Antimuscarinic Discontinuation in Patients with Overactive Bladder in Nursing Homes: A Retrospective Study of Medicare Beneficiaries

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ABSTRACT

Introduction: Although antimuscarinics form the first-line therapy in overactive bladder (OAB), little is known regarding antimuscarinic discontinuation among OAB patients in nursing homes. This study examined treatment patterns and predictors of antimuscarinic discontinuation among long-term nursing home (LTNH) residents with OAB.

Methods: The study cohort included LTNH residents (defined as residents staying ≥ 101 consecutive days) from the Minimum Data Set linked 2013–2015 Medicare claims data. Patients with OAB were defined by OAB-related claims and medication codes. Treatment patterns and discontinuation (medication gap ≥ 30 days) were characterized by examining OAB-specific antimuscarinics prescribed during LTNH stays. The Andersen Behavioral Model was used to identify predisposing, enabling and need factors that predict discontinuation. Kaplan-Meier curves and multivariable Cox proportional hazards regression model were used to assess the unadjusted and adjusted times to discontinuation, respectively, among different antimuscarinics.

Results: The mean age of the study cohort (n = 11,012) was 81.6 years (± 8.5), 74.6% were female, and 89.8% were non-Hispanic White. The mean duration of nursing home stay was 530.1 (± 268.4) days. The most commonly prescribed OAB-specific antimuscarinic was oxybutynin (69.8%). Overall, 66.5% of the study cohort discontinued the index antimuscarinic. Multivariable Cox PH regression analysis revealed that compared to LTNH residents who initiated treatment with oxybutynin, treatment discontinuation was lower with solifenacin or fesoterodin and discontinuation was more frequent when treatment was initiated with tolterodine, darifenacin or trospium compared with oxybutynin. In addition, several need factors (comorbidities, medication use and anticholinergic burden, etc.) were associated with antimuscarinic discontinuation.

Conclusion: About two-thirds of LTNH residents with OAB discontinued their index antimuscarinic during their nursing home stay. There was significant variation in discontinuation based on the index antimuscarinic agent...
with lowest risk of discontinuation with solifenacin and fesoterodin. Concerted efforts to optimize antimuscarinic use are needed to improve the management of OAB in nursing homes.

**Keywords:** Adherence; Antimuscarinic; Overactive bladder; Nursing home; Urology

### Key Summary Points

**Why carry out this study?**

Antimuscarinics are the front-line pharmacotherapy for overactive bladder (OAB), but there is a paucity of data on treatment persistence in this setting.

The objective of the present study was to examine treatment patterns and to assess the medication discontinuation among different antimuscarinics in long-term nursing home (LTNH) residents with OAB.

**What was learned from the study?**

A low proportion of LTNH residents with OAB under the fee-for-service Medicare plan is prescribed antimuscarinics.

Antimuscarinic discontinuation during nursing home stay was high among LTNH residents with OAB.

Discontinuation varied based on the index antimuscarinic agent, with the lowest risk of discontinuation among LTNH residents who were prescribed solifenacin and fesoterodin.

### INTRODUCTION

In 2014, there were an estimated 1.4 million nursing homes residents in the USA [1]. Although nursing home residents may vary in terms of their physical and mental ability and capacity for self-care, residents on average have a higher disease burden compared with community-dwelling individuals [2]. Urinary incontinence (UI) is a symptom accompanying many conditions common among older adults, affecting as many as 50–70% of nursing home residents [3, 4]. Many cases of UI are associated with overactive bladder (OAB), a clinically defined symptom complex characterized by urgency with or without incontinence, often accompanied by frequency and nocturia [5, 6]. In a large claims-based study, nursing home residents with OAB and/or UI had a higher prevalence of depression (47.7% vs. 32.4%), cerebrovascular accidents (20.4% vs. 10.4%) and dementia (40.8% vs. 35.4%) compared with those without OAB and/or UI [7]. In addition to the clinical burden associated with OAB among nursing home residents, the economic burden is substantial. Although recent data are lacking, in 2000, the total direct cost of OAB in nursing homes, including diagnostic, treatment, routine care and health-related consequences (i.e., falls, skin conditions and urinary tract infections), was estimated at 3.5 billion (year 2000 USD) [8].

Antimuscarinics such as oxybutynin, tolterodine, solifenacin, darifenacin, fesoterodine and trospium are approved as a first-line pharmacotherapy for OAB in the US, and, when used appropriately, are an effective and well-tolerated treatment that improves quality of life in patients with OAB [9]. Although there are limited data on pharmacotherapy treatments for OAB in nursing homes, antimuscarinics appear to be widely used [7]. In a retrospective analysis of nursing home residents, almost 80% of those with OAB were treated with an antimuscarinic (primarily oxybutynin extended-release) [7]. Despite their effectiveness at managing OAB symptoms, adherence (often defined as patients who take at least 80% of their prescribed medication or a medication possession ratio [MPR] \( \geq 0.8 \)) [10] to antimuscarinics is low [11, 12]. Among community-dwelling OAB patients, estimates of antimuscarinic adherence range from 14 to 35% [11, 12]. In a national survey, dissatisfaction with treatment effectiveness and side effects, which can include dry mouth, blurred vision, headache and constipation, have been cited as reasons for OAB treatment discontinuation [13]. Based on a systematic review, the treatment discontinuation rate among OAB patients was reported in the range of 43–83% [14].
To date, most studies on antimuscarinics have focused on adherence and have been conducted among community-dwelling individuals [11, 12, 15]; there is thus a paucity of data regarding antimuscarinic discontinuation among nursing home residents with OAB. Only one study examined discontinuation in US outpatient settings and found that 72% discontinued their antimuscarinics, suggesting a significant need to improve adherence [16]. Although it would seem likely that persistence and/or adherence to OAB medications among nursing home residents would be high, given the extensive nursing and supportive care, discontinuation of antimuscarinics and the factors associated with antimuscarinic discontinuation have not been examined in this setting.

Given the high frequency of UI/OAB in nursing home populations and the associated high clinical and economic burden, understanding treatment discontinuation in nursing homes may help improve adherence and quality of care for patients with OAB. Therefore, the objective of the present study was to examine treatment patterns and to characterize antimuscarinic discontinuation in long-term nursing home (LTNH) residents with OAB.

METHODS

Data Source

The Minimum Data Set (MDS) linking 2013–2015 Medicare claims data involving Part A, B and D claims [17, 18] was used to examine treatment patterns and predictors of antimuscarinic discontinuation among LTNH residents with OAB. The MDS is a federally mandated nursing home health assessment tool for all residents in Medicare/Medicaid-certified nursing facilities. It is administered to all nursing home residents within 14 days of admission and at quarterly intervals thereafter. It captures detailed information on physical, psychologic and psychosocial functioning and active clinical diagnosis, health conditions, treatments and services. It also provides information on patient’s cognitive functioning and behavioral problems. Medicare Part A covers hospital care, initial care in skilled nursing facilities, hospice care and home health care. Part B covers services such as laboratory, ambulance, outpatient mental health and other physician services that are not included in Part A. Each Part A and Part B record contains up to ten diagnoses recorded according to International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. Part D, launched in 2006, covers prescription benefits for Medicare beneficiaries. Each Part D Prescription Drug Event claim comprises information on prescription drug fills, including drug name, fill date, days of supply and quantity.

