted to those patients deemed to be newly diagnosed with BPH; patients with no claims activity containing a BPH diagnosis or relevant pharmacy claims for 6 months before the index date were therefore included. A follow-up period of 12 months was then created in relation to the index date.

Those patients not continuously enrolled during the 6-month pretreatment and 12-month follow-up periods were excluded from all analyses. Patients with a diagnosis of prostate cancer (*ICD-9-CM* 185.xx, 233.4x, 236.5x) at any point during the pretreatment or follow-up periods were also excluded. Additionally, patients had to be at least 45 years of age as of their index date. All claims spanning the period January 1, 1999, to June 30, 2002, were then extracted for eligible patients in the data set.

Measures and Analyses

The primary measures of interest for this study included the demographic and clinical characteristics of the newly-diagnosed BPH population (including type and duration of BPH pharmacotherapy) as well as the utilization and costs of the most frequently occurring BPH-related medical services over 12 months of follow-up. The rate of adverse events was also examined for patients undergoing a BPH-related surgical procedure during the 12-month follow-up period. BPH-related utilization was selected based on review of the available literature regarding common procedures,^{4,11,12} assumptions regarding those procedures likely to result in a healthcare encounter, and review of the reported frequency on the initial data distribution. Similarly, the adverse events selected for analysis—surgical re-treatment, acute urinary retention (AUR), serious urinary tract infection (UTI), erectile dysfunc-

tion, and permanent bladder dysfunction—were selected based on review of the literature regarding common postsurgical events^{4,11,12} as well as a review of the initial data distribution.

BPH-related procedure and laboratory costs were reported on an overall basis and stratified by type of plan or payer (ie, HMO, PPO, POS, Medicare Risk, and other; other included patients enrolled in mixed or hybrid products as well as those with an unknown plan or payer type). In addition, adverse event costs were only reported on an overall basis alone, because their frequency was expected to be too low for stratification by payer type. Duration of therapy with medications over the 12-month follow-up period was calculated based on the total number of recorded days on dispensed pharmacy claims.

During follow-up, patients utilizing each of the selected medical or surgical interventions, as well as those experiencing adverse events, were tracked. Costs were estimated based on health plan expenditures for services rendered and net of patient responsibility (ie, copayment, coinsurance, and/or deductible). Costs were reported during the year in which they were incurred; because the study was intended to reflect payments for services rendered during a period of observation, no special inflationary factors were applied.

The number of patients with each of the selected procedures at 1 year after their initial diagnosis was reported on an annual basis; the number of procedures performed was also tallied. Procedure costs (reimbursed amounts paid by health plans) were calculated on a per visit/procedure basis by dividing the total amount paid by the total number of visits or procedures. Univariate statistics were provided for each of the cost estimates (ie, mean, median, standard deviation [SD], 25th and 75th percentile). Total costs for each procedure were calculated as the product of the number of procedures performed multiplied by the average cost per procedure. Medication costs were analyzed based on levels of drug utilization and health plan reimbursed amounts; these costs were examined over the 12-month follow-up period, regardless of

when medication was initiated, to simulate truly prevalent costs in a 1-year snapshot. Costs were summed to produce a total annual cost of BPH within the first year of diagnosis for this commercially insured population and adjusted to the national level using US Census data.¹³

Adverse events were examined for the subgroup of patients who had 1 of the reported surgical procedures during the follow-up period. For the event to be considered surgery related, only events that occurred within 6 months after the first surgical procedure were considered procedure related; only infections occurring within 30 days of the last surgical procedure were considered procedure related. Re-treatment was defined as the presence of any subsequent surgical procedure on the urinary system within 6 months of the first, based on the assumption that 2 procedures separated by a longer period of time would likely be unrelated. For example, a patient with a transurethral resection of the prostate (TURP) procedure and a subsequent TURP or catheterization within 6 months would be considered to be re-treated. Costs associated with the treatment of each adverse event were also calculated based on the presence of a relevant diagnosis on inpatient or outpatient claims. Similar to the procedure analysis described above, univariate statistics were provided for each of the cost estimates.

Although the focus of this analysis was the utilization and costs of selected procedures and tests only, information on less common and less costly services is also provided.

