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Medication adherence in Medicare-enrolled older adults with asthma and chronic obstructive pulmonary disease before and during COVID-19 pandemic

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Abstract

Background: Medication adherence in Medicare-enrolled older adults with asthma and chronic obstructive pulmonary disease (COPD) before and during the coronavirus disease 2019 (COVID-19) pandemic is unknown.

Objectives: To evaluate medication adherence and determinants of high adherence before and during the COVID-19 pandemic in this population.

Design: Retrospective cohort study.

Methods: The proportion of days covered (PDC) reflected medication adherence from January to July 2019 and from January to July 2020. Patients <65 years of age, with COPD or asthma alone, or with cystic fibrosis were excluded. Paired *t* tests were used to assess adherence changes. Logistic regression explored association of age, sex, diagnosis of depression, number of medications, medication-related problems, prescribers, pharmacies, controller medication classes, albuterol rescue inhaler fills, oral corticosteroid fills, and having a 90-day supply with high adherence (PDC ⩾ 80%).

Results: This analysis included 989 patients. In this cohort, 61.2% of patients received oral corticosteroids. Over 60% of patients had ⩾3 rescue fills in both 2019 and 2020. Medication adherence to controller medications significantly decreased for all controller medications ($p < 0.001$) in 2020. In 2019 and 2020, number of controller medication classes and having a 90-day supply were associated with high adherence ($p < 0.001$). In 2019, variables associated with high adherence also included number of medication-related problems and having ⩾3 albuterol rescue inhalers ($p < 0.001$).

Conclusion: Medication adherence to controllers significantly decreased during the pandemic among older adults with asthma and COPD. Patients with multiple controller classes and a 90-day supply were more likely to be highly adherent. A 90-day supply of medications should be used to facilitate access to medication during the pandemic. Healthcare professionals should assess medication adherence, resolve the barriers of adherence and medication-related problems to achieve desired clinical outcomes among older adults with both asthma and COPD.

Keywords: asthma, COPD, COVID-19 pandemic, geriatric, Medicare, medication adherence

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Introduction

Chronic respiratory diseases, including asthma and chronic obstructive pulmonary disease (COPD), are leading causes of death in the United States (US), with age-adjusted mortality rate being 36.4 per 100,000 population in 2020.[1] Although asthma and COPD have different pathophysiology, clinical signs and symptoms, many older adults have been diagnosed with asthma and COPD overlap (ACO).[2,3] In the US, the prevalence of ACO was 3.8% among patients aged 65–85 years.[4]

ACO increases disease burden, leading to more frequent respiratory exacerbations and poorer quality of life.[5] Patients with ACO are at greater risk of coronary heart disease and heart failure, and experience greater economic burden compared to patients with COPD or asthma alone.[6,7] Moreover, among patients with COVID-19 infection, patients with ACO had higher mortality rates compared to no chronic respiratory diseases or COPD or asthma alone.[8]

In 2022, a report published by the Global Initiative for Chronic Obstructive Lung Disease recommended that treatment for ACO should primarily follow asthma guidelines.[9] The pharmacotherapy options include inhaled corticosteroids (ICS) with or without long-acting muscarinic antagonists (LAMA), long-acting β2-agonists (LABA), and biologic medications.[10,11] Inhaled, long-acting bronchodilators in combination with ICS are the standard treatment of ACO in the elderly patients.[12]

Medication adherence to maintenance therapies in older adults with ACO may be suboptimal. Nili *et al.*[13] reported that 56.7% of patients had persistently low adherence. Factors contributing to medication nonadherence include high costs, low health literacy, medication regimen complexity, and mental health disorder.[14] Nonadherence to medications was associated with poor patient outcomes, worsened quality of life, and high burden to healthcare and society.[14]

During the beginning of the COVID-19 pandemic, access to health care was limited, especially for people with hearing, vision, cognition, and mobility disabilities,[15] which are common comorbidities in older adults. Ravina Barrett and Robert Barrett[16] found the prescription claims for the treatment of asthma and COPD were lower than pre-pandemic period using data from English Prescribing Dataset. Our previous studies also showed significant decrease in medication adherence in Medicare-enrolled seniors with asthma or COPD alone during the pandemic compared to pre-pandemic period.[17,18] Measuring medication adherence in patients with both asthma and COPD is crucial due to increased vulnerability, more complex medication regimens, lower quality of life and worse patient outcomes in this population compared to those with asthma or COPD alone.[6–8] Moreover, no data on medication adherence in Medicare-enrolled older adults with ACO are currently available.