The study protocol was approved by the University of Houston Committee for the Protection of Human Subjects. Informed consent was not required given the deidentified nature of the data and feasibility considerations for a large retrospective database such as Medicare.

Study Design and Population

The retrospective cohort consisted of LTNH residents diagnosed with OAB. LTNH residents were defined based on a previously validated MDS/Skilled Nursing Facility algorithm as residents with at least one nursing home episode lasting at least 101 consecutive days [19]. Patients were included in the cohort using a step-wise process if they met the following criteria: (1) ≥ 65 years of age at index date, which was defined as the first long-stay nursing home admission date; (2) at least one claim with an OAB diagnosis either during the nursing home episode or prior (identified based on previously published lists of ICD-9-CM codes) [12, 20, 21] or at least one prescription claim for OAB-specific medication (antimuscarinics, mirabegron or onabotulinumtoxinA specific for bladder usage) during nursing home stay (Supplementary Table 1); (3) Parts A, B and D coverage in the 3 months before the nursing home admission and until the end of the nursing home stay; (4) newly initiated antimuscarinic medication claims lasting at least 30 days continuously during nursing home stay.
Outcome Measures

Antimuscarinics initiated during the nursing home stay were used to examine treatment patterns. Antimuscarinic medications were operationally defined using the American Hospital Formulary Service classification system and identified using National Drug Codes (NDC) [22]. Antimuscarinic medications included darifenacin, fesoterodine, oxybutynin, solifenacin, tolterodine and trospium. Treatment discontinuation was defined as the treatment gap of 30 days between prescription refills prior to nursing home discharge date [23, 24]. Accordingly, patients were categorized into two groups: those who discontinued the index antimuscarinic medication and those who did not discontinue the index antimuscarinic medication [25].

Conceptual Framework

A multivariable Cox proportional hazards (PH) regression analysis was performed to assess the time to discontinuation of antimuscarinic medication among OAB patients. The Andersen Behavioral Model (ABM) was used to guide selection of independent variables in the analysis [26, 27]. This model postulates that an individual’s use of health services is a function of predisposing, enabling and need characteristics [26, 27]. Variables corresponding to these factors were selected based on the published literature and data available in the Medicare claims and the MDS [11, 28]. Predisposing factors are the characteristics of an individual that were in existence before the illness and included age, gender, race/ethnicity and marital status. Enabling factors are related to the ability of an individual to secure the healthcare services and included region, Medicare-Medicaid dual eligibility and urban/rural area. Urban/rural area was captured using MDS as the data source. The urban/rural distinction was based on the location of nursing home facility. The need factors describe the perceived and actual health status of an individual. The need variables were captured from both the Medicare claims and the MDS. These included index antimuscarinic agent, comorbidities measured using the Elixhauser comorbidity scores [29] and falls, prescription medication use (such as antidepressants, diuretics, beta-blockers, calcium channel blockers, anticonvulsants, angiotensin converting enzyme [ACE] inhibitors, antipsychotics, antiparkinson agents and alpha-blockers), anticholinergic burden (measured using the Anticholinergic Cognitive Burden [ACB] scale [30]) and body mass index (BMI). All variables were measured 3 months prior to the first long-stay nursing home admission date. Need characteristics for the ABM were also determined based on the MDS assessment recorded at nursing home admission. These included the presence of urinary or bowel incontinence (defined as always continent, occasionally incontinent, frequently incontinent, always incontinent or not rated, the former of which has been used to characterize patients with urinary incontinence in several studies [31]), bladder continence management (i.e., use of an indwelling/external catheter, ostomy and/or intermittent catheterization), urinary toileting program, response to toileting program, current toileting program or trial, depressed mood indicator and scores on the Cognitive Performance Scale (CPS) [32] and Activities of Daily Living (ADL) scale [33]. Using the CPS, a higher score is indicative of greater impairment, ranging from 0 (intact cognition) to 6 (severe cognitive impairment). Mild cognitive impairment is associated with a score of 2. A higher score on the ADL is indicative of greater impairment/dependence [33]. Using the ADL, an individual’s independence is graded as dependent [4–6], limited/extensive assistance [7–9] and independent [10–18]. Due to the higher number of missing values, UI-specific measures (i.e., use of an indwelling/external catheter, ostomy, intermittent catheterization) were not included in the multivariable Cox PH regression model.

Statistical Analysis

Descriptive statistics were used to characterize LTNH residents with OAB and antimuscarinic use. For the study cohort, the discontinuation
rate based on the index antimuscarinic medication was reported. Categorical and continuous patient characteristics were compared among patients who discontinued the index antimuscarinic medication versus those who did not discontinue, using chi-square and student’s t-tests, respectively. Time to discontinuation between different antimuscarinic users was compared using Kaplan-Meier curves and log-rank test. Proportionality hazards assumption was confirmed using the Schoenfeld test. Multivariable Cox proportional hazards regression analysis was performed to assess the risk of discontinuation among different antimuscarinic medications with time to discontinuation as the dependent variable. Independent variables were predisposing, enabling and need characteristics based on the ABM framework. Death and loss to follow-up due to lack of insurance coverage were considered as censoring criteria. All relevant variables available in the data set were included in the model.

All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC) with statistical significance set at an a priori- specified level of 0.05.

RESULTS

Study Population

Figure 1 describes the process of cohort derivation. A total of 250,016 LTNH residents ≥ 65 years of age with evidence of OAB and continuous enrollment were initially identified. From this group, 11,012 (4.4%) LTNH residents were newly initiated with antimuscarinic prescription for OAB and had continuous supply of medication for at least 30 days dispensed during the LTNH stay. The mean (± SD) age of the cohort was 81.6 (± 8.5) years. The cohort consisted of 74.6% women and 89.8% non-Hispanic whites. Most of the patients were from South (37.4%) and Midwest (33.5%) regions and resided in urban areas (70.2%). Frequently reported comorbidities included hypertension (80.4%), cardiac arrhythmias (40.7%), diabetes (37.6%) and fluid and electrolyte disturbances (33.4%). The most frequently prescribed medications were antidepressants (47.4%), beta-blockers (41.5%) and diuretics (36.3%). The mean (± SD) ACB score of the cohort pre-index was 0.7 (± 1.4). This was a pre-index measure of anticholinergic burden. Additional characteristics of the study cohort are summarized in Table 1. The mean duration of nursing home stay was 530.1 (± 268.4) days.