RESULTS

Demographic and clinical characteristics of the study sample (n = 77 040) are presented in **Table 1**. The mean age of the study population was 58.1 years (median, 56 years); persons aged 55 to 64 years accounted for 51% of the sample. A total of 34.1% of patients in the sample had a comorbid diagnosis of hypertension. Nearly 6% of patients had a UTI, whereas approximately 8% had another urinary tract disorder. The prevalence of alopecia, another

Table 1. Demographic/clinical Characteristics of Patients Newly Diagnosed With BPH

Characteristic	N = 77 040
Age, years (%)	
45-54	35.2
55-64	51
≥65	13.8
Age	
Mean	58.1
Median	56
Minimum	45
Maximum	99
Plan type (%)	
PPO	34.7
HMO	25.9
POS	16
Medicare Risk	14.4
Other	9.0
Geographic region	
East	17.1
South	29.3
Midwest	32.3
West	21.3
Physician specialty (%)	
Urologist	26.9
GP/FP	18.8
Internist	14.2
Other	9.8
Unknown	30.4
Pharmacotherapy	
5-alpha reductase inhibitors	2.4
Alpha blockers	18.7
Prescriptions, mean	
5-alpha reductase inhibitors	6.2
Alpha blockers	6.9
Days dispensed, mean	
5-alpha reductase inhibitors	230.2
Alpha blockers	260.6
Medical comorbidities (%)	
Hypertension	34.1
UTI	5.8
Alopecia	0.1
Other urethra/urinary tract disorders	7.6

BPH indicates benign prostatic hyperplasia; PPO, preferred provider organization; HMO, health maintenance organization; POS, point-of-service; GP, general practitioner; FP, family practitioner; UTI, urinary tract infection.

potential indication for 5-alpha reductase inhibitor use, was 0.1%.

Prescription Drugs

A total of 14 392 (18.7%) patients received an alpha blocker during the follow-up

period (this may partially explain the prevalence of hypertension in our cohort, because alpha blockers are also indicated for this condition); 1860 (2.4%) received a 5-alpha reductase inhibitor (Table 1). Patients receiving pharmacotherapy tended to remain on their drug for most of the year. The average number of therapy days was 231 (of 365 possible days during follow-up) for patients taking alpha blockers and 261 for patients taking 5-alpha reductase inhibitors.

Average costs in the postdiagnosis year for each class of BPH drugs for this population were \$326 (±\$220) and \$575 (±\$489) for alpha blockers and 5-alpha reductase inhibitors, respectively (data not shown). Corresponding total annual costs in the sample were \$4.7 million and \$1.1 million.

Physician Visits

Utilization rates and costs for each of the selected services are displayed in Table 2. Of the patients in the study, 66.2% visited their primary care physician (PCP) at least once during the 12-month follow-up, and 36.2% had at least 1 visit to a urologist. These patients tended to visit their PCP regularly, averaging nearly 3 visits annually; patients visited a urologist every 6 months on average (1.9 visits/patient over 12 months). The average cost of a physician visit was \$47.11 for PCP encounters (SD, \$26.69) and \$47.92 for urologists (SD, \$35.79). The total annual cost was \$7.1 million for PCP visits and \$2.5 million for urologist visits.

The frequency of office visits and per-visit costs varied slightly across payer types. PCP visits per 12 months averaged 2.8 for PPO and POS plans, 2.9 for HMOs, 3.0 for other payer types, and 3.6 for Medicare Risk enrollees. Average visit costs did not materially differ, ranging from approximately \$46 to \$48 per PCP visit. Similar variation was observed for urologist visits. Patients belonging to an HMO or PPO visited urologists an average of 1.8 times annually, whereas those in POS and other plans had an average of 1.9 visits; Medicare Risk patients had the highest average, with 2.1 visits per 12 months. For these specialist encounters, there was more variation in visit costs for Medicare Risk patients (mean, \$37.16; SD, \$30.91)

