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Patterns of medical management of overactive bladder (OAB) and benign prostatic hyperplasia (BPH) in the United States

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Aims: Overactive bladder (OAB) and benign prostatic hyperplasia (BPH) are highly prevalent conditions that place a large burden on the United States (US) health care system. We sought to analyze patterns of prescription medication usage for incident OAB in men and women, and for incident BPH in men using US health insurance claims data.

Materials and Methods: This study used Truven Health MarketScan® Commercial and Medicare Supplemental Research databases. The data were pooled from diverse points of care. BPH subjects included men age 18+ with the first and last two diagnoses of BPH ≥30 days apart and no BPH diagnosis for 1 year prior. OAB subjects included men and women age 18+, who were diagnosed similarly with incident OAB. The type of medication, medication continuation (persistence), and switching to a different medication were analyzed through September 30, 2013.

Results: Medication persistence was much higher overall for BPH than OAB (56% vs 34%, respectively, $P < 0.0001$), and was highest among men with BPH age 65+ (62%). Patients age 18-64 were less likely to continue medication than older adults (age 65+) for both BPH and OAB. A 9.4% of patients in the OAB cohort and 6.9% of men with BPH switched from one medication to another.

Conclusions: Persistence was higher with BPH than OAB medications overall, whereas switching rates were higher in the OAB group. The lower persistence of OAB medication may be due to less efficacy or tolerability. The possibility of under treatment of OAB also warrants future investigations.

KEYWORDS
anticholinergic medication, benign prostatic hyperplasia, claims, non-surgical management, observational study, overactive bladder symptoms, urge incontinence, urgency incontinence, urinary frequency, urinary urgency

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David Ginsberg led the peer-review process as the Associate Editor responsible for the paper.

1 | INTRODUCTION

Lower urinary tract symptoms (LUTS) are associated with a wide range of diagnoses including overactive bladder (OAB) symptoms with and without urinary incontinence, bladder infections, benign prostatic hyperplasia (BPH), and bladder pain syndrome. These symptoms are common in both men and women, and studies show that they can lead to decreased quality of life.[1,2] Approximately one in five adults report moderate to severe LUTS.[2]

OAB syndrome, a cluster of LUTS, is a common disabling condition occurring in both men and women, and is associated with significant economic and healthcare burden. In 2002, the terminology defining OAB underwent revision by the International Continence Society (ICS) to reflect that OAB is a symptom syndrome characterized primarily by urgency, but which also may include frequency and urgency urinary incontinence.[1] Epidemiologic studies have shown that urgency and frequency are more prevalent than urgency urinary incontinence.[1] This emphasizes the focus on the symptomatology of this common disorder; it also points to the possibility of a symptom-based treatment approach, since the diagnosis of OAB is independent of the urodynamic diagnosis of detrusor overactivity.[1,2] The age-specific prevalence of OAB is similar among men and women.[1,2] Despite the large socio-economic burden of OAB, our recent work has shown that only 34% of women and 19% of men diagnosed with OAB are prescribed medication.[3]

Men with LUTS often experience coexisting storage, voiding, and postmicturition symptoms, suggesting the need for urologic evaluation.[4] BPH, a diagnosis made on the basis of histology, is a condition that occurs with aging. The prevalence of BPH increases from 25% among men 4-49 years of age to more than 80% among men 70-79 years of age+.[5] Approximately 25% of men over 50 have moderate-to-severe LUTS.[6] In fact, up to 60% of men with BPH take oral medication for their condition.[7] However, not all men with BPH develop LUTS and not all men with LUTS will have BPH. A greater percentage of men report storage symptoms (51.3%) than voiding (25.7%) or postmicturition (16.9%) symptoms.[4] This suggests that many men with a diagnosis of BPH may, in fact, have OAB.

For clinicians who treat LUTS, there have been several relevant clinical practice guidelines available to help guide management decisions.[8] Medications play a key role in treating both OAB and BPH, and are recommended by AUA/SUFU guidelines for most symptomatic patients in whom behavioral modification has failed.[9,10] They are commonly prescribed and effective. However, we still have a poor understanding of the patterns of medical treatment for these conditions. Herein we sought to measure medication prescribing patterns, medication continuance (repeat prescriptions, persistence), and medication switching in both BPH and OAB. We also sought to compare patterns of treatment between the two conditions.

