

# Utilization Patterns and Trends in the Use of Medications for Asthma in a Cohort of Colombian Patients

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**Purpose:** Asthma affects approximately 358 million people worldwide. This study aimed to determine the trend for the use of medications intended to treat asthma in a group of patients affiliated with the Colombian health system.

**Patients and Methods:** This was a retrospective study on prescription patterns of medications used to treat asthma in patients over 5 years of age between 2017 and 2019. Sociodemographic variables, medications used and combinations, the persistence of use, and prescribing physicians were considered. Data were obtained from a drug-dispensing database from Colombia.

**Results:** A total of 10,706 people diagnosed with asthma were identified, including predominantly females (56.8%), with a mean age of  $32.2 \pm 26.1$  years. At the beginning of the follow-up, 53.2% of patients aged 5–11 years were receiving monotherapy, with a mean of  $1.5 \pm 0.6$  drugs/patient, especially inhaled corticosteroids (ICSs; 55.9%) and short-acting  $\beta$ -agonists (SABAs; 55.6%). Moreover, in patients older than 12 years, 53.5% were treated with monotherapy, with a mean of  $1.6 \pm 0.7$  drugs/patient, 45.9% of whom were on SABAs, while 37.1% were on ICSs. Between 63.0% and 83.6% of patients were treated by a general practitioner. 12.5% of patients ( $n = 495$ ) received triple therapy (ICS/LABA + LAMA [long-acting antimuscarinic]), particularly fluticasone/salmeterol + tiotropium.

**Conclusion:** The identification of treatment patterns will allow physicians and decision makers to implement strategies in order to promote adherence to treatment and improve asthma medication use.

**Keywords:** asthma, anti-asthma agents, adrenergic beta-agonists, cholinergic antagonists, corticosteroids, pharmacoepidemiology

## Introduction

Asthma has been estimated to affect approximately 358 million people worldwide, whilst 397,000 deaths each year are related to the disease, with data showing that the prevalence increased by 12.6% between 1990 and 2015 despite a 26.7% decrease in mortality over the same period.<sup>1</sup>

The scarce information in Colombia estimates that the prevalence is close to 9%, with the underdiagnosis rate being up to 69.9%, and the most affected group to be between 5 and 17 years of age.<sup>2</sup> Asthma is one of the most common chronic diseases in children, leading to an increase in the number of hospital visits and costs for the healthcare system.<sup>3,4</sup>

From a pathophysiological perspective, asthma is characterized by airway inflammation and high reactivity to environmental stimuli, leading to inflammatory cell infiltration and chronic changes such as epithelial thickening, smooth muscle hypertrophy, increased mucus-producing glands, and symptoms such as wheezing, dyspnea, cough, and chest tightness.<sup>5,6</sup>

Treatment of asthma focuses primarily on reduction and control of inflammation with the use of inhaled corticosteroids (ICSs) and the use of short-acting  $\beta$ -agonists (SABAs) for episodes of bronchospasm, as well as a combination of ICSs + long-acting  $\beta$ -agonists (LABAs) in patients with uncontrolled asthma, and other medications such as anti-leukotrienes, long-acting muscarinic antagonists, systemic corticosteroids, or biological agents for more severe cases.<sup>7–9</sup>

From an environmental perspective, in Colombia in 2019, 92.7% of the air pollution monitoring stations show data below the permitted level, only exceeding the maximum level ( $50 \mu\text{g}/\text{m}^3$  of minor particulate matter to 10 microns) in the regions of the metropolitan areas of Medellín, Cali, Bogotá, and Sogamoso,<sup>10</sup> and the frequency of cigarette consumption has been estimated to be between 7.4% and 34.1%, with variations among cities in the country.<sup>11</sup> The Colombian Asthma Guidelines published in 2013 recommend administering a SABA as a rescue medication to improve acute asthma symptoms and ICSs in children of all ages with partially controlled asthma.<sup>12</sup> The mentioned above guidelines are consistent with the health benefit plan (social security insurance plan) for patients affiliated with the Colombian Healthcare System, which includes short-acting bronchodilators, such as terbutaline, salbutamol, and ipratropium bromide, ICS, such as beclomethasone, leukotriene inhibitors, antihistamines, and systemic corticosteroids, but does not include or cover other inhalers or any of the long-acting bronchodilators,<sup>13,14</sup> which, in combination with ICSs, are the agents of choice for uncontrolled asthma according to international clinical practice guidelines.<sup>9</sup> Thus, patients and physicians may have additional access barriers to these control therapies. Therefore, the aim of this study was to determine the trend for the use of asthma medications, in order to gain a better understanding of the therapies used in Colombia.