This study was aimed (1) to describe medication adherence in Medicare older adults with both asthma and COPD before and during the COVID-19 pandemic, (2) to investigate whether the pandemic impacted medication adherence and prescribing patterns in this population, (3) and to assess the factors associated with high adherence before and during the pandemic period.

Methods

Study design and population

This was a retrospective, observational pre-post cohort study of Medicare-enrolled, Medication therapy management (MTM) eligible older adults with both asthma and COPD. Criteria for inclusion of patients were: (1) enrollment in Medicare Part D program, (2) diagnosis of both asthma and COPD with international classification of disease, tenth revision (ICD-10) codes in 2019, (3) age ⩾65 years, (4) presence of at least two claims for the same maintenance medication in 2019. Patients were excluded if they were: (1) under the age of 65 years, (2) had the diagnosis of only asthma or COPD, or (3) had cystic fibrosis.

Controller medications assessed in this study included any ICS, LAMA, LABA, leukotriene receptor antagonist, and theophylline. Biologic medications were not assessed as they were not covered under the Medicare Part D plan that was evaluated in this research.

Data collection

Patient age, sex, number of medications, number of pharmacies, number of prescribers, and number of medication-related problems (MRPs)

in 2019, ICD codes, prescription claims, and the proportion of days covered (PDC) for controller medications were collected from the MTM provider and approved by the insurance plan. Prescription claims were collected for duration of 1 January 2019–31 July 2019, pre-pandemic, and 1 January 2020–31 July 2020, during the pandemic. The number of rescue inhalers and oral corticosteroid claims were collected as well. ICD codes reflected diagnoses made between 1 January 2019 and 31 December 2021. The list of medications assessed by class can be found in Supplemental eTable 1. MRPs included gaps in therapy, drug–drug interactions, drug–disease interactions, high-risk medications use, and nonadherence to medications for specific chronic conditions identified in the claims data.

Adherence to controller medications was assessed during the pre-pandemic period of 1 January 2019–31 July 2019, and the pandemic period of 1 January 2020–31 July 2020. PDC was used to compare adherence to controller therapy between the 2019 and 2020 periods. PDC reflected the percentage of days during which patient had access to certain medication, and it was calculated as the sum of days in which medications were available to the patients divided by the number of days in the period of interest. When PDC was greater than or equal to 80%, the patient was classified as highly adherent to the therapy. Adherence was considered low among patients with PDC below 80%. The total number of controllers was calculated by adding the number of controller medication classes used by patients in each period.

Statistical analyses

Microsoft Excel (2016 MSO, Redmond, Washington) and IBM SPSS software (version 26.0, IBM Corp, Armonk, New York) were used to manage and organize the data. Counts and percentages were used to describe nominal data. Means and standard deviations (SDs) described continuous variables. Age, number of medications, MRPs, prescribers, pharmacies, controller medications, and corticosteroid fills were transformed into categorical variables. Sex, number of rescue inhaler fills, having a 90-day supply of controller medication, and the diagnosis of depression were evaluated as binary variables. Age was stratified into three categories (65–74, 75–84, and $\geqslant$85 years).

Paired *t*-tests assessed differences in adherence between 2019 and 2020 for each medication class. The count and percentage of individuals considered highly adherent to any controllers in each period were reported as well.

Logistic regression was utilized to explore the associations between patient characteristics and medication adherence to controllers in 2019 and 2020 separately. Variables in the regression included age, sex, number of medications, number of MRPs, number of prescribers, number of pharmacies, diagnosis of depression, number of controller classes, number of albuterol inhaler fills, and number of oral corticosteroid claims, and having a 90-day medication supply. The logistic regression assessing adherence in 2020 also included a dichotomized variable that reflected whether the patient was highly adherent in 2019. A Bonferroni adjustment was used to determine the p value that established statistical significance.

Results

A total of 989 patients were included in this study. The mean age was 76.4 ± 6.7 years, with 77.7% being female. They had 6.6 ± 3.6 prescribers, were prescribed 14.6 ± 4.9 medications, and obtained prescription medications from 2.8 ± 1.7 pharmacies in 2019. In this cohort, 61.2% of patients received oral corticosteroids, and 23.2% had the diagnosis of depression. 87.5% of the patients needed more than one controller medication for ACO. Details can be found in Table 1.