2 | MATERIALS AND METHODS

This work was part of a mutual collaboration between the American Urological Association Data Committee and Pfizer, Inc., to better understand and characterize treatment patterns of BPH and OAB in the United States. The collaboration involved use of observational databases provided by Pfizer, Inc., in addition to AUA content experts to direct the analyses. Pfizer also provided statistical support. Our prior recent work addressed patterns of treatment for both BPH and OAB. Herein we specifically focused on medication prescribing patterns, including medication adherence and changing of medication.[3,7].

2.1 | Real-world observational database

Anonymized real-world claims data from the Truven Health MarketScan® Commercial Claims and Encounters database, and Medicare Supplemental Research Databases were analyzed.[11] These databases include de-identified medical claims and prescription drug claims for individuals in the United States with employer-sponsored health insurance, including individuals with Medicare supplemental coverage. The data were pooled from diverse points of care, including large employers, managed care organizations, hospitals, and public organizations, thus providing greater generalizability than single payer databases. No informed consent process or Institutional Review Board (IRB) approval were sought. Because this study used only de-identified patient records and does not involve the collection, use, or transmittal of individually identifiable data, IRB approval to conduct this study was not necessary.

2.2 | Study design

This observational study used the data from the Truven claims database from July 1, 2008 to September 30, 2013. The following study periods were included in this observational study:

The pre-index period is a fixed period of exactly 12 months with continuous enrollment before the index date. This period occurs sometime between July 1, 2008 and the first diagnosis.

The index date is the first OAB (or first BPH) diagnosis occurred sometime between July 1, 2009 and June 30, 2012, with patients having at least two OAB (or BPH) diagnoses. The first and the last OAB (or BPH) diagnoses would be at least 30 (ie, $\geq$30) days apart in keeping with standards for establishing and confirming a diagnosis over time.

The follow-up post-index period lasted from the 1st diagnosis to the most recent claims data available, which was until September 30, 2013. Because this was a retrospective observational database study to use all available data, sample size calculation was not performed.

2.3 | Inclusion and exclusion criteria

For OAB, the following inclusion criteria were applied: age 18+; at least two OAB diagnoses occurrences; with the first and last occurrences of OAB diagnosis at least 30 days apart (ie, ≥30 days between two OAB occurrences) after the index date. Corresponding International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes for the OAB diagnosis are listed in appendix 1.

The following exclusion criteria for patients were applied: unknown gender; only one diagnosis occurrence or the first and last occurrences within 0-29 days of each other; the occurrence of the following diagnoses at any time during the study period: neurogenic bladder (596.54, 596.55, 344.61); multiple sclerosis (340, 341.0, 341.1, 341.8, 341.9); Parkinson's disease (332.0, 332.1, 333.0, 094.82); cerebrovascular disease and personal history of other diseases of circulatory system (436, 435.9, 997.02, V12.59); spinal bifida (741, 741.0, 741.9, 756.17); spinal cord injury (952.x); radiation cystitis (595.82); paraplegia (344.1); paralysis (344.9); cerebral palsy (343.x); quadriplegia (344.x); urethral cancer (189.3); bladder cancer (188.x); prostate cancer (185); uterine or cervical cancer (179, 180, 180.0, 180.1, 180.8, 180.9, 182, 182.0, 182.1, 182.8); vaginal cancer (184, 184.0); urethral diverticulum (599.2); urethral stricture (598.X); interstitial cystitis (595.1); prostatitis (601.x).

For BPH, the following inclusion criteria for patients were applied: age 18+; with at least two BPH diagnoses occurrences; with the first and last occurrences (if there are at least two diagnoses) of BPH diagnosis at least 30 days apart (ie, 30+ days between two BPH occurrences) after the index date. The ICD-9-CM codes for the BPH diagnosis are listed in appendix 1.

The following exclusion criteria for patients were applied: females or unknown sex for BPH; only one occurrence of BPH diagnosis; the first and last occurrences within 0-29 days; neurogenic bladder (596.54, 596.55, 344.61); multiple sclerosis (340, 341.0, 341.1, 341.8, 341.9); Parkinson's disease (332.0, 332.1, 333.0, 094.82); cerebrovascular disease and personal history of other diseases of circulatory system (436, 435.9, 997.02, V12.59); spinal bifida (741, 741.0, 741.9, 756.17); spinal cord injury (952.x); radiation cystitis (595.82); paraplegia (344.1); paralysis (344.9); cerebral palsy (343.x); quadriplegia (344.x); urethral cancer (189.3); bladder cancer (188.x); prostate cancer (185); uterine or cervical cancer (179, 180, 180.0, 180.1, 180.8, 180.9, 182, 182.0, 182.1, 182.8); vaginal cancer (184, 184.0); urethral diverticulum (599.2); urethral stricture (598.X); interstitial cystitis (595.1); prostatitis (601.x).