Admission MDS assessments of LTNH residents with OAB revealed that 23.5% had UI frequently (i.e., incontinent seven or more episodes over a 7-day look-back period) and 37.1% had bowel continence constantly. Data on UI were missing for 22.2%. Approximately two-thirds (66.8%) of patients did not require any bladder continence management and 11.1% required some kind of continence management—including an indwelling/external catheter (9.7%), ostomy (1.9%) and intermittent catheterization (0.3%). Approximately 10.1% of the patients required a urinary toileting program (i.e., scheduled training, prompted voiding and bladder training). However, only 1.1% were completely dry (i.e., continent) or showed decreased wetness (i.e., whereby urinary incontinence frequently decreased) following the toileting program. The majority of patients had intact cognition (88.3%) but just over half (51.1%) were dependent on their ADLs (Table 1).

OAB Treatment and Antimuscarinic Discontinuation

About 4.4% (n = 11,012) of the LTNH residents were newly initiated with antimuscarinics with supply lasting at least 30 days continuously. Oxybutynin (69.8%) was the most commonly prescribed antimuscarinic, followed by tolterodine (13.0%) and solifenacin (12.3%) (Table 2). About 67% (n = 7319) of the study cohort was identified to have discontinued the index antimuscarinic medication during their nursing home stay, and while the median days to discontinuation was 61 (interquartile range [IQR]: 31–121) days, the mean (standard deviation) days to discontinuation was 99.9 (± 105.8) days. Discontinuation rate based on the index medication in the order were darifenacin...
(78.8%), trospium (78.2%), tolterodine (70.8%), oxybutynin (66.4%), fesoterodine (61.4%) and solifenacin (59.8%) (Table 2).

The Kaplan-Meier curve with discontinuation probabilities of antimuscarinic medication over time is shown in Fig. 2. Discontinuation of antimuscarinics varied solely based on the need characteristics (Table 3). Results from the multivariable Cox PH regression model revealed that LTNH residents who initiated with solifenacin (Hazard Ratio (HR) 0.79, 95% CI 0.73–0.85) and darifenacin (HR 0.82, 95% CI 0.68–0.99) were less likely to discontinue medication, while patients who started with tolterodine (HR 1.11, 95% CI 1.03–1.18), darifenacin (HR 1.33, 95% CI 1.06–1.67) and trospium (HR 1.44, 95% CI 1.24–1.66) were more likely to discontinue medication compared to those who were started with oxybutynin. Patients who had liver disease (HR 0.82, 95% CI 0.71–0.94), antipsychotic use (HR 0.93, 95% CI 0.86–0.99) and participated in a urinary toileting program (HR 0.75, 95% CI 0.58–0.97) were less likely to discontinue antimuscarinics than their counterparts, whereas LTNH residents with severe cognitive impairment (HR 1.25, 95% CI 1.10–1.42), dependent on ADL (HR 1.13, 95% CI 1.04–1.23) and occasionally bowel incontinent (HR 1.09, 95% CI 1.01–1.19) were more likely to discontinue antimuscarinics compared to their counterparts. For every unit increase in the pre-index ACB burden, there was a 4%
**Table 1** Demographics of long-term nursing home residents with OAB, overall and by discontinuation status

| Characteristic                      | Total (11,012) | Discontinued (7,319, 66.46%) | Not discontinued (3,693, 33.54%) | P value |
|-------------------------------------|----------------|------------------------------|----------------------------------|---------|
|                                     | n               | Percent (%)                  | n                                | Percent (%) | n                   | Percent (%) |       |
| Predisposing factors                |                |                              |                                  |          |                     |             |       |
| Age (mean ± SD)                     | 81.57 ± 8.52   | 81.5 ± 8.49                  | 81.7 ± 8.56                      | 0.313    |
|                                     | 65–75 years    | 2621 (23.80%)                | 1764 (24.10%)                    | 857 (23.21%) | 1305 (35.34%) |          | 0.568  |
|                                     | 75–85 years    | 3875 (35.19%)                | 2570 (35.11%)                    | 1305 (35.34%) |              |          |        |
|                                     | ≥ 85 years     | 4516 (41.01%)                | 2985 (40.78%)                    | 1531 (41.46%) |              |          |        |
| Gender                              |                |                              |                                  |          |                     |             |       |
| Male                                | 2799 (25.42%)  | 1877 (25.65%)                | 922 (24.97%)                     | 0.44     |
| Female                              | 8213 (74.58%)  | 5442 (74.35%)                | 2771 (75.03%)                    |          |
| Race/ethnicity                      |                |                              |                                  |          |                     |             |       |
| Non-Hispanic White                  | 9891 (89.82%)  | 6540 (89.36%)                | 3351 (90.74%)                    | 0.139    |
| Non-Hispanic Black                  | 734 (6.67%)    | 514 (7.02%)                  | 220 (5.96%)                      |          |
| Hispanics                           | 123 (1.12%)    | 83 (1.13%)                   | 40 (1.08%)                       |          |
| Others                              | 264 (2.40%)    | 182 (2.49%)                  | 82 (2.22%)                       |          |
| Marital status                      |                |                              |                                  | 0.82     |
| Unmarried (single/widowed)          | 8415 (76.42%)  | 5580 (76.24%)                | 2,835 (76.77%)                   |          |
| Married                             | 2529 (22.97%)  | 1694 (23.15%)                | 835 (22.61%)                     |          |
| Others                              | 68 (0.62%)     | 45 (0.61%)                   | 23 (0.62%)                       |          |
| Enabling factors                    |                |                              |                                  |          |                     |             |       |
| Medicare/Medicaid dual eligible     | 5077 (46.10%)  | 3462 (47.30%)                | 1615 (43.73%)                    | 0.004    |
| Region                              |                |                              |                                  | 0.39     |
| South                              | 4123 (37.44%)  | 2778 (37.96%)                | 1345 (36.42%)                    |          |
| Northeast                           | 2057 (18.68%)  | 1369 (18.70%)                | 688 (18.63%)                     |          |
| Midwest                             | 3688 (33.49%)  | 2420 (33.06%)                | 1268 (34.34%)                    |          |
| West                                | 1144 (10.39%)  | 752 (10.27%)                 | 392 (10.61%)                     |          |
| Urban–rural                         |                |                              |                                  | 0.377    |
| Rural                               | 3283 (29.81%)  | 2,162 (29.54%)               | 1121 (30.35%)                    |          |
| Urban                               | 7729 (70.19%)  | 5157 (70.46%)                | 2572 (69.65%)                    |          |
Table 1 continued

