



## 46 Characteristics Associated With Medication Adherence Among New Omalizumab Users

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## ABSTRACT

**OBJECTIVE:** Adherence to omalizumab (OMA) therapy has not been well studied. We sought to identify characteristics associated with adherence among new OMA users.

**METHODS:** This was a retrospective cohort analysis using a HIPAA-compliant claims database. The study identified asthma patients who were  $\geq 12$  years old, newly treated with OMA between 7/1/2004 and 6/30/2007, and enrolled for 1 year before and 1 year after the first OMA claim. Adherence was measured by medication possession ratio (MPR) (total days of medication supplied  $\div$  365) with each OMA claim considered a 28-day supply. Therapy step, as defined by the EPR3 guidelines, was assigned using a published algorithm. A base linear regression model was conducted with MPR as the dependent variable and demographics, physician specialty, respiratory comorbidities, asthma control, therapy step, and medication ratio forced into the model as independent variables. Other comorbidities were considered with forward selection and retained if significant at  $p < .05$ .

**RESULTS:** We identified 766 new OMA users; mean age was 43 (SD 14) years, and 61% ( $n=466$ ) were female. Forty-two percent of patients had allergists as their usual source of care, 20% pulmonologists, 28.3% primary care physicians, and the remainder other/unspecified. The mean number of chronic conditions was 5 (SD 2). Before starting OMA, most of patients were on EPR3 Step 5 therapy (28%), followed by Step 4 (18%), Step 3 (16%), Step 2 (15%), Step 1 (6%), and Step 6 (5%). Mean MPR in the year after treatment initiation was 0.68 (SD 0.30), and 55% persisted with therapy for at least 1 year. The final model included the base variables and diseases of circulatory system (the only additional significant predictor). Significant predictors of higher MPR were: care provided by allergists or pulmonologists, chronic otitis media, 5 or 6 vs  $\geq 7$  chronic conditions, and no disease of the circulatory system.

**CONCLUSIONS:** We found MPR for omalizumab to be higher on average than what has been reported for combination corticosteroid/long-acting beta-agonist therapy. Care by an allergist or pulmonologist was associated with greater adherence. Confounding by disease severity is possible, but the relationship was significant after controlling for therapy step. If this finding is confirmed in other studies, it supports the value of specialist care for patients with difficult to treat asthma.

## BACKGROUND

- Lack of adherence to prescribed treatments for asthma is a well-known problem. Rates of nonadherence range from 30% to 70%.<sup>1-3</sup>
- Poor asthma medication adherence is associated with decreases in asthma control and increases in emergency department visits, hospitalizations, and the need for oral corticosteroids.<sup>3,4</sup>
- Omalizumab, a humanized monoclonal antibody targeting immunoglobulin E, is approved in the United States for the treatment of adults and adolescents ( $\geq 12$  years) with moderate to severe persistent allergic asthma that is inadequately controlled with inhaled corticosteroids.<sup>5</sup>
- Adherence to omalizumab therapy has not been well studied. One prior analysis of asthma patients newly treated with omalizumab estimated adherence rates to be 64.6% with 54% persisting up to one year.<sup>5</sup>

## OBJECTIVE

- To identify characteristics associated with adherence and persistence among new omalizumab users

## METHODS

### Study Design

- A retrospective cohort analysis using a HIPAA-compliant administrative claims database of 10 million covered lives representing all major regions of the United States.
- Eligible patients were  $\geq 12$  years old, diagnosed with asthma, newly treated with omalizumab between 7/1/2004 and 6/30/2007, and followed for a year (Figures 1 and 2).