2.4 | Outcome measures

We sought to analyze the proportion of patients who continued their OAB (or BPH) medication, the proportion who discontinued medication altogether, and the proportion who changed medication. Among patients who switched their OAB (or BPH) medication, we sought to determine which specific OAB (or BPH) medications were switched.

Demographic characteristics were based on either the pre-index period or the index date. Medications were assessed during the post-index period and are listed by National Drug Code Directory (NDC) Codes in appendices 2 (OAB) and 3 (BPH). The first OAB or BPH medication prescribed during the index period was considered to be the index medication. Demographics variables included the following: age, sex, race, geographic region, urban/rural residence, insurance type, etc. Medications analyzed are listed in appendix 2 (OAB) and 3 (BPH).

Persistence was defined as no 135+ days gap between prescriptions for the index medication during follow-up period. We defined discontinuation as having a ≥135-day gap between the exhaustion of days supplied for one OAB (or BPH) medication and the filling of the next OAB (or BPH) medication prescription. The 135 day gap was selected based on a preliminary analysis of gaps between two consecutive prescriptions for OAB medications (mean of day gap = 142.33 days). Switching was defined as having a prescription claim for an OAB (or BPH) medication that is different from the index medication and the medication change occurred during 45 days after discontinuation of index OAB (or BPH) medication. The 45 days was selected to ensure the switching occurring not so far away from the discontinuation of the index medications. As a post-hoc secondary analysis, we also compared persistence rates between men with BPH and women with OAB using chi square statistics.

2.5 | Statistical methods

All statistical analyses were conducted using SAS Version 9.2 and/or 9.3 (SAS Institute, Cary, NC). Missing data were not imputed. Hypothesis-testing was not conducted since all analyses were exploratory in nature and analyses were univariate.

For continuous variables, descriptive statistics were computed. For categorical variables, number and percentage were computed. We also compared persistence rates between men with BPH and women with OAB using chi square statistics as a post-hoc secondary analysis.

2.6 | Subgroup analysis

Subgroup analysis was performed as pre-specified. For OAB, subgroup analysis included sex (men and women) and age intervals (<65 years old vs ≥65 years old). For BPH, subgroup analysis included age intervals (<65 years old vs ≥65 years old). Furthermore, subgroup analysis was conducted by stratification using post-index follow-up time-periods: 6-<24 months (ie, 180-<720 days) and 24+ months (ie, 720+ days).

3 | RESULTS

A total of 89 994 604 patients were enrolled for some time during July 1, 2009-June 30, 2012 in the Truven database. Of these, 2 947 100 (3.3%) were assigned at least one diagnosis of OAB (Table 1) and 2 058 953 (2.3%) were assigned a diagnosis of BPH (Table 2). A total of 160 853 patients with OAB and 171 224 patients with BPH met respective inclusion criteria. Average patient age in the OAB group was 61.7 years and the BPH group was 65.5 years (Tables 3 and 4). Women diagnosed with OAB were younger than men with a similar diagnosis (age 60.9 vs 65.3). For OAB, the majority (75%) of patients had employer-based insurance, and 47% of plans were preferred provider organizations (PPOs, Table 3). For BPH, 79% had employer based insurance and, of the benefit plans, 45% were PPOs. The largest minority of patients were located in the South (37% of OAB patients and 36% of BPH) followed by the North Central region (29% of OAB patients and 28% of BPH patients).

A total of 38 909 (24.2%) patients with a new OAB diagnosis were prescribed OAB medication, including 31 701 women (19.7%), and 7 208 men (4.5%). In addition, 69 079 (40.3%) of men with a new diagnosis of BPH were prescribed medication. Sixty-two percent of prescriptions for OAB were given to women in the younger age categories (19 783 women age 18-64 vs 11 918 women age 65+), whereas prescriptions were more evenly distributed by age in men with OAB (3 480, or 48.3%, of men age 18-64 vs 3 728, or 51.7%, of men age 65+).

The most frequently prescribed index OAB medication in both men and women (33.1% of OAB prescriptions) was oxybutynin, followed by solifenacin (30.1%), and tolterodine (17.5%, Table 5). OAB prescribing patterns were similar in both men and women. In men with BPH, the alpha blocker tamsulosin was most frequently prescribed (48.5%), followed by 5-alpha reductase inhibitors finasteride (12.9%) and dutasteride (10.0%, Table 6), and other alpha blockers.