## Materials and Methods

A retrospective study on the prescription patterns of bronchodilators and other medications used in the treatment of asthma was conducted using a population-based database of medication dispensing from Audifarma S.A., the largest logistics operator in the country, with data from more than 8.5 million people affiliated with the Colombian Healthcare System in six different insurance companies. All patients of either sex over 5 years of age with an asthma diagnosis were enrolled according to the International Classification of Diseases version 10.0 (ICD-10 codes: J450, J451, J458, J459), with dispensations of any control or rescue medication between 1 July 2017 and 30 June 2019. Patients under 5 years of age diagnosed with asthma were excluded.

From the medication consumption information for the population meeting the inclusion criteria, a database was constructed containing the following data.

1. Sociodemographic: Sex, age (recorded at the time of first dispensation), and city and department of care grouped by geographical area according to the regions of Colombia considering the classification of the National Administrative Department of Statistics (DANE) of Colombia. According to age, patients were categorized into childhood asthma (5–11 years) and adolescent or adult asthma ( $\geq 12$  years).
2. Comorbidities: Diagnoses identified as comorbidities according to ICD-10 codes during the observation period.
3. Prescribing physician: The prescribing physician's specialty.
4. Medications used for asthma: For each medication, the dosage form and dispensing date were identified. They were classified as a) short-acting (SABAs: salbutamol, others) – (used for asthma rescue medication (outpatient symptom management), long-acting (LABAs: salmeterol, formoterol, others), and ultralong-acting (U-LABAs: indacaterol, vilanterol)  $\beta_2$ -adrenergic agonists; b) short-acting (SAMAs: ipratropium), long-acting (LAMAs: tiotropium), and ultralong-acting (U-LAMAs: glycopyrronium, umeclidinium) muscarinic antagonists; c) ICSs: beclomethasone, budesonide, fluticasone, others; d) ICS/LABA combinations; e) LAMA/LABA combinations; and f) other drugs: theophylline, oral systemic corticosteroids, leukotriene antagonists, and biological agents (omalizumab, mepolizumab, benralizumab). A treatment-naïve patient was defined as an individual who received a bronchodilator for the first time. Persistence of use was estimated by the proportion of effective drug delivery at 12 and 24 months after the first prescription.
5. Treatment regimens: Whether the drugs were used as monotherapy or in combination was identified. The main combinations found were described. The use of a LABA + LAMA + ICS combination was categorized as triple therapy.
6. Concomitant medications: Medications prescribed for other indications identified during the study period were described.

This database does not include clinical information and thus the disease severity and other clinical variables could not be included.

## Statistical Analysis

The data were analyzed with the statistical package SPSS Statistics, version 26.0 for Windows (IBM, USA). A descriptive analysis was performed with frequencies and proportions for qualitative variables and central tendency and dispersion measures for quantitative variables. For these quantitative variables, normality was initially tested using the Kolmogorov–Smirnov test. For variables with normal behavior, the means and standard deviations are presented, and for variables without normality, the medians and interquartile ranges are presented.

## Bioethical Considerations

The protocol received endorsement from the Bioethics Committee of the Universidad Tecnológica de Pereira under the classification of “no risk” research (approval code: 01-100220). According to Resolution 8430 of 1993 of the Ministry of Health of Colombia, risk-free research does not require the signing of an informed consent if it is information obtained from databases or clinical records. The research was carried out with the authorization of Audifarma SA, the drug dispensing company that owns the database. The principles for the confidentiality of information established by the Declaration of Helsinki were observed.