Table 2. Costs of Physician and Emergency Department Visits for Men With BPH

Procedure	Patients	Number of procedures	Procedures per patient	Mean cost (\$)	SD (\$)	Median (\$)	25th Percentile (\$)	75th Percentile (\$)
PCP visits								
Overall (n = 77 040)	50 993	150 579	3	47.11	26.69	41.47	32.29	55.00
PPO (n = 26 712)	16 918	46 602	2.8	48.11	29.73	41.64	32.00	55.48
HMO (n = 19 918)	13 591	38 791	2.9	46.62	24.40	41.47	33.79	54.00
POS (n = 12 338)	7933	22 476	2.8	46.89	25.88	40.00	32.94	55.00
Medicare Risk (n = 11 122)	7839	28 478	3.6	46.99	25.51	42.24	31.68	55.31
Other (n = 6950)	4712	14 232	3	45.72	25.75	41.00	31.32	52.92
Urologist visits								
Overall (n = 77 040)	27 864	52 636	1.9	47.92	35.79	38.00	25.00	56.50
PPO (n = 26 712)	9106	16 566	1.8	51.01	33.45	41.00	30.00	60.00
HMO (n = 19 918)	6672	12 292	1.8	50.67	37.58	40.00	27.00	60.00
POS (n = 12 338)	3509	6498	1.9	52.77	40.88	39.99	26.00	47.17
Medicare Risk (n = 11 122)	5972	12 381	2.1	37.16	30.91	28.66	15.74	67.00
Other (n = 6950)	2605	4899	1.9	51.28	37.54	42.00	29.65	59.00
Emergency department								
Overall (n = 77 040)	8101	13 030	1.6	106.11	82.36	90.18	60.00	138.36
PPO (n = 26 712)	2403	3563	1.5	92.49	58.95	76.00	56.00	115.00
HMO (n = 19 918)	1865	3120	1.7	120.32	105.46	100.84	68.00	152.48
POS (n = 12 338)	1122	1775	1.6	104.05	73.89	88.88	53.00	152.00
Medicare Risk (n = 11 122)	1987	3356	1.7	113.26	86.12	102.00	65.25	133.00
Other (n = 6950)	724	1216	1.7	91.38	64.84	76.00	50.00	115.55

BPH indicates benign prostatic hyperplasia; SD, standard deviation; PCP, primary care provider; PPO, preferred provider organization; HMO, health maintenance organization; POS, point-of-service.

relative to all other payer types (which had average costs of \$51-\$53).

Emergency Department Visits

Of the 77 040 patients included in the study, 8101 (10.5%) had at least 1 emergency department (ED) visit (Table 2). Overall, the cost per visit averaged \$106.11 (SD, \$82.36). Annual costs of ED visits in this sample totaled approximately \$1.4 million. The percent of patients seeking care varied across payer groups. Approximately 18% (n = 1987) of Medicare Risk patients had an ED visit, at a cost of \$113.26 (SD, \$86.12) per visit compared with 9% (n = 1865) of HMO and 9% of PPO (n = 2403) patients, whose ED costs averaged \$120.32 (SD, \$105.46) and \$92.49 (SD, \$58.95) per visit, respectively. Rates of ED visits for other payer types were 9% and 10% for POS and other payer types, respectively, with corresponding average costs per visit of \$104.05 (SD, \$73.89) and \$91.38 (SD, \$58.39), respectively.

Screening, Diagnostic, and Monitoring Tests/procedures

Not surprising, the most common screening, diagnostic, or monitoring test/procedure was the prostate-specific antigen (PSA) test (Table 3). Overall, 64.3% of patients received 1 or more PSA tests over 12 months of follow-up (an average of 1.3 tests was performed among those receiving a test). The mean cost per test was \$28.27 (SD, \$21.95), and the total annual cost of PSA tests was approximately \$1.8 million. The average number of PSA tests among Medicare Risk patients was 1.5; however, the incidence of PSA testing was lower in this group (55.2%) relative to the overall average. As with visit costs, the mean cost per test was lowest among Medicare Risk patients (\$24.46; SD, \$12.10); costs were also lower in the HMO group (mean, \$25.62; SD, \$37.01), and were higher, but nonetheless similar, among patients in PPO, POS, and other payer types (approximately \$29-\$31).