Persistence of index medications was much higher overall for BPH than OAB (56.1% vs 33.7%, Table 7). This difference was statistically significant based on a post-hoc chi square analysis ($P < 0.0001$). Older men had a higher rate of continued medication usage for BPH than younger men (61.6% men age 65+ vs 51.2% men 18-64). Patients age 18-64 were also less likely to continue medication than older adults (age 65+) with OAB, though this age difference was smaller than that seen in BPH. This was seen in both men (32.5% age 18-64 continued vs 37.8% 65+) and women (32.2% age 18-64 continued vs 35.2% age 65+).

TABLE 1 OAB subject evaluation table with sample sizes based on the inclusion and exclusion criteria

Subject evaluation	*N*	%
1. All patients enrolled for some time during Jul. 1, 2009 to Jun. 30, 2012	89 994 604	100.000
2. (1) and female or male (excluding patients with unknown gender)	89 994 604	100.000
3. (2) and with any OAB diagnosis during Jul. 1, 2009 to Jun. 30, 2012	2 947 100	3.275
4. (3) and with 2+ OAB diagnosis at least 30 days apart	741 898	0.824
5. (4) and without any OAB diagnosis during 12 months (360 days) pre-index	682 306	0.758
6. (5) and with index and second immediate OAB diagnosis at least 30 days apart	531 285	0.590
7. (6) and with continuous enrollment during 1 year (360 days) pre-index	258 015	0.287
8. (7) and with continuous enrollment during 6 months (180 days) on or post-index	246 429	0.274
9. (8) and with age 18+	226 164	0.251
10. (9) and excluding patients with any exclusion diagnosis during study period	160 853	0.179
11.1. (10) and with follow-up days between 6 and <24 months	68 150	0.076
11.2. (10) and with follow-up days 24+ months	92 703	0.103
12. (10) and with any OAB treatment medications on the index date or post-index and with only 1 type of OAB Rx on the earliest OAB Rx date	38 909	0.043
13.1. (12) and with follow-up days between 6 and <24 months	13 855	0.015
13.2. (12) and with follow-up days 24+ months	25 054	0.028

All percentages are relative to all patients enrolled, ie, 89 994 604.

TABLE 2 BPH subject evaluation table with sample sizes based on inclusion and exclusion criteria

Subject evaluation	*N*	%
1. All patients enrolled for some time during Jul. 1, 2009 to Jun. 30, 2012	89 994 604	100.000
2. (1) and male only	43 710 062	48.000
3. (2) and with any Benign Prostatic Hypertrophy (BPH) diagnosis during Jul. 1, 2009 and Jun. 30, 2012	2 058 953	2.288
4. (3) and with 2+ BPH diagnosis at least 30 days apart	888 875	0.988
5. (4) and without any BPH diagnosis during 12 months (360 days) pre-index	767 605	0.853
6. (5) and with index and second immediate BPH diagnosis at least 30 days apart	583 227	0.648
7. (6) and with continuous enrollment during 1 year (360 days) pre-index	263 176	0.292
8. (7) and with continuous enrollment during 6 months (180 days) on or post-index	254 163	0.282
9. (8) and with age 18+	253 817	0.282
10. (9) and excluding patients with any exclusion diagnosis during study period	171 224	0.190
11.1. (10) and with follow-up days between 6 and <24 months	59 052	0.066
11.2. (10) and with follow-up days 24+ months	112 172	0.125
12. (10) and with any BPH treatment medications on the index date or post-index and with only 1 type of BPH Rx on the earliest BPH Rx date	69 079	0.077
13.1. (12) and with follow-up days between 6 and <24 months	20 641	0.023
13.2. (12) and with follow-up days 24+ months	48 438	0.054

All percentages are relative to all patients enrolled, ie, 89 994 604.

Rates of switching index medication were 10% or less in all groups (Table 7), though rates of switching were lower in the BPH groups than in the OAB groups (6.9% vs 9.4%). Switching was highest among women with OAB, particularly in the older age group (10%).