Figure 1. Study Timeline

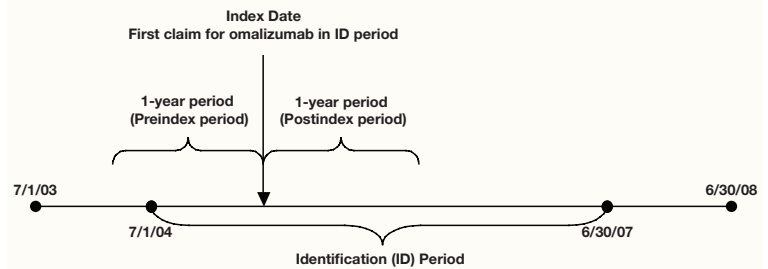
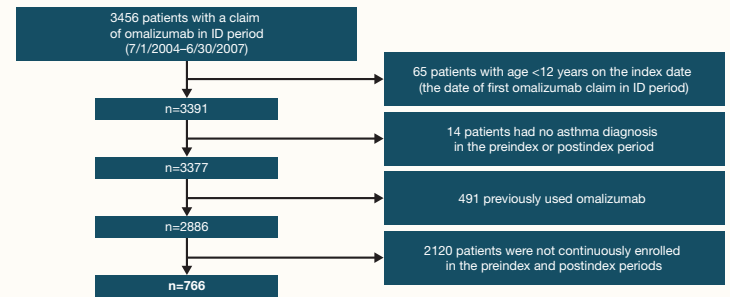


Figure 2. Cohort Selection for Omalizumab New Users.



ID = identification.

### Study Outcomes

- Adherence to omalizumab therapy during the postindex period, as measured by the medication possession ratio (MPR)
  - Calculated as the total days of medication supplied over the year, divided by 365
  - Each omalizumab claim was considered a 28-day supply
- Medication persistence during the postindex period, as measured by time to discontinuation
  - Calculated as the number of days on omalizumab with no gaps of more than 45 days

### Statistical Analysis

- To evaluate the association of baseline measures (patient demographic and clinical characteristics) with omalizumab adherence and persistence, we conducted a linear regression model with adherence (MPR) as the continuous dependent variable and all baseline measures as independent variables and a similar logistic regression model to predict persistence at one year.
  - Based on bivariate analysis results and clinical relevance, demographics (age, sex, and region), asthma physician specialty, number of chronic conditions, evidence of allergy, respiratory-specific comorbidities, therapy step, and medication ratio were first included in the linear regression model; we then used forward selection to identify significant results for other baseline measures.

## RESULTS

- We identified 766 new omalizumab users; average age was 43.4 years and 61% were female. Fifty percent of patients received asthma care from an allergist, 28% a pulmonologist, and 17% a primary care physician.
- Overall, the MPR was 0.68 (SD,  $\pm$  0.30). MPR stratified by baseline measures are presented in Table 1 and results of the multivariate analysis in Table 2.
- During follow-up, 45.3% of patients discontinued treatment. Mean (SD) time to discontinuation/end of study was 256.5 (131.6) days; median was 353 days (Table 3, Figure 3).
- The risk of discontinuing omalizumab was examined across a number of variables (Table 4).