About two-thirds of patients were highly adherent to their inhalers [LAMA (70.7%), LABA (67.4%), ICS (68.6%)] in 2019. In the first several months of the pandemic in 2020, however, the proportion of patients with high adherence dropped [LABA (49.2%), ICS (50.2%), LAMA (55.6%)]. Furthermore, PDC for controller inhalers decreased significantly ($p < 0.001$) (Table 2).

In comparison to the pre-pandemic period, the percentage of patients who were highly adherent to their treatment dropped from 80.4% to 66% during the pandemic. The percentage of patients who received ICS and LABA decreased from 80.5% to 69.9%. The number of patients who received LABA and LAMA decreased from 57 (5.8%) to 41 (4.1%). However, patients who used the combination of ICS, LABA, and LAMA increased from 47 (4.8%) to 67 (6.8%). The

Table 1. Descriptive data and findings from logistic regression evaluating association between patient characteristics and high adherence to controller inhalers in 2019.

Characteristics	Overall cohort	High adherence	Low adherence	*p* Value	Adjusted odds ratio (95% confidence interval)
	N = 989	795 (80.4%)	194 (19.6%)		
	N (%)	*N* (%)	*N* (%)		
Age, year				0.11	
65–74 (reference)	425 (43.0)	355 (44.7)	70 (36.1)		
75–84	439 (44.4)	340 (42.8)	99 (51)	0.04	0.67 (0.45–0.98)
⩾85	125 (12.6)	100 (12.6)	25 (12.9)	0.66	0.88 (0.49–1.57)
Sex					
Male (reference)	221 (22.3)	180 (22.6)	41 (21.1)		
Female	768 (77.7)	615 (77.4)	153 (78.9)	0.761	0.94 (0.61–1.43)
No. medications				0.33	
8–10 (reference)	215 (21.7)	164 (20.6)	51 (26.3)		
11–13	254 (25.7)	195 (24.5)	59 (30.4)	0.88	0.96 (0.60–1.56)
14–16	211 (21.3)	174 (21.9)	37 (19.1)	0.29	1.34 (0.78–2.29)
17–19	157 (15.9)	134 (16.9)	23 (11.9)	0.1	1.69 (0.90–3.16)
⩾20	152 (15.4)	128 (16.1)	24 (12.4)	0.28	1.44 (0.74–2.79)
No. medication related problems				<0.001	
0	97 (9.8)	88 (11.1)	9 (4.6)	<0.001	4.43 (1.98–9.93)
1	189 (19.1)	153 (19.2)	36 (18.6)	0.04	1.75 (1.04–2.96)
2	167 (16.9)	141 (17.7)	26 (13.4)	0.005	2.28 1.29-4.03)
3	156 (15.8)	129 (16.2)	27 (13.9)	0.008	2.13 (1.22–3.72)
4	92 (9.3)	67 (8.4)	25 (12.9)	0.82	1.07 (0.59–1.95)
⩾5 (reference)	288 (29.1)	217 (27.3)	71 (36.6)		
No. prescribers				0.75	
1–5 (reference)	328 (33.2)	261 (32.8)	67 (34.5)		
6–10	468 (47.3)	370 (46.5)	98 (50.5)	0.66	0.91 (0.61–1.37)
11–15	150 (15.2)	128 (16.1)	22 (11.3)	0.48	1.25 (0.67–2.31)

(Continued)

Table 1. (Continued)