4 | DISCUSSION

Among several surprising findings we noted that the overall diagnosis rate of both OAB and BPH was extremely low. We included numerous specific symptoms to diagnose OAB, including urinary incontinence and urinary frequency. In addition, for men with BPH, we also included urinary retention as a symptom of BPH. Despite our broad inclusion criteria, overall one-time diagnosis rates were only 3.3% for OAB and 2.3% for BPH. The rates of diagnosis of BPH and OAB we found are comparable to those previously found in the Veteran's Administration (VA) system as part of the Urologic Diseases in America Project, 4 811 per 100 000 veterans with BPH (4.8%) and 2 161 per 100 000 with urinary incontinence (including OAB, 2.2%).[12] These diagnosis rates are rather low, given the high known prevalence rates of these conditions found in other studies.[13–15] The National OAB Evaluation (NOBLE) program found prevalence to be similar between men (16.0%) and women (16.9%).[15] Our (low) incidence rate may suggest that many of the people with OAB or BPH symptoms do not seek care for them. Though the current study is not meant to measure prevalence, the discrepancy between national prevalence rates and diagnosis rates suggest under diagnosis of both conditions. Low rate of diagnosis for OAB and BPH are likely multifactorial. It is possible that patients in the cohort with symptoms are not bringing them to their providers' attention, or perhaps they discuss symptoms with their provider, but the symptoms do not warrant a separate ICD code diagnosis. It is also possible that the physician does not address the problem (due to lack of time or lack of knowledge). Alternatively, patients may choose not to take medication, evne if bothered. It is also possible that patients with milder symptoms elect not to discuss their symptoms with their provider at all.

A total of 38 909 (24.2%) patients with a new OAB diagnosis were prescribed OAB medication, including 31 701 women (19.7%) and 7 208 men (4.5%). Despite multiple medications on the market, the most commonly used drug was oxybutynin, possibly due to lower cost, better coverage of this agents on insurance plans, and prior provider experience with this agent. The fact that so little medication was prescribed to patients diagnosed with OAB symptoms suggests that providers may not be comfortable prescribing these medications, especially to men. Although the risk of retention from anticholinergics is extremely low (<1%),[16] even in men with known BPH, generalists may be less likely to treat OAB symptoms in men because of a theoretically higher risk of retention due to the presence of an obstructing prostate. In the case of BPH, a larger minority (40.3%) was prescribed medication, either an alpha-blocker or a 5-alpha reductase inhibitor. One reason for not prescribing medication in the majority of men with BPH may be that patients choose not to take medication for mild symptoms. Although alpha-blockers were the most popular BPH agents, 5-alpha reductase

TABLE 3 OAB patients' baseline demographic

Baseline demographic characteristics	Overall $N = 38\,909$	Females $N = 31\,701$	Females, 18-64 years old $N = 19\,783$	Females, 65 + year old $N = 11\,918$	Males $N = 7\,208$	Males, 18-64 years old $N = 3\,480$	Males, 65 + year old $N = 3\,728$
Age							
Mean (standard deviation)	61.73 (15.25)	60.92 (15.22)	51.41 (9.85)	76.71 (7.47)	65.31 (14.87)	52.84 (10.22)	76.95 (7.02)
Median	61.00	60.00	53.00	76.00	66.00	56.00	77.00
Geographic region							
Northeast region	4 844 (12.45%)	3 725 (11.75%)	2 154 (10.89%)	1 571 (13.18%)	1 119 (15.52%)	525 (15.09%)	594 (15.93%)
North central region	11 245 (28.90%)	9 042 (28.52%)	5 372 (27.15%)	3 670 (30.79%)	2 203 (30.56%)	1 015 (29.17%)	1 188 (31.87%)
South region	14 245 (36.61%)	11 881 (37.48%)	8 347 (42.19%)	3 534 (29.65%)	2 364 (32.80%)	1 267 (36.41%)	1 097 (29.43%)
West region	8 274 (21.27%)	6 791 (21.42%)	3 691 (18.66%)	3 100 (26.01%)	1 483 (20.57%)	644 (18.51%)	839 (22.51%)
Unknown region	301 (0.77%)	262 (0.83%)	219 (1.11%)	43 (0.36%)	39 (0.54%)	29 (0.83%)	10 (0.27%)
Insurance plan							
Employer	29 148 (74.91%)	23 435 (73.93%)	13 138 (66.41%)	10 297 (86.40%)	5 713 (79.26%)	2 416 (69.43%)	3 297 (88.44%)
Health plan	9 761 (25.09%)	8 266 (26.07%)	6 645 (33.59%)	1 621 (13.60%)	1 495 (20.74%)	1 064 (30.57%)	431 (11.56%)
Type of benefit plan							
Missing/unknown	944 (2.43%)	775 (2.44%)	553 (2.80%)	222 (1.86%)	169 (2.34%)	91 (2.61%)	78 (2.09%)
Comprehensive	8 879 (22.82%)	6 762 (21.33%)	966 (4.88%)	5 796 (48.63%)	2 117 (29.37%)	187 (5.37%)	1 930 (51.77%)
Exclusive provider organization (EPO)	282 (0.72%)	233 (0.73%)	226 (1.14%)	7 (0.06%)	49 (0.68%)	46 (1.32%)	3 (0.08%)
Health maintenance organization (HMO)	6 518 (16.75%)	5 487 (17.31%)	3 696 (18.68%)	1 791 (15.03%)	1 031 (14.30%)	586 (16.84%)	445 (11.94%)
Point of service (POS)	2 525 (6.49%)	2 069 (6.53%)	1 657 (8.38%)	412 (3.46%)	456 (6.33%)	330 (9.48%)	126 (3.38%)
Preferred provider organization (PPO)	18 355 (47.17%)	15 193 (47.93%)	11 516 (58.21%)	3 677 (30.85%)	3 162 (43.87%)	2 021 (58.07%)	1 141 (30.61%)
POS with capitation	113 (0.29%)	87 (0.27%)	82 (0.41%)	5 (0.04%)	26 (0.36%)	24 (0.69%)	2 (0.05%)
Consumer-directed health plan (CDHP)	984 (2.53%)	832 (2.62%)	828 (4.19%)	4 (0.03%)	152 (2.11%)	149 (4.28%)	3 (0.08%)
High-deductible health plan (HDHP)	309 (0.79%)	263 (0.83%)	259 (1.31%)	4 (0.03%)	46 (0.64%)	46 (1.32%)	0 (0.00%)