**Table 1. MPR of Omalizumab Stratified by Patient Demographics and Clinical Characteristics**

|  | N   | (%)     | MPR Mean (SD) | P Value |
|--|-----|---------|---------------|---------|
| <b>All</b>   | 766 | (100.0) | 0.68 (0.30)   |         |
| <b>Demographics</b>  |     |         |               |         |
| <b>Age, y</b> (mean 43.4; SD 14.5)                               |     |         |               | 0.157   |
| 12-17  | 68  | (8.9)   | 0.72 (0.28)   |         |
| 18-34  | 111 | (14.5)  | 0.62 (0.34)   |         |
| 35-44  | 183 | (23.9)  | 0.66 (0.30)   |         |
| 45-54  | 234 | (30.5)  | 0.68 (0.30)   |         |
| 55-64  | 141 | (18.4)  | 0.71 (0.27)   |         |
| 65+  | 29  | (3.8)   | 0.65 (0.24)   |         |
| <b>Sex</b>   |     |         |               | 0.174   |
| Female   | 466 | (60.8)  | 0.69 (0.30)   |         |
| Male   | 300 | (39.2)  | 0.66 (0.30)   |         |
| <b>Region</b>  |     |         |               | 0.056   |
| Midwest  | 184 | (24.0)  | 0.71 (0.28)   |         |
| Northeast  | 86  | (11.2)  | 0.62 (0.32)   |         |
| South  | 387 | (50.5)  | 0.66 (0.30)   |         |
| West   | 109 | (14.2)  | 0.70 (0.27)   |         |
| <b>Physician Specialty</b>                                       |     |         |               |         |
| <b>Usual asthma care physician<sup>a</sup></b>                   |     |         |               | 0.020   |
| Pulmonologist  | 214 | (27.9)  | 0.68 (0.28)   |         |
| Primary care   | 128 | (16.7)  | 0.64 (0.31)   |         |
| Allergists   | 381 | (49.7)  | 0.69 (0.29)   |         |
| Other  | 22  | (2.9)   | 0.66 (0.36)   |         |
| Unknown  | 21  | (2.7)   | 0.48 (0.39)   |         |
| <b>General Comorbidities</b>                                     |     |         |               |         |
| <b>No. of chronic conditions</b> (mean 4.7; SD 2.3)              |     |         |               | 0.047   |
| 1-2  | 155 | (20.2)  | 0.63 (0.33)   |         |
| 3-4  | 227 | (29.6)  | 0.69 (0.29)   |         |
| 5-6  | 216 | (28.2)  | 0.71 (0.27)   |         |
| 7+   | 168 | (21.9)  | 0.65 (0.29)   |         |
| <b>Charlson Comorbidity Index<sup>7</sup></b> (mean 1.8; SD 1.7) |     |         |               | 0.967   |
| 1  | 530 | (69.2)  | 0.68 (0.30)   |         |
| 2  | 86  | (11.2)  | 0.68 (0.29)   |         |
| 3+   | 150 | (19.6)  | 0.67 (0.29)   |         |
| <b>Evidence of allergy</b>                                       |     |         |               | <.001   |
| No   | 57  | (7.4)   | 0.55 (0.34)   |         |
| Yes  | 709 | (92.6)  | 0.69 (0.29)   |         |
| <b>Respiratory-Specific Comorbidities</b>                        |     |         |               |         |
| <b>COPD</b>  |     |         |               | 0.338   |
| No   | 577 | (75.3)  | 0.67 (0.31)   |         |
| Yes  | 189 | (24.7)  | 0.69 (0.27)   |         |
| <b>Sinusitis</b>   |     |         |               | 0.551   |
| No   | 243 | (31.7)  | 0.67 (0.31)   |         |
| Yes  | 523 | (68.3)  | 0.68 (0.29)   |         |
| <b>Rhinitis</b>  |     |         |               | <0.001  |
| No   | 93  | (12.1)  | 0.57 (0.33)   |         |
| Yes  | 673 | (87.9)  | 0.69 (0.29)   |         |
| <b>Tonsillitis</b>   |     |         |               | 0.321   |
| No   | 731 | (95.4)  | 0.67 (0.30)   |         |
| Yes  | 35  | (4.6)   | 0.72 (0.28)   |         |
| <b>Acute upper respiratory infection</b>                         |     |         |               | 0.471   |
| No   | 515 | (67.2)  | 0.67 (0.30)   |         |
| Yes  | 251 | (32.8)  | 0.69 (0.28)   |         |
| <b>Conjunctivitis</b>  |     |         |               | 0.894   |
| No   | 619 | (80.8)  | 0.68 (0.30)   |         |
| Yes  | 147 | (19.2)  | 0.67 (0.29)   |         |
| <b>Chronic otitis media</b>                                      |     |         |               | 0.002   |
| No   | 746 | (97.4)  | 0.67 (0.30)   |         |
| Yes  | 20  | (2.6)   | 0.81 (0.17)   |         |
| <b>Nasal polyposis</b>   |     |         |               | 0.073   |
| No   | 663 | (86.6)  | 0.68 (0.29)   |         |
| Yes  | 103 | (13.4)  | 0.63 (0.32)   |         |
| <b>Cough</b>   |     |         |               | 0.427   |
| No   | 381 | (49.7)  | 0.67 (0.31)   |         |
| Yes  | 385 | (50.3)  | 0.68 (0.28)   |         |