REPORTS

Table 3. Costs of Diagnostic Tests/procedures for Men With BPH

Procedure	Patients	Number of procedures	Procedures per patient	Mean cost (\$)	SD (\$)	Median (\$)	25th Percentile (\$)	75th Percentile (\$)
PSA tests								
Overall (n = 77 040)	49 570	63 906	1.3	28.27	21.95	25.99	20.33	35.00
PPO (n = 26 712)	18 721	23 561	1.3	30.55	12.95	27.60	21.84	36.00
HMO (n = 19 918)	12 690	15 987	1.3	25.62	37.01	24.33	16.56	30.38
POS (n = 12 338)	8066	10 239	1.3	29.49	14.93	26.00	20.33	34.89
Medicare Risk (n = 11 122)	6143	9163	1.5	24.46	12.10	16.56	14.95	35.40
Other (n = 6950)	3950	4956	1.3	30.53	13.59	27.60	21.36	36.00
Cost of associated laboratory tests								
Chemistry panel (Chem 7)	13 375	45 792		6.46	6.18	5.92	3.20	8.00
Complete blood work	30 043	48 223		11.77	7.62	10.92	7.04	13.53
Partial thromboplastin	2821	3627		11.29	9.36	8.66	4.88	14.00
Pelvic echography								
Overall (n = 77 040)	3775	5432	1.4	70.95	37.18	69.00	50.87	87.59
PPO (n = 26 712)	1164	1611	1.4	80.36	33.77	74.38	58.00	110.00
HMO (n = 19 918)	838	1155	1.4	68.52	39.92	64.06	50.68	87.59
POS (n = 12 338)	500	708	1.4	84.87	36.68	75.00	65.00	82.96
Medicare Risk (n = 11 122)	967	1515	1.6	53.48	33.29	55.20	19.10	100.00
Other (n = 6950)	306	443	1.4	81.02	30.48	79.00	65.00	88.31
Prostate biopsy								
Overall (n = 77 040)	5218	6160	1.2	156.83	128.87	142.00	109.00	166.00
PPO (n = 26 712)	1687	1967	1.2	166.42	111.46	144.00	121.25	167.00
HMO (n = 19 918)	1285	1521	1.2	156.71	151.91	140.50	103.66	181.48
POS (n = 12 338)	745	950	1.3	176.08	135.64	150.34	120.00	149.55
Medicare Risk (n = 11 122)	1094	1210	1.1	113.36	102.76	112.00	44.64	170.00
Other (n = 6950)	407	512	1.3	186.32	126.02	159.00	132.02	187.03
TRUS								
Overall (n = 77 040)	5155	6359	1.2	96.87	64.53	96.04	55.00	118.00
PPO (n = 26 712)	1547	1742	1.1	111.39	60.54	111.00	83.00	123.00
HMO (n = 19 918)	1426	1906	1.3	92.53	61.33	92.00	64.82	117.00
POS (n = 12 338)	647	794	1.2	111.46	65.35	109.23	71.00	97.52
Medicare Risk (n = 11 122)	1223	1534	1.3	72.83	65.45	67.00	32.25	125.00
Other (n = 6950)	312	383	1.2	118.67	59.30	117.00	84.80	138.81
Cost of associated diagnostic procedures								
Complex uroflowmetry	2203	2878		62.81	32.01	66.65	50.00	75.60
Digital rectal exam	64	65		9.69	5.62	9.47	6.31	12.60
Urinalysis	22 835	38 135		5.69	3.48	5.37	4.00	6.96
Urodynamics	451	774		109.83	91.56	99.11	67.50	124.00
Uroflow	151	181		46.55	29.00	44.00	26.12	56.00
Voiding pressure study	195	217		110.38	64.60	105.00	73.66	138.00

BPH indicates benign prostatic hyperplasia; SD, standard deviation; PSA, prostate-specific antigen; PPO, preferred provider organization; HMO, health maintenance organization; POS, point-of-service; TRUS, transrectal ultrasonography.

Prostate biopsy was also relatively common, occurring in 5218 (6.8%) of all patients in the sample. Biopsies occurred most frequently among Medicare Risk enrollees (9.8%). Overall, costs per biopsy averaged \$156.83 (SD, \$128.87) with a total annual cost just under \$1 million (this cost represents the biopsy procedure itself and does not include interpretation or pathology costs). The cost of prostate biopsies varied substantially by payer type. Once again, mean costs (\$113.36; SD, \$102.76) were lowest in the Medicare Risk group. Costs were also lower among HMO patients (mean, \$156.71; SD, \$151.91), and were progressively higher in PPO (mean, \$166.42; SD, \$111.46), POS (mean, \$176.08; SD, \$135.64), and other payer types (mean, \$186.32; SD, \$126.02).

Transrectal ultrasonography (TRUS) was also common, occurring in 5155 patients (6.7%). As with prostate biopsy, TRUS was performed most frequently among Medicare Risk patients (11.0%). Consistent with other reported estimates, mean per-test costs for TRUS were lowest in the Medicare Risk group (mean, \$72.83; SD, \$65.45), and were also low in the HMO group (mean, \$92.53; SD, \$61.33) relative to PPO and POS patients (mean, \$111 each) and other payer types (mean, \$118.67; SD, \$59.30). Total annual costs for TRUS for the cohort were \$616 001.

Finally, pelvic echography, most likely done to assess post-void residual urine volume, was performed in 3775 patients (4.9%) in the overall sample; the rate of this test also was highest in the Medicare Risk group (8.7%). Average costs were once again lowest in the Medicare Risk population (mean, \$53.48; SD, \$33.29) and HMO group (mean, \$68.52; SD, \$39.92); costs were similar in the PPO and other groups (\$80-\$81 average) and highest in the POS population (mean, \$84.87; SD, \$36.68). The annual cost of a pelvic echography in this cohort was \$385 400.