TABLE 4 BPH male patients' baseline demographics

Baseline demographic characteristics	Overall $N = 69\,079$	18-64 years old $N = 36\,336$	65 + years old $N = 32\,743$
Age			
Mean (standard deviation)	65.54 (11.12)	56.88 (5.88)	75.14 (6.88)
Median	64.00	58.00	74.00
Geographic region			
Northeast region	9 126 (13.21%)	4 426 (12.18%)	4 700 (14.35%)
North central region	19 146 (27.72%)	8 928 (24.57%)	10 218 (31.21%)
South region	25 131 (36.38%)	15 155 (41.71%)	9 976 (30.47%)
West region	15 265 (22.10%)	7 524 (20.71%)	7 741 (23.64%)
Unknown region	411 (0.59%)	303 (0.83%)	108 (0.33%)
Insurance plan			
Employer	54 419 (78.78%)	25 556 (70.33%)	28 863 (88.15%)
Health plan	14 660 (21.22%)	10 780 (29.67%)	3 880 (11.85%)
Type of benefit plan			
Missing/unknown	1 662 (2.41%)	910 (2.50%)	752 (2.30%)
Comprehensive	18 413 (26.65%)	2 245 (6.18%)	16 168 (49.38%)
Exclusive provider organization (EPO)	511 (0.74%)	476 (1.31%)	35 (0.11%)
Health maintenance organization (HMO)	10 719 (15.52%)	6 288 (17.31%)	4 431 (13.53%)
Point of service (POS)	4 160 (6.02%)	3 011 (8.29%)	1 149 (3.51%)
Preferred provider organization (PPO)	31 382 (45.43%)	21 236 (58.44%)	10 146 (30.99%)
POS with capitation	225 (0.33%)	199 (0.55%)	26 (0.08%)
Consumer-directed health plan (CDHP)	1 519 (2.20%)	1 492 (4.11%)	27 (0.08%)
High-deductible health plan (HDHP)	488 (0.71%)	479 (1.32%)	9 (0.03%)

TABLE 5 Type of index OAB medication during the follow-up period

Index OAB medication	Overall $N = 38\,909$	All male $N = 7\,208$	Male 18-64 years old $N = 3\,480$	Male 65 + year old $N = 3\,728$	All female $N = 31\,701$	Female 18-64 years old $N = 19\,783$	Female 65 + year old $N = 11\,918$
Darifenacin	3 227 (8.29%)	584 (8.10%)	234 (6.72%)	350 (9.39%)	2,643 (8.34%)	1 508 (7.62%)	1 135 (9.52%)
Fesoterodine	2 662 (6.84%)	527 (7.31%)	273 (7.84%)	254 (6.81%)	2 135 (6.73%)	1 360 (6.87%)	775 (6.50%)
Mirabegron	61 (0.16%)	14 (0.19%)	5 (0.14%)	9 (0.24%)	47 (0.15%)	23 (0.12%)	24 (0.20%)
Oxybutynin	12 896 (33.14%)	2 373 (32.92%)	1 155 (33.19%)	1 218 (32.67%)	10 523 (33.19%)	6 542 (33.07%)	3 981 (33.40%)
Solifenacin	11 726 (30.14%)	2 304 (31.96%)	1 205 (34.63%)	1 099 (29.48%)	9 422 (29.72%)	6 283 (31.76%)	3 139 (26.34%)
Tolterodine	6 802 (17.48%)	1 074 (14.90%)	492 (14.14%)	582 (15.61%)	5 728 (18.07%)	3 439 (17.38%)	2 289 (19.21%)
Trospium	1 535 (3.95%)	332 (4.61%)	116 (3.33%)	216 (5.79%)	1 203 (3.79%)	628 (3.17%)	575 (4.82%)