|  | N   | (%)     | MPR Mean (SD) | P Value |
|--|-----|---------|---------------|---------|
| <b>All</b>   | 766 | (100.0) | 0.68 (0.30)   |         |
| <b>Asthma Control in the Preindex Period</b>   |     |         |               |         |
| <b>Poor asthma control<sup>b</sup></b>   |     |         |               | 0.096   |
| No   | 191 | (24.9)  | 0.64 (0.32)   |         |
| Yes  | 575 | (75.1)  | 0.69 (0.29)   |         |
| <b>Asthma-related inpatient hospitalization</b>  |     |         |               | 0.340   |
| No   | 657 | (85.8)  | 0.68 (0.30)   |         |
| Yes  | 109 | (14.2)  | 0.65 (0.30)   |         |
| <b>Asthma-related ED visit</b>   |     |         |               | 0.412   |
| No   | 705 | (92.0)  | 0.67 (0.30)   |         |
| Yes  | 61  | (8.0)   | 0.71 (0.29)   |         |
| <b>Two or more oral corticosteroid prescriptions filled</b>                                |     |         |               | 0.031   |
| No   | 265 | (34.6)  | 0.64 (0.32)   |         |
| Yes  | 501 | (65.4)  | 0.69 (0.28)   |         |
| <b>Six or more short-acting beta-agonist prescriptions filled</b>                          |     |         |               | 0.310   |
| No   | 434 | (56.7)  | 0.67 (0.30)   |         |
| Yes  | 332 | (43.3)  | 0.69 (0.29)   |         |
| <b>EPR-3 Guidelines<sup>8</sup> Therapy Step in Preindex Period</b>                        |     |         |               |         |
| <b>Therapy step prior to initiating omalizumab</b>   |     |         |               | 0.006   |
| No asthma meds   | 68  | (8.9)   | 0.56 (0.33)   |         |
| Step 1   | 44  | (5.7)   | 0.61 (0.32)   |         |
| Step 2   | 112 | (14.6)  | 0.67 (0.30)   |         |
| Step 3   | 121 | (15.8)  | 0.73 (0.27)   |         |
| Step 4   | 136 | (17.8)  | 0.69 (0.28)   |         |
| Step 5   | 214 | (27.9)  | 0.69 (0.29)   |         |
| Step 6   | 37  | (4.8)   | 0.63 (0.33)   |         |
| Unclassified   | 34  | (4.4)   | 0.72 (0.28)   |         |
| <b>Medication Ratio<sup>c</sup> and Other Asthma Medication Use in the Preindex Period</b> |     |         |               |         |
| <b>Medication ratio</b> (mean 0.64; SD 0.28 among 718 patients with medication ratios)     |     |         |               | 0.003   |
| Low ratio (<0.5)   | 197 | (25.7)  | 0.64 (0.31)   |         |
| High ratio (≥0.5)  | 521 | (68.0)  | 0.70 (0.28)   |         |
| Missing (no controller or reliever)  | 48  | (6.3)   | 0.55 (0.35)   |         |
| <b>Short-acting beta-agonist inhalers</b>  |     |         |               | 0.044   |
| No   | 115 | (15.0)  | 0.62 (0.32)   |         |
| Yes  | 651 | (85.0)  | 0.68 (0.29)   |         |
| <b>Anticholinergics</b>  |     |         |               | 0.077   |
| No   | 521 | (68.0)  | 0.66 (0.30)   |         |
| Yes  | 245 | (32.0)  | 0.70 (0.29)   |         |
| <b>Oral corticosteroids</b>  |     |         |               | 0.119   |
| No   | 153 | (20.0)  | 0.64 (0.32)   |         |
| Yes  | 613 | (80.0)  | 0.68 (0.29)   |         |
| <b>ICS/LABA combination</b>  |     |         |               | 0.051   |
| No   | 240 | (31.3)  | 0.64 (0.31)   |         |
| Yes  | 526 | (68.7)  | 0.69 (0.29)   |         |
| <b>ICS alone</b>   |     |         |               | 0.286   |
| No   | 450 | (58.7)  | 0.67 (0.31)   |         |
| Yes  | 316 | (41.3)  | 0.69 (0.28)   |         |
| <b>LABA alone</b>  |     |         |               | 0.790   |
| No   | 643 | (83.9)  | 0.67 (0.30)   |         |
| Yes  | 123 | (16.1)  | 0.68 (0.30)   |         |
| <b>Mast cell stabilizers</b>   |     |         |               | 0.108   |
| No   | 734 | (95.8)  | 0.67 (0.30)   |         |
| Yes  | 32  | (4.2)   | 0.76 (0.25)   |         |
| <b>Methylxanthines</b>   |     |         |               | 0.810   |
| No   | 670 | (87.5)  | 0.67 (0.30)   |         |
| Yes  | 96  | (12.5)  | 0.68 (0.26)   |         |
| <b>Leukotriene receptor antagonists</b>  |     |         |               | 0.078   |
| No   | 221 | (28.9)  | 0.65 (0.31)   |         |
| Yes  | 545 | (71.1)  | 0.69 (0.29)   |         |