| Characteristic                        | Total (11,012) | Discontinued (7,319, 66.46%) | Not discontinued (3,693, 33.54%) | P value |
|---------------------------------------|----------------|-------------------------------|----------------------------------|---------|
| n                                     | Percent (%)    | n                             | Percent (%)                       |         |
| **Need factors**                      |                |                               |                                  |         |
| Index antimuscarinic prescriptionY    |                |                               |                                  | < 0.0001|
| Solifenacin                           | 1353           | 12.29%                        | 809                              | 11.05%  |
| Fesoterodin                           | 189            | 1.72%                         | 116                              | 1.58%   |
| Tolterodine                           | 1437           | 13.05%                        | 1017                             | 13.90%  |
| Tropidone                             | 243            | 2.21%                         | 190                              | 2.60%   |
| Darifenacin                           | 99             | 0.90%                         | 78                               | 1.07%   |
| Oxybutinine                           | 7691           | 69.84%                        | 5109                             | 69.80%  |
| **Elixhauser comorbidities**          |                |                               |                                  |         |
| Elixhauser Index Score (mean ± SD)    | 10.12 ± 8.77   | 9.8 ± 8.67                    | 10.7 ± 8.95                      | < 0.0001|
| Prior history of falls                | 2858           | 25.95%                        | 1833                             | 25.04%  |
| Congestive heart failure              | 3171           | 28.80%                        | 2040                             | 27.87%  |
| Cardiac arrhythmias                   | 4477           | 40.66%                        | 2,882                            | 39.38%  |
| Valvular disease                      | 1715           | 15.57%                        | 1068                             | 14.59%  |
| Pulmonary circulation disorders       | 683            | 6.20%                         | 414                              | 5.66%   |
| Peripheral vascular disorders         | 2747           | 24.95%                        | 1808                             | 24.70%  |
| Hypertension                          | 8851           | 80.38%                        | 5888                             | 80.45%  |
| Paralysis                             | 635            | 5.77%                         | 426                              | 5.82%   |
| Other neurologic disorders            | 2780           | 25.25%                        | 1860                             | 25.41%  |
| Chronic pulmonary disease             | 3404           | 30.91%                        | 2236                             | 30.55%  |
| Diabetes                              | 4137           | 37.57%                        | 2767                             | 37.81%  |
| Hypothyroidism                        | 2643           | 24.00%                        | 1746                             | 23.86%  |
| Renal failure                         | 2031           | 18.44%                        | 1325                             | 18.10%  |
| Liver disease                         | 357            | 3.24%                         | 211                              | 2.88%   |
| Peptic ulcer                          | 164            | 1.49%                         | 105                              | 1.43%   |
| AIDS/HIV                              | 14             | 0.13%                         | ***                              | ***     |
| Lymphoma                              | 91             | 0.83%                         | 58                               | 0.79%   |
| Metastatic cancer                     | 163            | 1.48%                         | 86                               | 1.18%   |
| Solid tumor without metastasis        | 782            | 7.10%                         | 501                              | 6.85%   |
| Rheumatoid arthritis                  | 622            | 5.65%                         | 407                              | 5.56%   |
| Coagulopathy                          | 510            | 4.63%                         | 329                              | 4.50%   |

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Table 1 continued

| Characteristic                      | Total (11,012) | Discontinued (7,319, 66.46%) | Not discontinued (3,693, 33.54%) | P value |
|-------------------------------------|----------------|-------------------------------|----------------------------------|---------|
|                                     | n   | Percent (%)       | n   | Percent (%)      | n   | Percent (%)      |         |
| Obesity                             | 847 | 7.69%             | 562 | 7.68%            | 285 | 7.72%            | 0.214   |
| Weight loss                         | 962 | 8.74%             | 622 | 8.50%            | 340 | 9.21%            | 0.102   |
| Fluid and electrolyte disorders     | 3682| 33.44%            | 2,409| 32.91%           | 1273| 34.47%           | 0.937   |
| Blood loss anemias                  | 222 | 2.02%             | 147 | 2.01%            | 75  | 2.03%            | 0.299   |
| Deficiency anemias                  | 1020| 9.26%             | 663 | 9.06%            | 357 | 9.67%            | 0.349   |
| Alcohol abuse                       | 185 | 1.68%             | 117 | 1.60%            | 68  | 1.84%            | 0.953   |
| Drug abuse                          | 189 | 1.72%             | 126 | 1.72%            | 63  | 1.71%            | 0.266   |
| Psychoses                           | 1905| 17.30%            | 1287| 17.58%           | 618 | 16.73%           | **0.005**|
| Depression                          | 3171| 28.80%            | 2171| 29.66%           | 1000| 27.08%           | **0.018**|
| Medication use                      |      |                  |      |                  |      |                  |         |
| Alpha-blockers                      | 228 | 2.07%             | 155 | 2.12%            | 73  | 1.98%            | 0.624   |
| Beta-blockers                       | 4564| 41.45%            | 3030| 41.40%           | 1534| 41.54%           | 0.889   |
| Calcium channel blockers            | 2984| 27.10%            | 2034| 27.79%           | 950 | 25.72%           | **0.021**|
| ACE inhibitors                      | 2985| 27.11%            | 1991| 27.20%           | 994 | 26.92%           | 0.749   |
| Diuretics                           | 3996| 36.29%            | 2632| 35.96%           | 1364| 36.93%           | 0.316   |
| Antidepressants                     | 5219| 47.39%            | 3543| 48.41%           | 1676| 45.38%           | **0.003**|
| Antipsychotics                      | 1716| 15.58%            | 1,170| 15.99%          | 546 | 14.78%           | **0.101**|
| Anticonvulsants                     | 2742| 24.90%            | 1,884| 25.74%           | 858 | 23.23%           | **0.004**|
| Antiparkinson agents                | 1130| 10.26%            | 759 | 10.37%           | 371 | 10.05%           | 0.597   |
| ACB scale (mean ± SD)               | 0.65| ± 1.35            | 0.72| ± 1.42           | 0.53| ± 1.18           | < **0.0001**|
| Body mass index*                    |      |                  |      |                  |      |                  |         |
| Underweight                         | 2878| 26.14%            | 1940| 26.51%           | 938 | 25.40%           |         |
| Normal weight                       | 482 | 4.38%             | 323 | 4.41%            | 159 | 4.31%            |         |
| Overweight                          | 2385| 21.66%            | 1600| 21.86%           | 785 | 21.26%           |         |
| Obese                               | 2686| 24.39%            | 1750| 23.91%           | 936 | 25.35%           |         |
| Missing/unknown                     | 2581| 23.44%            | 1706| 23.31%           | 875 | 23.69%           |         |
| Urinary continence*†                |      |                  |      |                  |      |                  |         |
| Always continent                    | 1835| 16.66%            | 1153| 15.75%           | 682 | 18.47%           |         |
| Occasionally incontinent            | 1932| 17.54%            | 1216| 16.61%           | 716 | 19.39%           |         |
| Frequently incontinent              | 2583| 23.46%            | 1755| 23.98%           | 828 | 22.42%           |         |
| Always incontinent†                 | 1,241| 11.27%        | 941 | 12.86%           | 300 | 8.12%            | < **0.0001**|