Surgery for BPH

TURP, and minimally invasive surgical procedures, and open prostatectomies were performed relatively infrequently among patients in the newly-diagnosed cohort.

Minimally invasive procedures performed included transurethral microwave thermotherapy (TUMT), transurethral needle ablation (TUNA), and visual laser ablation of the prostate (VLAP). A total of 946 (1.2%) of the 77 040 patients in the study had a TURP over the 12 months of follow-up; TURP procedures were more common among Medicare Risk patients (3.2%) (Table 4). The average TURP cost was \$5603 (excluding urologist and anesthesiologist fees), most of which was attributable to the cost of the inpatient stay (because of the importance of TURP, exploratory analyses that included urologist and anesthesiologist fees were conducted for TURP alone; with these fees included, total procedural costs would average \$6818 [data not shown]). Total annual cost was not insignificant, even though TURPs were performed relatively infrequently, totaling more than \$5 million. TURP costs for the Medicare Risk population (mean, \$5279) were lower than among patients with a PPO payer type (\$5556), but higher than among patients in HMO (\$5029) and POS (\$5098) settings. TURP costs were by far the highest among patients with other payer types (mean, \$9695), although the sample size in that particular subset was small.

Minimally invasive surgical procedures were less frequent than TURPs, with only 264 (115 TUMT, 46 TUNA, and 103 VLAP) patients (0.3%) having evidence of such a procedure (Table 5). Average costs of TUMT, TUNA, and VLAP were \$937.24, \$737.85, and \$899.54, respectively. The total annual cost of minimally invasive procedures was \$345 492.

Finally, open prostatectomy procedures occurred with even less frequency; 51 patients (0.1%) had evidence of such a procedure. Because of the small size of this sample, open prostatectomies were not considered for costing purposes.

A total of 759 patients (1%) underwent radical prostatectomy. The mean cost for radical prostatectomy, including surgery and total inpatient costs (but excluding urologist and anesthesiologist fees), was \$10 389.25. Because this procedure is performed primarily for prostate cancer and not BPH, cost results are not discussed in further detail in this article.

Table 4. Costs Associated With TURP Procedures by Type of Cost and Payer

	Number of patients	Procedures*	Mean cost (\$)	SD (\$)	Median (\$)	25th Percentile (\$)	75th Percentile (\$)
Overall (N = 77 040)							
TURP operation	946	1247	793.60	470.30	845.10	314.31	1058.00
Total inpatient costs for those with TURP (excluding operation)	631	631	4809.61	8487.16	3869.00	2569.50	5381.00
PPO (N = 26 712)							
TURP operation	227	284	962.34	476.68	981.87	705.60	1128.43
Total inpatient costs for those with TURP (excluding operation)	158	158	4593.48	2350.73	4283.00	3433.00	5555.66
HMO (N = 19 918)							
TURP operation	174	244	844.52	449.25	964.17	413.58	1082.33
Total inpatient costs for those with TURP (excluding operation)	115	115	4184.30	2549.87	3700.06	2490.00	5023.14
POS (N = 12 338)							
TURP operation	120	160	945.18	486.98	1004.93	650.82	1153.50
Total inpatient costs for those with TURP (excluding operation)	81	81	4152.38	2928.45	3649.00	2907.66	4680.00
Medicare Risk (N = 11 122)							
TURP operation	359	471	601.08	386.40	662.05	298.78	859.51
Total inpatient costs for those with TURP (excluding operation)	228	228	4677.55	5061.01	3338.70	2147.61	5343.78
Other (N = 6808)							
TURP operation	64	84	848.24	530.32	995.00	320.00	1244.00
Total inpatient costs for those with TURP (excluding operation)	47	47	8846.59	28 134.60	4071.00	3281.00	6728.00
Medicaid (N = 142)							
TURP operation	2	4	1165.83	347.05	1339.36	992.30	1339.36
Total inpatient costs for those with TURP (excluding operation)	2	2	4644.06	1416.56	4644.06	3642.40	5645.72

*Procedures include both physician and facility billing, as a result the number of procedures may be greater than the number of patients.

TURP indicates transurethral resection of the prostate; SD, standard deviation; PPO, preferred provider organization; HMO, health maintenance organization; POS, point-of-service.