## Results

A total of 10,706 participants diagnosed with asthma were evaluated during the observation period (asthma 5–11 years:  $n = 3973$ ; asthma  $\geq 12$  years:  $n = 6733$ ), with a female predominance among those over 12 years and a male predominance among those aged 5–11 years. The region with the most cases was Bogotá D.C., followed by the Atlantic and southwest regions. [Table 1](#) depicts the data according to sex, age, and region of dispensation.

Approximately 23.8% ( $n = 2482$ ) of patients had some comorbidities, most commonly found in patients aged 12 years or older (34.0%), while they were present in only 6.4% of patients between 5 and 11 years of age. The most prevalent comorbidities were allergic rhinitis in patients with childhood asthma and arterial hypertension, allergic rhinitis, diabetes mellitus, and hypothyroidism in adolescents and adults. A total of 28.0% ( $n = 2999$ ) of the patients were prescribed some other medication in addition to those required for asthma treatment, with the most common being antihypertensive and antihistamine drugs (see [Table 1](#)).

## Childhood Asthma (5–11 Years)

Of the 3973 patients identified at baseline of the observation period, 2115 (53.2%) a single asthma medication, 1562 (39.3%) two medications, and the remaining 296 (7.5%) patients were receiving between three and five medications. Regarding the prescribing physician, 2503 (58.0%) cases were being treated by a general practitioner and 1002 (25.2%) by a pediatrician.

[Table 2](#) shows the number of drugs per patient, the specialty of the prescribing physician, the type of drug used, and the main combinations used at the time of the initial observation and after 12 and 24 months of follow-ups.

ICSs were the most often prescribed group of drugs at baseline during the observation period (55.9%), with beclomethasone being the most frequently used, followed by SABAs, where salbutamol was the most commonly dispensed. Control monotherapy with beclomethasone was used in 685 patients (17.2%). Additionally, 201 patients (5.1%) were treated with LABA + ICS at baseline, mainly salmeterol/fluticasone. [Table 3](#) presents the most commonly used medications by frequency at the start of the follow-up, as well as the persistence of use in the first 12 and 24 months.

## Asthma in Adolescents and Adults ( $\geq 12$ Years)

Of the 6733 patients identified at baseline during the observation period, 3600 (53.5%) a single medication, 2412 (35.8%) two medications, and the remaining 721 (10.7%) three or four medications for asthma management. In addition, most patients were mainly treated by a general practitioner ( $n = 5627$ ; 83.6%) or a pulmonologist ( $n = 221$ ; 3.3%). ([Table 2](#)).

SABAs were the most commonly used medications at baseline, especially salbutamol, followed by ICSs ( $n = 2495$ , 37.1%), particularly beclomethasone. A total of 1710 patients (25.4%) were identified as receiving LABA + ICS therapy at baseline, mainly salmeterol/fluticasone ( $n = 983$ ; 14.6%) and formoterol/budesonide ( $n = 791$ ; 11.7%) ([Table 3](#)).

**Table 1** Sociodemographic Characteristics, Regions of Origin, Comorbidities, and Concomitant Medications in a Group of Patients with Asthma in Colombia