* Adis
### Table 1 continued

| Characteristic                                           | Total (11,012) | Discontinued (7,319, 66.46%) | Not discontinued (3,693, 33.54%) | P value |
|----------------------------------------------------------|----------------|------------------------------|----------------------------------|---------|
|                                                          | n   | Percent (%) | n     | Percent (%) | n     | Percent (%) |
| Not rated                                                | 975 | 8.85%       | 644  | 8.80%       | 331  | 8.96%       |
| Missing/unknown                                          | 2446| 22.21%      | 1610 | 22.00%      | 836  | 22.64%      |
| **Bladder continence management**                        |     |             |      |             |      |             |
| Indwelling/external catheter                             |     |             |      |             |      |             |
| Yes                                                      | 1068| 9.70%       | 703  | 9.61%       | 365  | 9.88%       |
| No                                                       | 7514| 68.23%      | 5015 | 68.52%      | 2499 | 67.67%      |
| Missing/unknown                                          | 2430| 22.07%      | 1601 | 21.87%      | 829  | 22.45%      |
| Ostomy                                                   |     |             |      |             |      |             |
| Yes                                                      | 210 | 1.91%       | 149  | 2.04%       | 61   | 1.65%       |
| No                                                       | 8372| 76.03%      | 5569 | 76.09%      | 2803 | 75.90%      |
| Missing/unknown                                          | 2430| 22.07%      | 1601 | 21.87%      | 829  | 22.45%      |
| Intermittent catheterization                            |     |             |      |             |      |             |
| Yes                                                      | 34  | 0.31%       | 19   | 0.26%       | 15   | 0.41%       |
| No                                                       | 8548| 77.62%      | 5699 | 77.87%      | 2849 | 77.15%      |
| Missing/unknown                                          | 2430| 22.07%      | 1601 | 21.87%      | 829  | 22.45%      |
| None of the above bladder appliance                      |     |             |      |             |      |             |
| Yes                                                      | 7359| 66.83%      | 4907 | 67.04%      | 2452 | 66.40%      |
| No                                                       | 1223| 11.11%      | 811  | 11.08%      | 412  | 11.16%      |
| Missing/unknown                                          | 2430| 22.07%      | 1601 | 21.87%      | 829  | 22.45%      |
| Urinary toileting program*                               |     |             |      |             |      |             |
| Yes                                                      | 1115| 10.13%      | 795  | 10.86%      | 320  | 8.67%       |
| No                                                       | 6020| 54.67%      | 4170 | 56.97%      | 1850 | 50.09%      |
| Missing/unknown                                          | 3877| 35.21%      | 2354 | 32.16%      | 1,523| 41.24%      |
| Response to toileting program*                           |     |             |      |             |      |             |
| No improvement                                           | 151 | 1.37%       | 111  | 1.52%       | 40   | 1.08%       |
| Decreased wetness                                        | 81  | 0.74%       | 61   | 0.83%       | 20   | 0.54%       |
| Completely dry (continent)                              | 39  | 0.35%       | 26   | 0.36%       | 13   | 0.35%       |
| Missing/unknown                                          | 10,741| 97.54%   | 7121 | 97.29%      | 3620 | 98.02%      |
| Current toileting program or trial*                      |     |             |      |             |      |             |
| Yes                                                      | 751 | 6.82%       | 528  | 7.21%       | 223  | 6.04%       |
| No                                                       | 515 | 4.68%       | 368  | 5.03%       | 147  | 3.98%       |
| Missing/unknown                                          | 9746| 88.50%      | 6423 | 87.76%      | 3323 | 89.98%      |
Table 1 continued

| Characteristic                          | Total       | Discontinued          | Not discontinued  | P value |
|-----------------------------------------|-------------|-----------------------|-------------------|---------|
|                                         |             | (11,012)              | (7,319, 66.46%)   |         |
|                                         | n           | Percent (%)           | n                 | Percent (%) |
| Bowel continence*                       |             |                       |                   | < 0.0001 |
| Always continent                        | 4090        | 37.14%                | 2574              | 35.17%  |
| Occasionally incontinent                | 1216        | 11.04%                | 792               | 10.82%  |
| Frequently incontinent                  | 1638        | 14.87%                | 1158              | 15.82%  |
| Always incontinent                      | 1416        | 12.86%                | 1046              | 14.29%  |
| Not rated                               | 206         | 1.87%                 | 138               | 1.89%   |
| Missing/unknown                         | 2446        | 22.21%                | 1611              | 22.01%  |
| MDS Cognition Scale*                    |             |                       |                   | < 0.0001 |
| Intact                                  | 9724        | 88.30%                | 6391              | 87.32%  |
| Mild                                    | 146         | 1.33%                 | 93                | 1.27%   |
| Moderate                                | 370         | 3.36%                 | 241               | 3.29%   |
| Moderate/severe                         | 93          | 0.84%                 | 69                | 0.94%   |
| Severe                                  | 395         | 3.59%                 | 311               | 4.25%   |
| Missing/unknown                         | 284         | 2.58%                 | 214               | 2.92%   |
| Activities of daily living*             |             |                       |                   | < 0.0001 |
| Independent                             | 2708        | 24.59%                | 1578              | 21.56%  |
| Limited/extentive assistance            | 379         | 3.44%                 | 258               | 3.53%   |
| Dependent                               | 5624        | 51.07%                | 3981              | 54.39%  |
| Missing/unknown                         | 2301        | 20.90%                | 1502              | 20.52%  |
| Depressed mood indicator*               |             |                       |                   | < 0.0001 |
| Yes                                     | 245         | 2.22%                 | 182               | 2.49%   |
| No                                      | 7637        | 69.35%                | 5,135             | 70.16%  |
| Missing/unknown                         | 3130        | 28.42%                | 2002              | 27.35%  |

ACB anticholinergic burden, AIDS/HIV acquired immune deficiency syndrome/human immune deficiency virus, LTHN long-term nursing home, MDS minimum data set, OAB overactive bladder, SD standard deviation

Significant values are bolded
*Based on MDS Admission Assessment and includes missing data
**Based on enrollment data and includes missing data
***Cannot report due to small cell size
† Categories of urinary incontinence were defined as: always continent (over a 7-day look-back period, resident was continent with urine, with no episodes of incontinence); occasionally incontinent (over a 7-day look-back period, resident was incontinent less than 7 episodes); frequently incontinent (over a 7-day look-back period, resident was incontinent 7 or more episodes); always incontinent (over a 7-day look-back period, resident had no continent episodes); not rated (over a 7-day look-back period the resident had an indwelling catheter, condom catheter, ostomy or no urine output for the entire 7 days)
‡ Index antimuscarinic prescription refers to antimuscarinic medication that patients were newly started with upon nursing home admission

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increased likelihood of discontinuing the antimuscarinic medication.