Characteristics	Overall cohort	High adherence	Low adherence	*p* Value	Adjusted odds ratio (95% confidence interval)
	***N* = 989**	**795 (80.4%)**	**194 (19.6%)**		
	***N* (%)**	***N* (%)**	***N* (%)**		
⩾16	43 (4.3)	36 (4.5)	7 (3.6)	0.91	0.94 (0.33–2.66)
No. pharmacies				0.29	
1 (reference)	242 (24.5)	203 (25.5)	39 (20.1)		
2	275 (27.8)	218 (27.4)	57 (29.4)	0.17	0.71 (0.43–1.16)
3	216 (21.8)	170 (21.4)	46 (23.7)	0.11	0.65 (0.39–1.11)
⩾4	256 (25.9)	204 (25.7)	52 (26.8)	0.08	0.63 (0.37–1.06)
No. controlled medication classes				<0.001	
1 (reference)	124 (12.5)	84 (10.6)	40 (20.6)		
2	333 (33.7)	222 (27.9)	111 (57.2)	0.54	0.86 (0.54–1.39)
3	368 (37.2)	327 (41.1)	41 (21.1)	<0.001	2.98 (1.75–5.09)
⩾4	164 (16.6)	162 (20.4)	2 (1.0)	<0.001	29.58 (6.81–128.56)
No. oral corticosteroids fills				0.77	
0 (reference)	384 (38.8)	296 (37.2)	88 (45.4)		
1	249 (25.2)	203 (25.5)	46 (23.7)	0.54	1.15 (0.74–1.79)
2	132 (13.3)	113 (14.2)	19 (9.8)	0.87	1.05 (0.58–1.93)
⩾3	224 (22.6)	183 (23.0)	41 (21.1)	0.56	0.87 (0.58–1.40)
No. albuterol inhalers					
<3 (reference)	306 (30.9)	218 (27.4)	88 (45.4)		
⩾3	683 (69.1)	577 (72.6)	106 (54.6)	0.002	1.82 (1.25–5.64)
90-day supply for inhalers					
No (reference)	650 (65.7)	490 (61.6)	160 (82.5)		
Yes	339 (34.3)	305 (38.4)	34 (17.5)	<0.001	2.23 (1.45–3.44)
Depression					
Yes	229 (23.2)	186 (23.4)	43 (22.2)	0.71	1.09 (0.70–1.70)
No (reference)	760 (76.8)	609 (76.6)	151 (77.8)		

Bonferroni-adjusted *p* value = 0.0045.

Table 2. Adherence and prescribing of controller medications in 2019 and 2020.

Medications	1 January–31 July 2019	1 January–31 July 2020	*p* Value	Patients with less than two fills in January–July 2020
All patients with COPD and asthma (*N* = 989)				
	PDC (Mean ± SD)	PDC (Mean ± SD)		*N* (%)
LABA (*N* = 789)	83.35 ± 20.09	62.55 ± 38.85	<0.001	133 (16.9)
LAMA (*N* = 440)	85.44 ± 18.92	66.06 ± 38.60	<0.001	18 (2.7)
ICS (*N* = 873)	83.68 ± 20.22	63.45 ± 38.78	<0.001	155 (17.8)
Theophylline (*N* = 21)	90.33 ± 18.83	53.19 ± 46.76	<0.001	5 (23.8)
Leukotriene (*N* = 555)	90.04 ± 15.90	70.68 ± 39.00	<0.001	58 (10.4)
Proportion of individuals with high adherence to controllers (*N* = 989)				
	N (%)	*N* (%)		
LABA (*N* = 789)	532 (67.4)	388 (49.2)		
LAMA (*N* = 324)	229 (70.7)	180 (55.6)		
ICS (*N* = 873)	599 (68.6)	438 (50.2)		
Theophylline (*N* = 21)	18 (85.7)	11 (52.4)		
Leukotriene (*N* = 555)	460 (82.9)	439 (79.1)		
Proportion of patients with at least one combination inhaler (*N* = 989)				
	N (%)	*N* (%)		
ICS and LABA	796 (80.5)	691 (69.9)		
ICS, LABA, and LAMA	47 (4.8)	67 (6.8)		
LABA and LAMA	57 (5.8)	41 (4.1)		

COPD, chronic obstructive pulmonary disease; ICS, inhaled corticosteroids; LABA, long-acting β2-agonists; LAMA, long-acting muscarinic antagonists; PDC, proportion of days covered; SD, standard deviation.

number and percentage of patients who received oral corticosteroids decreased from 605 (61.2%) in 2019 to 424 (42.9%) in 2020.

In the regression model of 2019, variables that were associated with high adherence to controllers were number of MRPs ($p < 0.001$), number of maintenance inhalers ($p < 0.001$), having ⩾3 albuterol inhalers [odds ratio (OR), 1.82; 95% confidence interval (CI), 1.25–2.64; $p < 0.001$], and a 90-day supply for controller medications (OR, 2.23; 95% CI, 1.45–3.44; $p < 0.001$). Patients without medication-related problems had odds of 1.98–9.93 times for being adherent to controller medications compared to patients with more than five MRPs. Patients with ⩾3 controller medication classes were 2.98–29.58 times the odds of being adherent to controller medications *versus* patients with one controller ($p < 0.001$) (Table 1).