Variables – n (%)	Asthma, Children (5–11 Years)	Asthma, Children ≥ 12 Years and Adults	Total
	n = 3973	n = 6733	N = 10,706
Sex, male	2251 (56.7)	2377 (35.3)	4628 (43.2)
Age (mean, SD)	6.4 (2.3)	47.4 (21.3)	32.2 (26.1)
Region of dispensation			
Bogota D.C.	1523 (38.3)	2499 (37.1)	4022 (37.6)
Atlantic	1269 (31.9)	1618 (24.0)	2887 (27.0)
South-West	216 (5.4)	801 (11.9)	1017 (9.5)
Coffee Axis (central)	421 (10.6)	785 (11.7)	1206 (11.3)
Antioquia/Chocó	303 (7.6)	590 (8.8)	893 (8.3)
Santanderes	183 (4.6)	238 (3.5)	421 (3.9)
Tolima/Huila	40 (1.0)	145 (2.2)	185 (1.7)
Eastern plains	18 (0.5)	57 (0.8)	75 (0.7)
Treatment-naïve patient	989 (24.9)	1493 (22.2)	2482 (23.2)
Comorbidities	255 (6.4)	2291 (34.0)	2546 (23.8)
Comorbidities (mean, SD)	0.1 (0.3)	0.4 (0.7)	0.3 (0.6)
Arterial hypertension	0	1526 (22.7)	1526 (14.3)
Allergic rhinitis	152 (3.8)	205 (3.0)	357 (3.3)
Diabetes mellitus	16 (0.4)	290 (4.3)	306 (2.9)
Hypothyroidism	27 (0.7)	229 (3.4)	256 (2.4)
Depression	1 (0.0)	117 (1.7)	118 (1.1)
Dyslipidemia	2 (0.1)	95 (1.4)	97 (0.9)
Obesity	5 (0.1)	77 (1.1)	82 (0.8)
Gastroesophageal reflux	23 (0.6)	55 (0.8)	78 (0.7)
Chronic kidney disease	0	65 (1.0)	65 (0.6)
Osteoporosis	0	56 (0.8)	56 (0.5)
Migraine	3 (0.1)	44 (0.7)	47 (0.4)
Heart failure	0	45 (0.7)	45 (0.4)
Atopic dermatitis	24 (0.6)	13 (0.2)	37 (0.3)
Rheumatoid arthritis	1 (0.0)	34 (0.5)	34 (0.3)
Anxiety	0	27 (0.4)	27 (0.3)
Obstructive sleep apnea	1 (0.0)	22 (0.3)	23 (0.2)
Ischemic heart disease	0	12 (0.2)	12 (0.1)
Myocardial Infarction	0	4 (0.1)	4 (0.0)
Nasal polyps	1 (0.0)	2 (0.0)	3 (0.0)
Peripheral vascular disease	0	2 (0.0)	2 (0.0)
Cancer	0	0	0 (0.0)
Comedications	11 (0.3)	2988 (44.4)	2999 (28.0)
Antihistamines	9 (0.2)	2085 (31.0)	2094 (19.6)
Antibiotics	7 (0.2)	1902 (28.2)	1909 (17.8)
Nonopioid analgesics	6 (0.2)	1711 (25.4)	1717 (16.0)
Antiulcer agents	4 (0.1)	1509 (22.4)	1513 (14.1)
Antihypertensives and diuretics	2 (0.1)	1251 (18.6)	1253 (11.7)
Opioid analgesics	1 (0.1)	1221 (18.1)	1222 (11.4)
Hypolipidemic agents	1 (0.1)	1111 (16.5)	1112 (10.4)
Intestinal antispasmodics	3 (0.1)	890 (13.2)	893 (8.3)
Antidepressants	2 (0.1)	628 (9.3)	630 (5.9)
Thyroid hormone	2 (0.1)	461 (6.8)	463 (4.3)
Antidiabetics	2 (0.1)	381 (5.7)	383 (3.6)
Antiepileptics	0	354 (5.3)	354 (3.3)
Antipsychotics	0	105 (1.6)	105 (1.0)
Anxiolytics	1 (0.0)	104 (1.5)	105 (1.0)
Anti-dementia drugs	0	23 (0.3)	23 (0.2)
Antiparkinsonians	0	22 (0.3)	22 (0.2)

**Table 2** Frequencies of Use of Medications for the Treatment of Asthma by Age Group and During the Different Observation Time Points in a Group of Patients with Asthma in Colombia