Surgical Adverse Events

A total of 5250 patients of 77 040 (6.8%) met the selection criteria for analyses of those at risk for postsurgical adverse events (ie, evidence of at least 1 BPH-related surgical intervention). Nearly 1 in 5 of these patients (n = 1001; 18.7%) required re-treatment within 6 months of their initial surgical procedure (Table 5). Costs associated with re-treatment averaged \$1887.83 per patient (SD, \$1636.21), yielding a total annual cost of nearly \$1.9 million in the

sample. Although detail on the actual re-treatment procedures performed was unavailable, the relatively low average cost appears to reflect a mixture of low-cost procedures, such as catheterization and higher-cost surgical procedures.

AUR occurred in approximately 10% of patients after a surgical intervention (n = 514), with an associated per patient cost of \$367.14 (SD, \$647.28) and total annual cost in the sample of \$188 710. UTIs occurred in 9% of patients in the adverse-

Table 5. Costs Associated With Selected BPH Surgical Procedures* and Postsurgical Adverse Events†

	Number of patients	Procedures	Mean cost (\$)	SD (\$)	Median (\$)	25th Percentile (\$)	75th Percentile (\$)
Procedures							
TUMT	115	146	937.24	919.50	713.59	585.00	904.00
TUNA	46	69	964.16	737.85	734.00	557.00	1045.00
VLAP	103	158	899.54	592.19	910.12	386.88	1072.00
Adverse events							
Re-treat	1001	N/A	1887.83	1636.21	1890.00	264.00	2858.00
AUR	514	N/A	367.14	647.28	158.00	63.51	359.34
Serious UTI	452	N/A	340.64	2638.76	35.08	12.64	96.20
Erectile dysfunction	166	N/A	145.52	247.60	64.11	31.00	167.00
Bladder dysfunction	163	N/A	538.78	2044.32	56.85	23.02	250.12
No event	2954	N/A	N/A	N/A	N/A	N/A	N/A

*Procedures include both physician and facility billing, and, as a result, multiple bills may apply to 1 procedure.

†In a total of 5250 patients with BPH-related surgical procedure.

BPH indicates benign prostatic hyperplasia; SD, standard deviation; TUMT, transurethral microwave thermotherapy; TUNA, transurethral needle ablation; VLAP, visual laser ablation of prostate; AUR, acute urinary retention; N/A, not applicable; UTI, urinary tract infection.

event subsample (n = 452). The average cost per patient for an episode of this condition was \$340.64 (SD, \$2638.76; total annual cost, \$153 970). Erectile dysfunction and bladder dysfunction (ie, functional bladder disorder or detrusor instability) each occurred in 3% of the cases, with corresponding mean related costs of \$145.52 (SD, \$247.60) and \$538.78 (SD, \$2044.32), with corresponding total annual costs of \$24 156 and \$87 821, respectively.

Total BPH Costs—Cohort and National Estimates

Overall costs associated with BPH within the first year of diagnosis for this sample of more than 77 000 men are summarized in **Table 6**. The overall average annual cost of diagnosis and management of BPH was \$31.4 million.

Based on recent US Census estimates (July 2003), there are 37.7 million US men ≥ 50 years of age. Using the assumption that a minimum of 50% of these men have BPH, and that 50% of men with BPH will seek treatment, a total of 9.4 million men are estimated to be eligible for treatment of BPH annually in the United States. Multiplying our cohort cost estimates by this figure yields a direct cost estimate of approximately \$3 billion for the year after BPH diagnosis.

DISCUSSION

In an effort to better understand utilization and costs associated with the treatment of BPH in a large, commercially insured cohort, a retrospective analysis of pharmacy and medical claims for patients newly diagnosed with BPH was undertaken. The number of patients utilizing each of the services was examined, as were the number and cost of services performed. In addition, the rate of common adverse events after surgery, along with their associated costs, was assessed.

The relatively high rate of office visits and PSA testing, coupled with the infrequent utilization of pharmacotherapy and/or surgical procedures, indicate that watchful waiting appears to be the preferred treatment approach in the majority of patients during the first year after diagnosis of BPH, which is in agreement with published clinical guidelines.⁴ Interestingly, nearly 10% of patients had a prostate biopsy within 1 year of their initial diagnosis, suggesting that PSA elevation is a concern in some patients. Members of a Medicare Risk plan tended to have higher utilization of medical services relative to other payer types. As stated earlier, this may be due in part to the advanced age of this cohort.