**DISCUSSION**

To our knowledge, this is the first study to characterize discontinuation among different antimuscarinics in LTNH residents with OAB. A total of 11,012 (4.4%) residents were newly started with an OAB antimuscarinic prescription during the LTNH stay. Despite the significant impact of OAB on patients’ quality of life and the availability of effective pharmacotherapies that can mitigate those symptoms, a small portion elderly LTNH residents in the current study initiated antimuscarinic medications. The low proportion of patients initiating pharmacotherapies for their OAB identified in the present study may be due to several factors including prescription costs and coverage, perceptions around antimuscarinic safety and effectiveness, inclusion of high-level anticholinergics as part of Beers criteria, patient and provider preferences as well as low rates of persistence with OAB medications [24, 34].

Consistent with the previous US-based literature [35–37], the most commonly prescribed antimuscarinics observed in the present study were oxybutynin (69.8%) followed by solifenacin (12.3%) and tolterodine (13.0%). The high percentage of oxybutynin use is consistent with Zarowitz et al. who reported that among US nursing facilities, 61.1% were treated with oxybutynin extended release [7]. The high frequency of oxybutynin prescriptions may likely be because of generic status, formulary coverage and capitated payment for initial nursing home stays. High rates of use of oxybutynin may be another example of potentially inappropriate medication use within nursing homes, especially in older populations with cognitive issues [38, 39]. In fact, according to the FORTA list, oxybutynin is rated as C/D and should be used with caution or even avoided in older populations [40]. Therefore, if behavioral options are not effective and pharmacotherapies are required given the risk of cognitive effects associated with oxybutynin, caution must be exercised prior to prescribing oxybutynin in older and/or frail adults presenting with OAB [41–44]. The high rates of oxybutynin use combined with relatively longer times to discontinuation identified in this study give reasons for concern. Although physicians were not queried in this study, it may indicate that clinicians are possibly complacent regarding these risks, especially for the older populations with cognitive issues.

As OAB usually requires long-term treatment to achieve symptom control, persistence to prescribed pharmacotherapy is important in achieving the best treatment outcomes. This study found that almost 67% of the study cohort discontinued antimuscarinic medication prior to their nursing home discharge and several need factors were associated with treatment discontinuation. Across other studies, the discontinuation rate of antimuscarinics among individuals with OAB has been estimated to be about 43–83% based on a systematic review [14, 24] and 52% to 89% from a more recent study [16]. Although persistence in nursing homes may naturally be higher compared to community-dwelling individuals because of the active involvement of care providers in medication management, it is still sub-optimal given that adherence to antimuscarinics improves quality of life in patients with OAB [45]. Although patient-reported reasons for antimuscarinic discontinuation and non-adherence could not be evaluated in the present study because of the data limitations, future research on this is needed to explore the common reasons for discontinuation and develop personalized treatment plans to optimize OAB management.

In the current study, the specific type of index antimuscarinic medication was significantly associated with antimuscarinic discontinuation. Compared to oxybutynin users, solifenacin and fesoterodine users had less risk of discontinuation, whereas tolterodine, darifenacin and trospium carried higher risk of discontinuation. However, in a study that assessed antimuscarinic discontinuation among a Medicare elderly population in a community setting, all five agents (solifenacin, fesoterodine, darifenacin, tolterodine and trospium) showed less
risk of discontinuation compared to oxybutynin [16].

In this study, 67% of LTNH residents discontinued their index antimuscarinic, which is similar to the proportion reported by Vouri et al., among community-based Medicare older adults [16]. An unexpected finding was that none of the predisposing and enabling factors contributed to antimuscarinic discontinuation in LTNH residents, which is in contrast to the aforementioned community-based study. Furthermore, in the Vouri et al. study patients with congestive heart failure, mild cognitive impairment, depression, diabetes and hypertension were all less likely to discontinue their antimuscarinics [16]. However, in the current study, none of these factors were associated with discontinuation. It is possible that differences between the two studies are due to underlying characteristics of the two populations. The presence of liver failure, obesity and utilization history of antipsychotics were all negatively associated with discontinuation, whereas use of calcium channel blockers/anti-convulsants and severe cognitive decline were positively associated with discontinuation. The current study indicated that a high anticholinergic burden was associated with higher likelihood of discontinuation. Although the overall anticholinergic burden was assessed pre-index in the present study, and therefore relatively low (0.53), it was nevertheless associated with increased discontinuation. As all of the antimuscarinics assessed in the present study would have had an ACB score of 3 had the anticholinergic burden been assessed post-treatment initiation, the results from the present study indicate that even low levels of anticholinergic burden impact persistence among OAB LTNH residents. It is, however, very
Table 3  Factors associated with discontinuation of antimuscarinic drugs in long-term nursing home residents with OAB. Results from multivariable Cox proportional hazards regression model

| Characteristic               | Adjusted hazards ratio (95% CI) | P value |
|-----------------------------|---------------------------------|---------|
| **Predisposing factors**    |                                 |         |
| Age (mean ± SD)             |                                 |         |
| 65–75 years                 | Reference                        |         |
| 75–85 years                 | 0.96 (0.90–1.02)                 | 0.176   |
| ≥ 85 years                  | 0.97 (0.90–1.04)                 | 0.391   |
| Gender                      |                                 |         |
| Male                        | Reference                        |         |
| Female                      | 0.95 (0.89–1.00)                 | 0.070   |
| Race/ethnicity              |                                 |         |
| Non-Hispanic White          | Reference                        |         |
| Non-Hispanic Black          | 1.05 (0.95–1.15)                 | 0.346   |
| Hispanics                   | 0.99 (0.79–1.23)                 | 0.906   |
| Others                      | 1.04 (0.89–1.21)                 | 0.632   |
| Marital status              |                                 |         |
| Unmarried (single/widowed)  |                                 |         |
| Married                     | 1.04 (0.98–1.10)                 | 0.214   |
| Others                      | 1.03 (0.76–1.38)                 | 0.867   |
| **Enabling factors**        |                                 |         |
| Medicare/Medicaid dual eligible | 0.98 (0.93–1.03)             | 0.460   |
| Region                      |                                 |         |
| South                       | Reference                        |         |
| Northeast                   | 0.98 (0.91–1.05)                 | 0.509   |
| Midwest                     | 1.02 (0.96–1.08)                 | 0.558   |
| West                        | 1.05 (0.96–1.14)                 | 0.271   |
| Urban-rural                 |                                 |         |
| Rural                       | Reference                        |         |
| Urban                       | 1.03 (0.98–1.09)                 | 0.258   |
| **Need factors**            |                                 |         |
| Index antimuscarinic prescription¥ |                       |         |
| Solifenacin                 | 0.79 (0.73–0.85)                 | < 0.0001|
| Fesoterodine                | 0.82 (0.68–0.99)                 | 0.039   |
| Tolterodine                 | 1.11 (1.03–1.18)                 | 0.004   |
Table 3 continued

| Characteristic                        | Adjusted hazards ratio (95% CI) | P value |
|---------------------------------------|---------------------------------|---------|
| Trospium                              | **1.44 (1.24–1.66)**            | < 0.0001|
| Darifenacin                           | **1.33 (1.06–1.67)**            | 0.012   |
| Oxybutinin                            | Reference                       |         |