Medication Use	Asthma, Children (5–11 Years)			Asthma, Children ≥ 12 Years, Adults		
	Index Dispensation	Month 12	Month 24	Index Dispensation	Month 12	Month 24
	N = 3973	N = 3973	N = 3973	N = 6733	N = 6733	N = 6733
	Frequency - n (%)	Frequency - n (%)	Frequency - n (%)	Frequency - n (%)	Frequency - n (%)	Frequency - n (%)
Salbutamol, systemic		8 (0.2)				
Salbutamol, inhaled	2302 (57.9)	795 (20.0)	329 (8.3)	3558 (52.8)	2049 (30.4)	1162 (17.2)
Terbutaline	0	1 (0.0)	0	3 (0.0)	3 (0.0)	3 (0.0)
Levosalbutamol	4 (0.1)	2 (0.1)	4 (0.1)	6 (0.1)	24 (0.4)	14 (0.2)
Ipratropium	191 (4.8)	65 (1.6)	24 (0.6)	934 (13.9)	803 (11.9)	453 (6.7)
Ipratropium/Salbutamol				1 (0.01)		
Ipratropium/Fenoterol	2 (0.05)	3 (0.1)	2 (0.1)			
Indacaterol				6 (0.1)	6 (0.1)	5 (0.1)
Glycopyrronium				16 (0.2)	24 (0.4)	17 (0.3)
Umeclidinium				0	2 (0.0)	4 (0.1)
Tiotropium	1 (0.0)	0	0	158 (2.3)	258 (3.8)	240 (3.6)
Beclomethasone	1994 (50.2)	528 (13.3)	212 (5.3)	2472 (36.8)	1128 (16.8)	494 (7.3)
Budesonide	68 (1.7)	37 (0.9)	16 (0.4)	10 (0.1)	7 (0.1)	5 (0.1)
Fluticasone	158 (3.0)	131 (3.3)	60 (1.5)	13 (0.2)	12 (0.2)	4 (0.1)
Mometasone				2 (0.02)	1 (0.0)	0
Budesonide/Formoterol	38 (1.0)	55 (1.4)	42 (1.05)	791 (11.7)	804 (11.9)	605 (9.0)
Mometasone/Formoterol	1 (0.0)	0 (0.0)	0	41 (0.6)	29 (0.4)	21 (0.3)
Fluticasone/Salmeterol	161 (4.1)	176 (4.4)	93 (2.3)	983 (14.6)	943 (14.0)	648 (9.6)
Fluticasone/Vilanterol	0 (0.0)	0	0	1 (0.01)	15 (0.2)	47 (0.7)
Fluticasone/Formoterol	1 (0.03)			27 (0.4)	48 (0.7)	30 (0.4)
Beclomethasone/Formoterol				0	1 (0.01)	1 (0.01)
Glycopyrronium/Indacaterol				10 (0.1)	33 (0.5)	30 (0.4)
Umeclidinium/Vilanterol				0	2 (0.0)	8 (0.1)
Tiotropium/Olodaterol				7 (0.1)	18 (0.3)	17 (0.3)
Prednisone	45 (1.2)	22 (0.5)	6 (0.2)	311 (4.6)	189 (2.8)	71 (1.0)
Prednisolone	471 (11.8)	168 (4.2)	49 (1.2)	456 (6.8)	358 (5.3)	170 (2.5)
Methylprednisolone				1 (0.01)	4 (0.06)	2 (0.03)
Deflazacort				8 (0.1)	9 (0.1)	8 (0.1)
Montelukast	705 (17.7)	539 (13.6)	261 (6.56)	745 (11.1)	751 (11.2)	389 (5.7)
Theophylline	3 (0.1)	0	0	93 (1.4)	105 (1.6)	68 (1.0)
Omalizumab	0	0	1 (0.0)	9 (0.1)	20 (0.3)	24 (0.4)
Mepolizumab	0	0	1 (0.0)	0	0	1 (0.0)

## Triple Therapy

A total of 495 (12.5%) patients were identified as receiving triple therapy (LABA + LAMA + ICS) during the follow-up, only two of whom were in the 5- to 11-year-old group. The most frequently used combination was fluticasone/salmeterol + tiotropium, followed by budesonide/formoterol + tiotropium. Table 4 shows the characteristics according to age, sex, prescribing physician's specialty, time elapsed since the first formulation at the beginning of the observation period until they initiated triple therapy, and previously used medications.