Table 6. Total Annual Average BPH Costs

	Overall (N = 77 040)								
	Number of patients	Number of procedures	Procedures per patient	Mean Cost (\$)	SD (\$)	Median (\$)	25th Percentile (\$)	75th Percentile (\$)	Total Cost (\$)
Physician/urologist and ED visits									
PCP	50 993	150 579	2.95	47.11	26.69	41.47	32.29	55.00	7 093 442
Urologist	27 864	52 636	1.89	47.92	35.79	38.00	25.00	56.50	2 522 343
ED	8101	13 030	1.6	106.11	82.36	90.18	60.00	138.36	1 382 673
Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10 998 459
TURP procedures									
TURP (surgery)	946	1247	1.32	793.60	470.30	845.10	314.31	1058.00	989 620
Urologist	777	809	1.04	890.97	407.23	935.19	720.00	1105.00	720 795
Anesthesiologist	775	930	1.20	322.97	175.64	321.73	198.80	411.00	300 358
Total inpatient costs for those with TURP (excluding operation, anesthesia)	631	631	1.00	4809.61	8487.16	3869.00	2569.50	5381.00	3 034 866
Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 045 639
Other procedures among men with BPH									
Catheterization	475	641	—	59.51	72.62	44.94	27.39	76.72	38 145
Chest x-ray	15 648	30 121	—	25.95	20.83	17.66	12.00	37.00	781 762
Complex uroflowmetry	2203	2878	—	62.81	32.01	66.65	50.00	75.60	180 759
Digital rectal exam	64	65	1.02	9.69	5.62	9.47	6.31	12.60	630
Electrocardiogram	22 012	33 691	—	26.86	17.90	27.85	14.23	34.02	905 098
Pelvic echography	3775	5432	1.44	70.95	37.18	69.00	50.87	87.59	385 400
Prostate biopsy	5218	6160	1.2	156.83	128.87	142.00	109.00	166.00	966 097
TRUS	5155	6359	1.23	96.87	64.53	96.04	55.00	118.00	616 001
Urinalysis	22 835	38 135	1.67	5.69	3.48	5.37	4.00	6.96	217 047
Urodynamics	451	774	1.72	109.83	91.56	99.11	67.50	124.00	85 007
Uroflow	151	181	1.20	46.55	29.00	44.00	26.12	56.00	8426
Voiding pressure study	195	217	1.11	110.38	64.60	105.00	73.66	138.00	23 953
Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4 208 325
Selected post-surgical adverse events									
Re-treat	1001	—	—	1887.83	1636.21	1890.00	264.00	2858.00	1 889 717
AUR	514	—	—	367.14	647.28	158.00	63.51	359.34	188 710
Serious UTI	452	—	—	340.64	2638.76	35.08	12.64	96.20	153 970
Erectile dysfunction	166	—	—	145.52	247.60	64.11	31.00	167.00	24 157
Bladder dysfunction	163	—	—	538.78	2044.32	56.85	23.02	250.12	87 821
No event	2954	—	—	N/A	N/A	N/A	N/A	N/A	—
Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2 344 375
Medication cost									
Alpha blockers	14 406	—	6.9	1.41	—	—	—	—	4 692 335
5-alpha reductase inhibitors	1849	—	6.2	2.20	—	—	—	—	1 061 673
Total									5 754 007
Laboratory costs									
PSA tests	49 570	63 906	1.29	28.27	21.95	25.99	20.33	35.00	1 806 847
Chemistry panel (Chem 7)	13 375	45 792	—	6.46	6.18	5.92	3.20	8.00	295 854
Complete blood work	30 043	48 223	—	11.77	7.62	10.92	7.04	13.53	567 608
Partial thromboplastin	2821	3627	—	11.29	9.36	8.66	4.88	14.00	40 950
Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2 711 259
Other BPH surgical procedure costs									
TUMT	115	146	1.27	937.24	919.50	713.59	585.00	904.00	136 837
TUNA	46	69	1.50	964.16	737.85	734.00	557.00	1045.00	66 527
VLAP	103	158	1.53	899.54	592.19	910.12	386.88	1072.00	142 128
Total	264	N/A	N/A	N/A	N/A	N/A	N/A	N/A	345 492
Grand total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31 407 557

BPH indicates benign prostatic hyperplasia; SD, standard deviation; PCP, primary care provider; ED, emergency department; N/A, not applicable; TURP, transurethral resection of the prostate; TRUS, transrectal ultrasonography; AUR, acute urinary retention; UTI, urinary tract infection; PSA, prostate-specific antigen; TUMT, transurethral microwave thermotherapy; TUNA, transurethral needle ablation; VLAP, visual laser ablation of the prostate.