Elixhauser comorbidities

| Elixhauser Index score (mean ± SD) | P value |
|------------------------------------|---------|
| Prior history of falls             | 0.95 (0.90–1.00) | 0.050 |
| Congestive heart failure           | 0.98 (0.93–1.04) | 0.518 |
| Cardiac arrhythmias                | 0.96 (0.92–1.01) | 0.141 |
| Valvular disease                   | 0.95 (0.89–1.02) | 0.135 |
| Pulmonary circulation disorders    | 0.92 (0.83–1.02) | 0.124 |
| Peripheral vascular disorders      | 0.97 (0.92–1.02) | 0.248 |
| Hypertension                        | 1.00 (0.94–1.06) | 0.888 |
| Paralysis                           | 1.01 (0.91–1.11) | 0.908 |
| Other neurologic disorders          | 1.00 (0.94–1.06) | 0.979 |
| Chronic pulmonary disease           | 1.01 (0.95–1.06) | 0.829 |
| Diabetes                            | 1.01 (0.96–1.06) | 0.833 |
| Hypothyroidism                      | 0.99 (0.93–1.04) | 0.650 |
| Renal failure                       | 1.01 (0.95–1.08) | 0.653 |
| Liver disease                       | **0.82 (0.71–0.94)** | **0.005** |
| Peptic ulcer                        | 0.98 (0.81–1.20) | 0.861 |
| AIDS/HIV                            | 1.71 (0.96–3.03) | 0.067 |
| Lymphoma                            | 0.85 (0.66–1.11) | 0.238 |
| Metastatic cancer                   | 0.80 (0.64–1.01) | 0.056 |
| Solid tumor without metastasis      | 1.03 (0.94–1.14) | 0.492 |
| Rheumatoid arthritis                | 1.02 (0.92–1.13) | 0.679 |
| Coagulopathy                        | 1.03 (0.92–1.15) | 0.633 |
| Obesity                             | 1.07 (0.98–1.18) | 0.134 |
| Weight loss                         | 0.97 (0.89–1.06) | 0.494 |
| Fluid and electrolyte disorders     | 1.00 (0.95–1.05) | 0.852 |
| Blood loss anemias                  | 1.06 (0.90–1.25) | 0.495 |
| Deficiency anemias                  | 1.00 (0.92–1.08) | 0.924 |
| Alcohol abuse                       | 0.97 (0.80–1.17) | 0.757 |
Table 3 continued

| Characteristic                   | Adjusted hazards ratio (95% CI) | P value |
|----------------------------------|---------------------------------|---------|
| Drug abuse                       | 0.95 (0.79–1.14)                | 0.567   |
| Psychoses                        | 0.98 (0.92–1.05)                | 0.606   |
| Depression                       | 1.06 (1.00–1.12)                | 0.060   |
| Medication use                   |                                 |         |
| Alpha-blockers                   | 1.01 (0.86–1.18)                | 0.935   |
| Beta-blockers                    | 1.00 (0.96–1.06)                | 0.872   |
| Calcium channel blockers         | 1.06 (1.01–1.12)                | 0.022   |
| ACE inhibitors                   | 1.00 (0.95–1.05)                | 0.931   |
| Diuretics                        | 0.98 (0.93–1.03)                | 0.379   |
| Antidepressants                  | 1.00 (0.95–1.05)                | 0.896   |
| Antipsychotics                   | 0.93 (0.86–0.99)                | 0.032   |
| Anticonvulsants                  | 1.07 (1.01–1.13)                | 0.016   |
| Antiparkinson agents             | 1.00 (0.92–1.08)                | 0.945   |
| ACB scale (mean ± SD)            | 1.04 (1.03–1.06)                | < 0.0001|
| Body mass index*                 |                                 |         |
| Underweight                      | Reference                       |         |
| Normal weight                    | 1.04 (0.92–1.17)                | 0.554   |
| Overweight                       | 0.97 (0.90–1.03)                | 0.314   |
| Obese                            | 0.90 (0.84–0.97)                | 0.006   |
| Missing/unknown                  | 0.99 (0.82–1.21)                | 0.960   |
| Urinary continence††             |                                 |         |
| Always continent                 | Reference                       |         |
| Occasionally incontinent         | 0.95 (0.87–1.04)                | 0.258   |
| Frequently incontinent           | 0.99 (0.90–1.08)                | 0.800   |
| Always incontinent               | 1.09 (0.96–1.22)                | 0.176   |
| Not rated                        | 1.03 (0.83–1.28)                | 0.809   |
| Missing/unknown                  | 0.65 (0.28–1.51)                | 0.315   |
| Bladder continence management*   |                                 |         |
| Indwelling/external catheter     |                                 |         |
| Yes                              | Reference                       |         |
| No                               | 0.86 (0.59–1.24)                | 0.411   |
| Missing/unknown                  | 1.36 (0.60–3.08)                | 0.455   |
### Table 3 continued

| Characteristic                                      | Adjusted hazards ratio (95% CI)     | P value |
|-----------------------------------------------------|------------------------------------|---------|
| Ostomy                                              |                                    |         |
| Yes                                                 | Reference                          |         |
| No                                                  | 1.46 (1.01–2.12)                   | 0.044   |
| Missing/unknown                                     | -                                  |         |
| Intermittent catheterization                        |                                    |         |
| Yes                                                 | Reference                          |         |
| No                                                  | 0.68 (0.41–1.13)                   | 0.133   |
| Missing/unknown                                     | -                                  |         |
| None of the above bladder appliance                 |                                    |         |
| Yes                                                 | Reference                          |         |
| No                                                  | 0.96 (0.68–1.34)                   | 0.793   |
| Missing/unknown                                     | -                                  |         |
| Urinary toileting program*                          |                                    |         |
| Yes                                                 | Reference                          |         |
| No                                                  | 0.75 (0.58–0.97)                   | 0.027   |
| Missing/unknown                                     | 0.76 (0.66–0.86)                   | < 0.0001|
| Response to toileting program*                      |                                    |         |
| No improvement                                      | Reference                          |         |
| Decreased wetness                                   | 1.18 (0.86–1.63)                   | 0.299   |
| Completely dry (continent)                          | 0.93 (0.60–1.43)                   | 0.736   |
| Missing/unknown                                     | 1.02 (0.83–1.26)                   | 0.829   |
| Current toileting program or trial*                 |                                    |         |
| Yes                                                 | Reference                          |         |
| No                                                  | 0.95 (0.83–1.10)                   | 0.510   |
| Missing/unknown                                     | 0.72 (0.56–0.91)                   | 0.006   |
| Bowel continence*                                   |                                    |         |
| Always continent                                    | Reference                          |         |
| Occasionally incontinent                            | 1.00 (0.92–1.09)                   | 0.988   |
| Frequently incontinent                              | 1.09 (1.01–1.19)                   | 0.036   |
| Always incontinent                                  | 1.09 (0.98–1.21)                   | 0.125   |
| Not rated                                           | 0.78 (0.57–1.08)                   | 0.136   |
| Missing/unknown                                     | 1.32 (0.59–2.94)                   | 0.496   |
likely that the burden was much higher after antimuscarinic initiation and may have been a stronger predictor of discontinuation. Furthermore, patients with participation in a urinary toileting program, those who were dependent on ADL and those with frequent bowel incontinence were associated with higher discontinuation. As this is the first study that assessed antimuscarinic discontinuation among nursing home residents and adjusted for several need variables, comparison and contrast were not possible in the context of these variables.