<sup>a</sup>The usual asthma care physician was determined by the largest plurality of office visits with evaluation and management services and asthma diagnosis.

<sup>b</sup>Asthma-related inpatient hospitalization, asthma-related ED visit, ≥2 oral corticosteroid prescriptions filled, or ≥6 short-acting beta-agonist prescriptions filled.

<sup>c</sup>Medication ratio is units of asthma controllers to units of controllers + units of relievers.

COPD = chronic obstructive pulmonary disease; ED = emergency department; EPR-3 = National Asthma Education and Prevention Program Expert Panel Report 3; ICS = inhaled corticosteroid; LABA = long-acting beta-agonist; MPR = medication possession ratio.

**Table 2.** Multivariate Analysis: Characteristics Associated With Omalizumab MPR

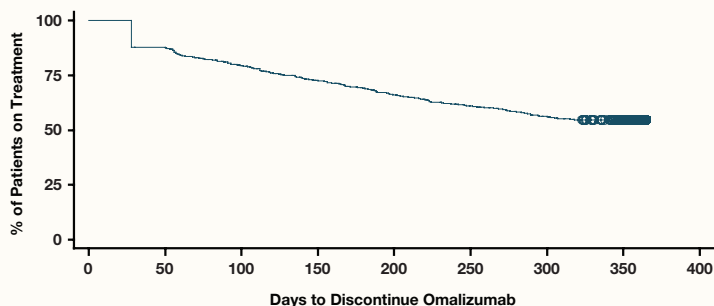
|  | Coefficient | SE   | P Value |
|--|-------------|------|---------|
| <b>Intercept</b>   | 0.49        | 0.10 | <0.001  |
| <b>Age, y</b>  |             |      |         |
| 12-17 vs 65+   | 0.04        | 0.07 | 0.567   |
| 18-34 vs 65+   | -0.04       | 0.06 | 0.520   |
| 35-44 vs 65+   | 0.01        | 0.06 | 0.845   |
| 45-54 vs 65+   | 0.04        | 0.06 | 0.483   |
| 55-64 vs 65+   | 0.06        | 0.06 | 0.298   |
| <b>Female vs male</b>                                    | 0.03        | 0.02 | 0.268   |
| <b>Region</b>  |             |      |         |
| Midwest vs West  | 0.03        | 0.04 | 0.375   |
| Northeast vs West  | -0.03       | 0.04 | 0.545   |
| South vs West  | -0.03       | 0.03 | 0.290   |
| <b>Usual asthma care physician specialty</b>             |             |      |         |
| Allergist vs primary/other                               | 0.04        | 0.03 | 0.178   |
| Pulmonologist vs primary/other                           | 0.04        | 0.03 | 0.193   |
| <b>No. of chronic conditions</b>                         |             |      |         |
| 1-2 vs 7+  | -0.03       | 0.04 | 0.522   |
| 3-4 vs 7+  | 0.03        | 0.03 | 0.334   |
| 5-6 vs 7+  | 0.07        | 0.03 | 0.028   |
| <b>Evidence of allergy</b>                               | 0.06        | 0.06 | 0.351   |
| <b>Therapy step</b>                                      |             |      |         |
| No asthma medication vs Step 6                           | -0.02       | 0.07 | 0.818   |
| Step 1 vs Step 6   | -0.01       | 0.07 | 0.933   |