TABLE 6 Type of index BPH medication during the follow-up

Index BPH medication	Overall *N* = 69 079	18-64 years old *N* = 36 336	65 + years old *N* = 32 743
Alfuzosin	4 035 (5.84%)	2 646 (7.28%)	1 389 (4.24%)
Doxazosin	5 363 (7.76%)	2 786 (7.67%)	2 577 (7.87%)
Dutasteride	6 894 (9.98%)	3 341 (9.19%)	3 553 (10.85%)
Dutasteride/tamsulosin	1 503 (2.18%)	889 (2.45%)	614 (1.88%)
Finasteride	8 918 (12.91%)	3 627 (9.98%)	5 291 (16.16%)
Mirabegron	24 (0.03%)	11 (0.03%)	13 (0.04%)
Prazosin	256 (0.37%)	106 (0.29%)	150 (0.46%)
Silodosin	2 120 (3.07%)	1 382 (3.80%)	738 (2.25%)
Tamsulosin	33 472 (48.45%)	18 432 (50.73%)	15 040 (45.93%)
Terazosin	6 494 (9.40%)	3 116 (8.58%)	3 378 (10.32%)

inhibitors were prescribed (either alone or in combination with alpha blockers) in 25% of men treated with medication. In fact, after tamsulosin, finasteride, and dutasteride were the two most commonly prescribed BPH medications.

The literature supports generally good compliance with both alpha-blockers and 5-alpha reductase inhibitors,[17] In fact, Shortridge et al analyzed electronic health records of 1 807 men with LUTS/BPH and identified 4-year persistence of BPH medication to be 48%. There is evidence in the literature of poor compliance with anticholinergic medication for OAB,[18] Similar to our study, Wagg et al in the United Kingdom (UK) found that older adults (patients age 60+) were more likely to persist with OAB medication than those <age 60. This combination of better efficacy and fewer side effects of BPH, compared to OAB medications, likely explains the better persistence we identified. What our dataset did not capture were reasons for cessation of medication. We assume that cessation of medication may be due to poor efficacy and/or intolerable side effects. However, it may be that, at least in some patients, symptoms of OAB remit and patients no longer need medication.[19]

Among men with a diagnosis of BPH in this study, persistence was higher among men age 65+ than among younger men. This might be due to the fact that BPH symptoms worsen over time, so older men are more compliant in order to maintain symptom control. It may also be possible that men become more compliant with medication as they age. The rate of medication switching was low for both OAB and BPH, yet suggests that patients are more likely to stop medication altogether than switch. The fact that switching was slightly higher in the OAB group is consistent with the higher discontinuation rate in this group. Patients who are unsatisfied (either from poor efficacy or poor tolerability) may be more likely to stop a medication and try a new one. Also, there are more OAB

TABLE 7 OAB and BPH treatment usage patterns during the follow-up period

OAB medications	Overall *N* = 38 909	Males *N*=7 208	Males 18-64 years *N* = 3 480	Males 65 + years *N* = 3 728	Females *N* = 31 701	Females 18-64 years *N* = 19 783	Females 65 + years *N* = 11 918
Continued	13 098 (33.66%)	2 538 (35.21%)	1 131 (32.50%)	1 407 (37.74%)	10 560 (33.31%)	6 364 (32.17%)	4 196 (35.21%)
Discontinued	22 169 (56.98%)	4 074 (56.52%)	2 078 (59.71%)	1 996 (53.54%)	18 095 (57.08%)	11 565 (58.46%)	6 530 (54.79%)
Switched	3 642 (9.36%)	596 (8.27%)	271 (7.79%)	325 (8.72%)	3 046 (9.61%)	1 854 (9.37%)	1 192 (10.00%)
BPH medications	**Overall (males only) *N* = 69 079**	**Males *N* = 69 079**	**Males 18-64 years *N* = 36 336**	**Males65 + years *N* = 32 743**	**N/A**	**N/A**	**N/A**
Continued	38 762 (56.11%)	38 762 (56.11%)	18 600 (51.19%)	20 162 (61.58%)	N/A	N/A	N/A
Discontinued	25 585 (37.04%)	25 585 (37.04%)	15 102 (41.56%)	10 483 (32.02%)	N/A	N/A	N/A
Switched	4 732 (6.85%)	4 732 (6.85%)	2 634 (7.25%)	2 098 (6.41%)	N/A	N/A	N/A

medications on the market, likely leading to more switching between medication options.