**Table 3** Prescribing Patterns, Frequency of Medication Use, and Combinations Used in a Group of Asthma Patients in Colombia

	Asthma, Children (5–11 Years)			Asthma, Children ≥ 12 Years and Adults		
	Dispensation Baseline	Month 12	Month 24	Dispensation Baseline	Month 12	Month 24
<b>Variables</b>	N = 3973	N = 1297	N = 650	N = 6733	N = 3582	N = 2454
Number of different medications, mean (SD)	1.5 (0.6)	0.64 (1.1)	0.27 (0.6)	1.6 (0.7)	1.1 (1.3)	0.6 (1.0)
<b>Number of different medications for asthma</b>						
0	0 (0.0)	2676 (NA)	3213 (NA)	0 (0.0)	3151 (NA)	4175 (NA)
1	2115 (53.2)	505 (38.9)	513 (67.5)	3600 (53.5)	1193 (33.3)	1309 (51.2)
2	1562 (39.3)	434 (33.5)	189 (24.9)	2412 (35.8)	1315 (36.7)	813 (31.8)
3	277 (7)	291 (22.4)	49 (6.4)	662 (9.8)	679 (19.0)	308 (12.0)
4	18 (0.5)	53 (4.1)	9 (1.2)	59 (0.9)	259 (7.2)	100 (3.9)
≥ 5	1 (0.0)	14 (1.1)	0 (0.0)	0 (0.0)	136 (3.8)	28 (1.1)
<b>Prescribing physician</b>						
General practitioner	2503 (63.0)			5627 (83.6)		
Pediatrician/Internal medicine	1002 (25.2)			168 (2.5)		
Neurology	124 (3.1)			88 (1.3)		
Pneumonologist	109 (2.8)			221 (3.3)		
Allergology specialist	60 (1.5)			77 (1.1)		
Other	175 (4.4)			552 (8.2)		
<b>Short-acting bronchodilators</b>						
SABA	2208 (55.6)	758 (58.4)	314 (48.3)	3093 (45.9)	1584 (44.2)	915 (37.3)
SAMA	93 (2.3)	18 (1.4)	6 (0.9)	461 (6.9)	321 (9.0)	196 (8.0)
SABA + SAMA	98 (2.5)	45 (3.5)	18 (2.8)	473 (7.0)	478 (13.3)	256 (10.4)
SABA/SAMA	2 (0.05)	3 (0.2)	2 (0.3)	5 (0.07)	9 (0.3)	7 (0.3)
<b>Control therapy</b>						
ICS	2220 (55.9)	669 (51.6)	283 (43.5)	2495 (37.1)	965 (26.9)	438 (17.8)
LAMA alone	1 (0.03)	0 (0.0)	0 (0.0)	45 (0.7)	14 (0.4)	24 (1.0)
LABA alone	0 (0.0)	0 (0.0)	0 (0.0)	6 (0.1)	4 (0.1)	4 (0.2)
ICS/LABA	201 (5.06)	230 (17.7)	135 (20.8)	1710 (25.4)	1545 (43.1)	1110 (45.2)
ICS + LABA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.03)	0 (0.0)
LAMA/LABA	0 (0.0)	0 (0.0)	0 (0.0)	13 (0.2)	30 (0.8)	37 (1.5)
LAMA + LABA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.04)
ICS + LAMA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (0.2)	4 (0.2)
Triple therapy	0 (0.0)	0 (0.0)	0 (0.0)	133 (2.0)	280 (7.8)	245 (10.0)
<b>Other control therapy</b>						
Theophylline	3 (0.1)	0 (0.0)	0 (0.0)	93 (1.4)	105 (2.9)	68 (2.7)
Omalizumab	0 (0.0)	0 (0.0)	1 (0.1)	9 (0.1)	20 (0.6)	24 (1.0)
Mepolizumab	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	1 (0.04)
Montelukast	705 (17.7)	539 (41.6)	261 (40.2)	745 (11.1)	751 (20.1)	389 (15.9)
OCS	515 (13.0)	188 (14.5)	55 (8.5)	773 (11.5)	531 (14.8)	241 (9.8)

**Abbreviations:** SABA: short-acting beta agonist. SAMA: short-acting beta agonist. ICS: inhaled corticosteroids. LABA: long-acting beta agonist. LAMA: long-acting muscarinic antagonist. OCS: oral corticosteroids.