Although this study provided insights regarding treatment patterns and predictors of antimuscarinic discontinuation, there are several limitations to be acknowledged. First, MDS

### Table 3 continued

| Characteristic                          | Adjusted hazards ratio (95% CI) | P value |
|-----------------------------------------|---------------------------------|---------|
| MDS cognition scale*                    |                                 |         |
| Intact                                  | Reference                       |         |
| Mild                                    | 1.10 (0.89–1.36)                | 0.387   |
| Moderate                                | 1.04 (0.90–1.20)                | 0.575   |
| Moderate/severe                         | 1.02 (0.80–1.30)                | 0.867   |
| Severe                                  | **1.25 (1.10–1.42)**            | **0.0001** |
| Missing/unknown                         | 1.11 (0.97–1.28)                | 0.132   |
| Activities of daily living*             |                                 |         |
| Independent                             | Reference                       |         |
| Limited/extensive assistance            | 1.14 (0.99–1.32)                | 0.061   |
| Dependent                               | **1.14 (1.05–1.23)**            | **0.003** |
| Missing/unknown                         | 1.00 (0.81–1.25)                | 0.965   |
| Depressed mood indicator*               |                                 |         |
| Yes                                     | Reference                       |         |
| No                                      | 1.00 (0.86–1.17)                | 0.964   |
| Missing/unknown                         | 1.21 (1.05–1.39)                | 0.010   |

ACB anticholinergic burden, AIDS/HIV acquired immune deficiency syndrome/human immune deficiency virus, LTNH long-term nursing home, MDS minimum data set, OAB overactive bladder, CI confidence interval, SD standard deviation

All regression models were adjusted for predisposing, enabling and need factors

Significant values are bolded

*Based on MDS Admission Assessment and includes missing data

**Based on enrollment data and includes missing data

† Categories of urinary incontinence were defined as: always continent (over a 7-day look-back period, resident was continent with urine, with no episodes of incontinence); occasionally incontinent (over a 7-day look-back period, resident was incontinent less than 7 episodes); frequently incontinent (over a 7-day look-back period, resident was incontinent 7 or more episodes); always incontinent (over a 7-day look-back period, resident had no continent episodes); not rated (over a 7-day look-back period the resident had an indwelling catheter, condom catheter, ostomy or no urine output for the entire 7 days)

† Index antimuscarinic prescription refers to antimuscarinic medication that patients were newly started with upon nursing home admission

△ Adis
measurements are assessed by nursing home providers and are used for resource use and reimbursement purposes rather than research. Therefore, there may be missing data if specific measures are not regarded as relevant, which may explain the high number of missing values for UI-related variables. Second, patients were assumed to have administered the medication-based prescription fills prior to discontinuation. Hence, it should be acknowledged that time to discontinuation could have been much earlier than estimated here in the event that the medications were not taken. However, this would not differentially impact individual antimuscarinic agents. Third, as prescription medication use and discontinuation were based on Part D claims only during the nursing home stay, any medications provided by nursing homes as part of their care under the prospective payment system were not captured. The discontinuation was assessed based on Part D claims only; the issues with Part A coverage were not specifically addressed as Part A covers only the first 100 days and does not include prescription details; also, significant variability exists regarding the coverage source for Part D medications. However, this would not lead to differential bias in adherence/persistence. Fourth, as only antimuscarinics were examined in the present study, more research is needed to evaluate non-antimuscarinics such as mirabegron, sacral neuromodulation, posterior tibial nerve stimulation or the wider category of anticholinergics. As a result, the treatment and discontinuation patterns presented here can only be generalized to LTNH residents with OAB treated with antimuscarinics, and overall treatment rates may actually be higher than those estimated in the current study. Fifth, although the MDS may be a rich data source, several other factors not captured in the data source could not be included. Also, we decided to use a 3-month baseline period to increase the sample size. This could have led to some comorbidities not being captured. Other limitations include that the use of non-pharmacologic treatments (i.e., pads/briefs, or enemas/irrigation) was not captured, and as the data are limited to fee-for-service Medicare beneficiaries, the results cannot be generalized to uninsured nursing home residents or residents insured through Medicare Advantage plans. Lastly, although the ICD codes used here were consistent with those used to identify patients with OAB from other studies, there was the potential for misclassification, as evident by 5% of the study cohort identified with paralysis, which is typically associated with neurogenic detrusor overactivity rather than OAB. Furthermore, although males represented only one-fourth of OAB cases in the present study, it is possible that some of these cases were cases of BPH rather than OAB.

CONCLUSION

This retrospective cohort study found that 67% of LTNH residents with OAB discontinue antimuscarinic medications during nursing home stay, and several need characteristics were associated with discontinuation. Most importantly, the study found significant variation in medication discontinuation based on the index antimuscarinic agent. The study found that oxybutynin is most frequently used in nursing homes and discontinuation risk with oxybutynin is higher than for solifenacin and fesoterodine, but less than for toleterodine, trospium and darifenacin. Therefore, concerted efforts are needed to optimize and improve antimuscarinic medication use to improve quality of care of OAB in nursing homes.

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Compliance with Ethics Guidelines. The study protocol was approved by the University of Houston Committee for the Protection of Human Subjects. Informed consent was not required given the deidentified nature of the data and feasibility considerations for a large retrospective database such as Medicare.

Data Availability. Researchers may request access to anonymized participant-level data, trial-level data and protocols from Astellas-sponsored clinical trials at www.clinicalstudydatarequest.com. For the Astellas criteria on data sharing see: https://clinicalstudydatarequest.com/Study-Sponsors/Study-Sponsors-Astellas.aspx. The datasets generated during and/or analyzed during the current study are not publicly available as, per government regulations and the data use agreement, data from the Centers for Medicare and Medicaid Services cannot be shared.

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