In 2020 regression model, variables that were associated with high adherence to maintenance medications included number of controller medication classes ($p < 0.001$), and a 90-day supply for controller medications (OR, 4.26; 95% CI, 2.91–6.23; $p < 0.001$), as described in Table 3.

Table 3. Results from logistic regression evaluating association between patient characteristics and adherence to controller medications in 2020 (*N* = 989).

Characteristic	Overall cohort	High adherence	Low adherence	*p* Value	Adjusted odds ratio (95% confidence interval)
	N = 989	*N* = 653 (66%)	*N* = 336 (34%)		
	N (%)	*N* (%)	*N* (%)		
Age, year				0.94	
65–74 (reference)	425 (43.0)	290 (44.4)	135 (40.2)		
75–84	439 (44.4)	287 (44)	152 (45.2)	0.86	0.97 (0.67–1.4)
⩾85	125 (12.6)	76 (11.6)	49 (14.6)	0.74	0.91 (0.52–1.58)
Sex					
Male (reference)	221 (22.3)	145 (22.2)	76 (22.6)		
Female	768 (77.7)	508 (77.8)	260 (77.4)	0.992	1 (0.66–1.51)
No. medications				0.07	
8–10 (reference)	215 (21.7)	118 (18.1)	97 (28.9)		
11–13	254 (25.7)	168 (25.7)	86 (25.6)	0.12	1.47 (0.91–2.39)
14–16	211 (21.3)	141 (21.6)	70 (20.8)	0.37	1.28 (0.75–2.17)
17–19	157 (15.9)	110 (16.8)	47 (14)	0.02	2.1 (1.14–3.84)
⩾20	152 (15.4)	116 (17.8)	36 (10.7)	0.02	2.18 (1.15–4.13)
No. medication related problems				0.37	
0	97 (9.8)	69 (10.6)	28 (8.3)	0.87	1.06 (0.54–2.08)
1	189 (19.1)	120 (18.4)	69 (20.5)	0.87	1.04 (0.62–1.75)
2	167 (16.9)	117 (17.9)	50 (14.9)	0.57	0.85 (0.49–1.48)
3	156 (15.8)	95 (14.5)	61 (18.2)	0.47	0.82 (0.48 -1.40)
4	92 (9.3)	66 (10.1)	26 (7.7)	0.08	1.81 (0.93–3.54)
⩾5 (reference)	288 (29.1)	186 (28.5)	102 (30.4)		
No. prescribers				0.26	
1–5 (reference)	454 (45.9)	263 (40.3)	191 (56.8)		
6–10	401 (40.5)	291 (44.6)	110 (32.7)	0.04	1.48 (1.01–2.17)
11–15	113 (11.4)	83 (12.7)	30 (8.9)	0.49	1.24 (0.68–2.28)
⩾16	21 (2.1)	16 (2.5)	5 (1.5)	0.72	1.26 (0.36–4.44)
No. pharmacies				0.24	
1 (reference)	242 (24.5)	167 (25.6)	75 (22.3)		

(Continued)

Table 3. (Continued)

Characteristic	Overall cohort	High adherence	Low adherence	*p* Value	Adjusted odds ratio (95% confidence interval)
	N **= 989**	***N*** **= 653 (66%)**	***N*** **= 336 (34%)**		
	N **(%)**	***N*** **(%)**	***N*** **(%)**		
2	275 (27.8)	179 (27.4)	96 (28.6)	0.97	0.99 (0.62–1.59)
3	216 (21.8)	142 (21.7)	74 (22)	0.26	0.75 (0.45–1.24)
⩾4	256 (25.9)	165 (25.3)	91 (27.1)	0.09	0.65 (0.39–1.07)
No. controlled medication classes				<0.001	
1 (reference)	263 (26.6)	68 (10.4)	195 (58)		
2	245 (24.8)	163 (25)	82 (24.4)	<0.001	6.35 (4.11–9.82)
3	301 (30.4)	259 (39.7)	42 (12.5)	<0.001	15.01 (9.28–24.27)
⩾4	180 (18.2)	163 (25)	17 (5.1)	<0.001	23.28 (12.41–43.69)
No. oral corticosteroids fills				0.08	
0 (reference)	565 (57.1)	356 (54.5)	209 (62.2)		
1	171 (17.3)	106 (16.2)	65 (19.3)	0.07	0.65 (0.41–1.04)
2	95 (9.6)	79 (12.1)	16 (4.8)	0.2	1.56 (0.79–3.11)
⩾3	158 (16)	112 (17.2)	46 (13.7)	0.23	0.74 (0.44–1.22)
No. albuterol inhalers					
<3 (reference)	357 (36.1)	188 (28.8)	169 (50.3)		
⩾3	632 (63.9)	465 (71.2)	167 (49.7)	0.029	1.5 (1.04–2.16)
90-day supply for inhalers					
No (reference)	580 (58.6)	311 (47.6)	269 (80.1)		
Yes	409 (41.4)	342 (52.4)	67 (19.9)	<0.001	4.26 (2.91–6.23)
Adherent to any inhalers in 2019					
No (reference)	194 (19.6)	92 (14.1)	102 (30.4)		
Yes	795 (80.4)	561 (85.9)	234 (69.6)	0.005	1.82 (1.2–2.76)
Depression					
Yes	229 (23.2)	163 (25.0)	66 (19.6)	0.857	1.04 (0.67–1.61)
No (reference)	760 (76.8)	490 (75.0)	270 (80.4)		