Although the use of surgical interventions was relatively limited in the 12-month follow-up period (approximately 7% of the population), these events appear to be quite costly. Depending on the approach, the costs of prostate resection procedures (incorporating both facility and provider components) ranged from ~\$5600 to \$10 400 per event. Importantly, the rate of adverse events associated with surgical procedures also was relatively high, which should be considered in estimating the cost of surgical intervention. More than 20% of patients had at least 1 adverse event after surgical treatment. The most common (and most costly) adverse event was the occurrence of another invasive procedure within 6 months of original surgery, although rates of AUR and UTI were also relatively high. The total annual cost of surgery (both invasive and minimally invasive) and the resulting complications and re-treatment in our sample was nearly \$8 million.

Comparing surgical costs with those of pharmacotherapy, we find a greater proportion of patients treated with pharmacotherapy (approximately 20% of the population), between 230 to 260 of 365 potential days of therapy on average, and a total annual cost of \$5.7 million. The question of whether a proportion of the costs of surgery and the resulting complications and adverse events could have been avoided had more patients been initiated on pharmacotherapy before considering surgical treatment cannot be answered within the scope of this study, but should be considered for future research.

Some important limitations of our analysis should be noted. First, cost results were based on amounts paid by health plans. Because payment amounts are often in part influenced by employer and health plan contractual arrangements, they do not necessarily represent the true societal cost of these procedures and events. Nevertheless, they represent important estimates of health plan expenditures from a national data source. In addition, we used commercially insured persons as the basis for our national projections, which may limit the generalizability of our estimates to the universe of all potential payers.

In addition, a single claim with a diagnosis of BPH was used to identify patients with the

condition. As a result, the prevalence of this condition may be overestimated in the database, because patients may be initially diagnosed with the condition and later ruled out pending the results of laboratory testing. Nevertheless, the cost estimates in this study were based on incident procedures or events (and were calculated only among patients experiencing the events) and were not dependent on any underlying assumptions regarding prevalence. Furthermore, facility costs specific to selected procedures are not able to be differentiated from unrelated costs due to billing practices in the United States and were not included in our procedure cost estimates. The same holds true for other services (eg, interpretation of imaging or pathology studies) not directly tied to the primary procedure itself. Our cost estimates can therefore be interpreted as conservative.

Our analyses did not include estimates of the costs of drug-related adverse events. The side effect profile of the agents of interest is generally mild¹⁴ and unlikely to result in major healthcare expenditures. We did conduct exploratory analyses of selected adverse events with regard to drug exposure and found rates similar to patients who were not exposed to drugs. For example, erectile dysfunction occurred in <0.25% of patients receiving alpha blockers, finasteride, or no drug therapy; similar results were observed for impotence, headache, and dizziness.

Finally, the analyses conducted were descriptive in nature only; therefore, no modeling or extrapolation was conducted to assess the statistical rigor of the estimates. Although such an approach is typical in a noncomparative, burden-of-illness examination, it is important to note that no special techniques were employed to adjust for variability in our estimates. This variability was observed even in the presence of large sample sizes, suggesting that many variables affect costs in addition to sample size.

We considered all subsequent surgical procedures as candidates for re-treatment. As such, these procedures varied in intensity (eg, catheterization vs subsequent TURP); nevertheless, they represented additional BPH-related cost and were therefore included. It is also possible that the relatively high rate of re-treatment observed in this study

was due to the typical practice setting as opposed to the controlled environment and short duration of most clinical trials.

Despite these limitations, this study has important implications. To the best of our knowledge, it is the first study to examine detailed utilization and costs of BPH management under conditions of typical practice in a large sample of commercially insured persons. Findings from this study indicate that patients with BPH are initially treated primarily through watchful waiting. Although rates of surgical intervention in the year after diagnosis are low, the associated costs are substantial, approaching \$11 000 in some cases. Adverse events occurred in 1 in 5 persons undergoing surgery, with costs ranging from ~\$150 to \$1900 per event. Therefore, early and frequent testing and monitoring of this condition, coupled with effective noninvasive treatment where indicated, may further reduce the need for surgical intervention, resulting in potential savings to healthcare payers and providers.

Most patients newly diagnosed with BPH appear to undergo watchful waiting in the year after diagnosis. Although rates of surgical intervention and adverse events at 1 year are low, these events are costly. Strategies to prevent or delay the need for surgery, such as regular examinations, testing, and use of pharmacotherapy where indicated, may further reduce the need for surgical intervention.

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