| Step 2 vs Step 6   | 0.01        | 0.06 | 0.817   |
| Step 3 vs Step 6   | 0.08        | 0.06 | 0.138   |
| Step 4 vs Step 6   | 0.04        | 0.05 | 0.506   |
| Step 5 vs Step 6   | 0.04        | 0.05 | 0.443   |
| Unclassified vs Step 6                                   | 0.10        | 0.07 | 0.182   |
| <b>Medication ratio</b>                                  |             |      |         |
| Low ratio (<0.5) vs high ratio (≥0.5)                    | -0.03       | 0.06 | 0.602   |
| Missing (no controller or reliever) vs high ratio (≥0.5) | -0.08       | 0.06 | 0.211   |
| <b>COPD</b>  | 0.03        | 0.03 | 0.317   |
| <b>Sinusitis</b>   | 0.00        | 0.02 | 0.927   |
| <b>Rhinitis</b>  | 0.08        | 0.05 | 0.112   |
| <b>Tonsillitis</b>                                       | 0.07        | 0.05 | 0.178   |
| <b>Acute upper respiratory infection</b>                 | 0.00        | 0.02 | 0.950   |
| <b>Conjunctivitis</b>                                    | -0.02       | 0.03 | 0.477   |
| <b>Chronic otitis media</b>                              | 0.13        | 0.07 | 0.050   |
| <b>Nasal polyposis</b>                                   | -0.09       | 0.03 | 0.005   |
| <b>Cough</b>   | 0.01        | 0.02 | 0.684   |
| <b>Diseases of the circulatory system</b>                | -0.07       | 0.03 | 0.008   |

COPD = chronic obstructive pulmonary disease; MPR = medication possession ratio.

**Table 3.** Omalizumab Use in the Postindex Period

|                                      |                       | Omalizumab New Users (N=766) |
|--------------------------------------|-----------------------|------------------------------|
| MPR (Range 0-1)                      | Mean (SD)<br>[Median] | 0.68 (0.30)<br>[0.80]        |
| Discontinued omalizumab              | n (%)                 | 347 (45.3)                   |
| Days to discontinuation/end of study | Mean (SD)<br>[Median] | 256.5 (131.6)<br>[353]       |
| Number of omalizumab claims          | Mean (SD)<br>[Median] | 10.1 (5.4)<br>[11]           |
| 1                                    | n (%)                 | 64 (8.4)                     |
| 2-5                                  | n (%)                 | 94 (12.3)                    |
| 6-11                                 | n (%)                 | 249 (32.5)                   |
| 12+                                  | n (%)                 | 359 (46.9)                   |