Limitations common to observational studies involving Electronic Health Records (EHR) data also apply to this study, including problems with missing data. We relied on diagnosis codes, which do not reflect symptom severity, and may not always be accurate. Also, our means to define discontinuation and switching may not accurately reflect true patterns of medication usage. Many patients try samples of a medication without receiving a prescription. We also could not differentiate between short-acting versus long-acting formulations of OAB medications and we lacked information on the time of day medications were prescribed. Both of these factors could affect persistence rates. Because this study uses data from the Truven claims database only, the results may not be generalized to all patients with OAB or BPH. Nonetheless, the patterns of care elucidated here identify areas where improvement of care is needed in the care of patients, men in particular, with OAB. Despite the low rate of retention when anticholinergics are given to men with BPH,[20] there remains a lack of anticholinergic prescribing for this population.

5 | CONCLUSIONS

In conclusion, we found that medication persistence was higher with BPH than OAB medications overall, whereas switching rates were higher in the OAB group. The lower persistence of OAB medication may be due to less efficacy or tolerability. The possibility of under treatment of OAB also warrants future investigations.

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APPENDIX 1. THE INTERNATIONAL CLASSIFICATION OF DISEASES, 9TH REVISION, CLINICAL MODIFICATION (ICD-9-CM) CODES

Overactive Bladder (OAB) Syndrome

- 596.51 Hypertonicity of bladder
- 788.30 Urinary incontinence, unspecified
- 788.3 Urinary incontinence
- 788.31 Urge incontinence
- 788.33 Mixed incontinence (urge and stress)
- 788.34 Incontinence without sensory awareness
- 788.35 Post-void dribbling
- 788.36 Nocturnal enuresis
- 788.37 Continuous leakage
- 788.38 Overflow incontinenc
- 788.39 Other urinary incontinence
- 788.41 Urinary frequency
- 788.42 Polyuria
- 788.43 Nocturia
- 788.63 Urgency of urination
- 788.91 Functional urinary incontinence

Benign Prostatic Hyperplasia (BPH)

- 600.x Hyperplasia of prostate
- 596.0 Bladder neck obstruction
- 788.20 Urinary retention
- 788.21 Urinary retention with bladder neck obstruction/ incomplete bladder

APPENDIX 2. NATIONAL DRUG CODE DIRECTORY (NDC) CODES FOR OAB

Antimuscarinics

- Oxybutynin (or Ditropan and Ditropan XL)–NDC 00591-0779 and NDC 0121-0671-16
- Tolterodine (or Detrol and Detrol LA)–NDC 0093-2056-06 and NDC 00093-2056-42
- Darifenacin (or Enablex)–NDC 0430-0171and NDC 35356-272
- Solifenacin (or VesiCare)–NDC 51248-150
- Trospium (or Sanctura)–NDC 00574-0145
- Fesoterodine (or Toviaz)–NDC 0069-0242

Beta-3 Agonist

- Mirabegron (or Myrbetriq) NDC 0469-2601

APPENDIX 3. NATIONAL DRUG CODE DIRECTORY (NDC) CODES FOR BPH

Beta-3 Agonist

- Mirabegron (or Myrbetriq)–NDC 0469-2601

Alpha-blockers

- Prazosin (or Minipress)–NDC 0093-4068-01
- Terazosin (or Hytrin)–NDC 00179-1359
- Doxazosin (or Cardura and Cardura XL)–NDC 0093-8120-93
- Tamsulosin (or Flomax)–NDC 00228-2996 and NDC 12838-0058
- Silodosin (or Rapaflo)–NDC 52544-152-19
- Alfuzosin (or Uroxatral)–NDC 13668-021-64
- Proscar (Finasteride)–NDC 0006-0072-31 and NDC 0006-0072-58
- Avodart (Dutasteride)–NDC 0173-0712-02, NDC 0173-0712-04, NDC 0173-0712-15, NDC 35356-210-30, NDC 54868-5114-0, NDC 54868-5114-1
- Jalyn (Dutasteride/Tamsulosin)–NDC 0173-0809-13, NDC 0173-0809-59, NDC 0173-0809-61 and NDC 54868-6328-0