Bonferroni-adjusted *p* value = 0.0042.

Discussion

This is the first study to investigate the medication prescribing patterns, medication adherence, and the predictors of high adherence in Medicare-enrolled, MTM-eligible older adults with asthma and COPD before and during the COVID-19 pandemic. This study found that adherence to maintenance controllers was negatively impacted by the COVID-19 pandemic based on the decreased PDC rate in the first several months of the pandemic compared to a pre-pandemic period. Predictors for high adherence to maintenance medication in 2019 and 2020 included multiple numbers of controller medication classes and having a 90-day supply of controller medications. These findings indicated that access to medications may have been disrupted during the first few months of the pandemic among older patients with COPD and asthma overlap.

The proportion of individuals who were adherent to any controller medication declined to varying degrees depending on the medication class during the pandemic, which aligns with our previous findings in patients with asthma or COPD alone. In general, the low adherence to controller inhalers may have stemmed from the lack of knowledge about the essential role of controller medication for the management of asthma and COPD, difficulties with access to and the use of the inhalers during the pandemic, high cost, use of multiple medications, and distant pharmacies.[19,20] Landete *et al.*[21] reported only 51.1% of patients with asthma and 45.7% of patients with COPD had a PDC rate over 80% during the pandemic. Our previous studies found 66% of asthma patients and 58.1% of COPD patients had high adherence during the pandemic.[17,18] Social distancing policies limited access to the family caregivers, making some older adults experience health instability.[22] Further, older adults might not be able to afford their medications due to the economic insecurity triggered by the pandemic.[23] These factors may contribute to decreased adherence.

The present findings indicated that patients with a 90-day supply were more adherent to controller medications compared to those without 90-day supply of medications. Rymer *et al.*[24] suggested that a 90-day supply may improve medication adherence relative to a 30-day supply. Similarly, Taitel *et al.*[25] found that medication adherence in Medicaid patients was 20% higher when patients received a 90-day supply compared to a 30-day supply. We had observed 90-day supply to be associated with high medication adherence in our previous work.[17,18] Therefore, the 90-day supply should be preferred during the pandemic to sustain high medication adherence.

Ease of use and device suitability are two main factors that need to be considered when choosing inhalers for older patients with respiratory disorders.[26] Landete *et al.*[21] recommended inhalers for COPD and asthma control should be chosen based on the ease of use during the pandemic. Accordingly, we observed an increased proportion (from 4.8% to 6.8%) of patients prescribed with ICS–LABA–LAMA inhaler, which only requires a single inhalation once daily, during the pandemic compared to pre-pandemic period.

Overall, about 80% of patients were prescribed more than 10 medications by multiple prescribers in both 2019 and 2020. Polypharmacy was a common problem in older adults, and it has been associated with adverse drug events, medication nonadherence, and decreased quality of life.[27,28] In this study, we did not observe a significant association between the number of medications and high adherence, in part because all patients were receiving eight or more medications concurrently. However, polypharmacy can increase the risk of MRPs,[29] which can contribute to reduced quality of life, falls, and hospitalization.[30] Patients with potentially inappropriate medication use were more likely to be nonadherent to the prescribed medications.[31] Similarly, we discovered that patients with no MRPs were more likely to be adherent to medications in the 2019 regression model. Patients with greater number of controller medication classes were associated with high adherence. This finding was consistent with the health belief that the severity of disease or intensity of symptoms was associated with increased adherence.[32] This can be explained by the presence of higher symptom burden in association with more severe disease in those with COPD and asthma to achieve symptom relief and improve quality of life with the use of multiple medication classes.