**Figure 3.** Days to Discontinuation of Omalizumab.



**Table 4.** Risk of Discontinuing Omalizumab: Adjusted Hazard Ratios and 95% Confidence Intervals

|  | HR   | (95% CI)      | P Value |
|--|------|---------------|---------|
| <b>Age, y</b>  |      |               |         |
| 12-17 vs 65+   | 0.82 | (0.41 - 1.67) | 0.576   |
| 18-34 vs 65+   | 1.15 | (0.64 - 2.16) | 0.655   |
| 35-44 vs 65+   | 0.86 | (0.50 - 1.57) | 0.600   |
| 45-54 vs 65+   | 0.81 | (0.48 - 1.46) | 0.457   |
| 55-64 vs 65+   | 0.76 | (0.44 - 1.38) | 0.344   |
| <b>Female vs male</b>                                    | 0.83 | (0.66 - 1.05) | 0.121   |
| <b>Region</b>  |      |               |         |
| Midwest vs West  | 0.76 | (0.52 - 1.12) | 0.164   |
| Northeast vs West  | 0.98 | (0.63 - 1.51) | 0.917   |
| South vs West  | 1.16 | (0.84 - 1.62) | 0.380   |
| <b>Usual asthma care physician specialty</b>             |      |               |         |
| Allergist vs primary/other                               | 0.85 | (0.64 - 1.13) | 0.264   |
| Pulmonologist vs primary/other                           | 0.84 | (0.62 - 1.14) | 0.273   |
| <b>No. of chronic conditions</b>                         |      |               |         |
| 1-2 vs 7+  | 0.89 | (0.59 - 1.35) | 0.596   |
| 3-4 vs 7+  | 0.81 | (0.58 - 1.13) | 0.212   |
| 5-6 vs 7+  | 0.69 | (0.51 - 0.94) | 0.020   |
| <b>Evidence of allergy</b>                               | 0.97 | (0.53 - 1.71) | 0.914   |
| <b>Therapy step</b>                                      |      |               |         |
| No asthma medication vs Step 6                           | 1.25 | (0.64 - 2.49) | 0.518   |
| Step 1 vs Step 6   | 1.21 | (0.61 - 2.44) | 0.580   |
| Step 2 vs Step 6   | 1.18 | (0.69 - 2.13) | 0.560   |
| Step 3 vs Step 6   | 0.79 | (0.46 - 1.44) | 0.430   |
| Step 4 vs Step 6   | 0.92 | (0.54 - 1.66) | 0.769   |
| Step 5 vs Step 6   | 0.90 | (0.54 - 1.58) | 0.689   |
| Unclassified vs Step 6                                   | 0.73 | (0.33 - 1.59) | 0.437   |
| <b>Medication ratio</b>                                  |      |               |         |
| Low ratio (<0.5) vs high ratio (≥0.5)                    | 1.18 | (0.66 - 2.07) | 0.563   |
| Missing (no controller or reliever) vs high ratio (≥0.5) | 1.36 | (0.77 - 2.43) | 0.289   |
| <b>COPD</b>  | 0.93 | (0.71 - 1.22) | 0.613   |
| <b>Sinusitis</b>   | 0.99 | (0.77 - 1.27) | 0.916   |
| <b>Rhinitis</b>  | 0.65 | (0.40 - 1.09) | 0.082   |
| <b>Tonsillitis</b>                                       | 0.58 | (0.29 - 1.02) | 0.083   |
| <b>Acute upper respiratory infection</b>                 | 1.12 | (0.88 - 1.42) | 0.341   |
| <b>Conjunctivitis</b>                                    | 1.13 | (0.85 - 1.49) | 0.384   |
| <b>Chronic otitis media</b>                              | 0.61 | (0.26 - 1.24) | 0.218   |
| <b>Nasal polyposis</b>                                   | 1.46 | (1.05 - 2.00) | 0.019   |
| <b>Cough</b>   | 0.95 | (0.75 - 1.19) | 0.627   |
| <b>Diseases of the circulatory system</b>                | 1.32 | (1.00 - 1.76) | 0.052   |

CI = confidence interval; HR = hazard ratio.

## LIMITATIONS

- Administrative claims data do not indicate the dosing schedule for omalizumab; in this analysis, each dose of omalizumab was assumed to be a 28 day supply.
- Inclusion of concomitant asthma medications as covariates is indicative only of those medications filled and not reflective of patient adherence to therapy.

## CONCLUSIONS

- Among new omalizumab users, we estimated the MPR to be 0.68 with 54.7% persisting on omalizumab at one year after initiating therapy.
- Omalizumab adherence and persistence are consistent with previously published reports, although this analysis indicates slightly higher estimates.
- The number of chronic conditions and select respiratory comorbidities were significant predictors of adherence and persistence in our multivariate models.

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