The number of pharmacies was not a significant predictor of high adherence in this study. However,

we observed a trend that with more pharmacies, patients were less likely to adhere to the medication. Studies have shown that more pharmacies and pharmacy visits were associated with lower medication adherence, and using a single pharmacy was associated with high medication adherence.[33,34] Receipt of all medications from a single pharmacy can facilitate maintenance of a complete medication list for each patient to optimize drug utilization and resolve polypharmacy and MRPs.[35]

Our study revealed that 69.1% of patients in 2019 and 63.9% of patients in 2020 had ⩾3 albuterol rescue inhaler fills. Jansen *et al.* found that 30% adults with asthma overused short-acting beta-2 agonists (SABA) in Sweden, 38% of patients overused SABA in the UK, and the overuse rate was 58% among individuals with moderate to severe asthma.[36] Previous studies also observed that more than 50% of older patients with asthma or COPD processed more than three albuterol inhalers in first 7 months of 2019 and 2020.[17,18] Overuse of rescue inhalers to control symptoms can increase the risk of exacerbations and mortality in both COPD and asthma population.[37,38] Moreover, SABA overuse may lead to adverse effects such as depression, tachycardia, vasodilation, and tremor.[39] Healthcare providers including pharmacists may identify rescue inhaler overuse and resolve MRPs, while monitoring patients with ACO.[40] Our study also showed that the oral corticosteroid fill claims decreased during the first few months of 2020, which may have been a result of preventive measures such as the facemask use and social distancing policies.[41]

Limitations

This study had several limitations. First, Medicare-enrolled beneficiaries from a single insurance plan provider were included in this study. Therefore, it may not represent the entire Medicare population. Inclusion criteria for ACO in this study required the utilization of two diagnosis codes for COPD and asthma. However, patients may have been initially diagnosed with asthma and later found to have COPD, and vice versa. Furthermore, medication adherence during the pandemic may have been underestimated since this study only examined the prescription claims from the first 7 months of 2020. Despite using PDC to estimate adherence, it was not possible to definitively determine whether patients utilized the prescribed medications as intended. We cannot demonstrate the specific reasons accounting for the decreased adherence. The percentage of patients who used LAMA in the high adherence group was not investigated. The impact of dosing frequency on adherence was not assessed in this study as well. Additionally, this study was not designed to determine the influence of out-of-pocket medication costs on adherence. Lastly, since COVID-19 infection data were not available in this database, the direct effect of COVID-19 infection on medication adherence could not be determined.

Conclusion

Numerous medications were often prescribed concurrently by multiple prescribers and obtained from multiple pharmacies among older patients with asthma and COPD during the pre-pandemic and pandemic periods. Decreased medication adherence was observed in the first few months of pandemic compared to pre-pandemic in this population. Results from this study revealed that the COVID-19 pandemic negatively influenced medication adherence. Patients with more controller medication classes and a 90-day supply were more likely to adhere to the inhalers. A 90-day supply of medications should be used to increase access to medication when access to pharmacies is disrupted during the pandemic. Healthcare professionals, including pharmacists, should assess medication adherence and resolve the barriers of adherence and MRPs to achieve desired clinical outcomes in the older adults with ACO.

Declarations

Ethics approval and consent to participate

This study was approved by The Ohio State University Biomedical Science Institutional Review Board (22 September 2020; Study Title: Assessment of Medication Prescribing and Adherence in Older Adults with Asthma and Chronic Obstructive Pulmonary Disease; Study ID: 2020H0393). Written and verbal informed consent were waived by the Institutional Review Board.

Consent for publication

Not applicable.

Author contributions

Ligang Liu: Conceptualization; Data curation; Formal analysis; Software; Writing – original draft; Writing – review & editing.

Armando Silva Almodóvar: Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Software; Writing – review & editing.

Milap C. Nahata: Conceptualization; Funding acquisition; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing – review & editing.

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

Not applicable.

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Supplemental material

Supplemental material for this article is available online.

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