## Discussion

This study identified patterns of medication use in children, adolescents, and adults diagnosed with asthma, as well as the most frequent comorbidities, commonly used concomitant medications, combinations of asthma control medications, and persistence of use.

**Table 4** Sociodemographic and Prescribing Characteristics and Frequency of Triple Therapy Use Patterns (LABA, LAMA, ICS) in a Group of Colombian Patients with Asthma

<b>Patients with Triple Therapy</b>	<b>Asthma, Children (5–11 Years)</b>	<b>Asthma, Children ≥ 12 Years and Adults</b>
<b>Variables</b>	<b>N = 2</b>	<b>N = 493</b>
Age, mean (SD)	9.5 ± NA	62.2 ± 14.9
Sex; Female, n (%)	2 (100.0)	338 (68.6)
<b>Prescribing physician (triple therapy)</b>		
General practitioner	2 (100.0)	381 (77.3)
Pneumonologist	0 (0.0)	11 (2.2)
Allergology specialist	0 (0.0)	11 (2.2)
Internist	0 (0.0)	7 (1.4)
Pediatrician	0 (0.0)	1 (0.2)
Other	0 (0.0)	38 (7.7)
<b>Months since dispensation baseline [first-time patients only], mean (SD)</b>	<b>7.9 ± 9.8</b>	<b>7.8 ± 7.4</b>
<b>Triple therapy composition</b>		
Fluticasone/Salmeterol + Tiotropium	1 (0.5)	212 (43.0)
Budesonide/Formoterol + Tiotropium	1 (0.5)	168 (34.1)
Beclometasone + Indacaterol/Glycopyrronium	0 (0.0)	18 (3.7)
Budesonide/Formoterol + Glycopyrronium	0 (0.0)	16 (3.2)
Fluticasone/Salmeterol + Tiotropium + Beclometasone	0 (0.0)	14 (2.8)
Budesonide/Formoterol + Tiotropium + Beclometasone	0 (0.0)	10 (2.0)
Fluticasone/Salmeterol + Glycopyrronium	0 (0.0)	9 (1.8)
Beclometasone + Olodaterol/Tiotropium	0 (0.0)	4 (0.8)
Beclometasone + Vilanterol/Umeclidinium	0 (0.0)	2 (0.4)
Fluticasone/Vilanterol + Umeclidinium	0 (0.0)	2 (0.4)
Fluticasone/Salmeterol + Olodaterol/Tiotropium	0 (0.0)	2 (0.4)
Budesonide + Indacaterol/Glycopyrronium	0 (0.0)	1 (0.2)
Fluticasone/Salmeterol + Indacaterol/Glycopyrronium	0 (0.0)	1 (0.2)
Budesonide/Formoterol + Indacaterol/Glycopyrronium	0 (0.0)	1 (0.2)
Other triple therapy combination	0 (0.0)	25 (5.1)
<b>Drugs used before triple therapy</b>		
SABA total	0 (0.0)	100 (20.3)
SAMA total	0 (0.0)	63 (12.8)
ICS/LABA	1 (50.0)	170 (34.5)
SABA or SAMA + ICS	0 (0.0)	27 (5.5)
LAMA alone	1 (50.0)	30 (6.1)
OCS alone	0 (0.0)	23 (4.7)
SABA + SAMA + ICS	0 (0.0)	9 (1.8)
LABA + LAMA	0 (0.0)	7 (1.4)
ICS alone	0 (0.0)	4 (0.8)
SABA + SAMA + ICS/OCS	0 (0.0)	2 (0.4)
LABA alone (indacaterol)	0 (0.0)	1 (0.2)
ICS + LAMA	0 (0.0)	1 (0.2)
Triple therapy (before follow-up)	0 (0.0)	124 (25.2)
Theophylline	0 (0.0)	7 (1.4)
Roflumilast	NA	NA
Omalizumab	0 (0.0)	1 (0.2)
Montelukast	0 (0.0)	92 (18.7)

**Abbreviations:** SABA, short-acting beta agonist; SAMA, short-acting beta agonist; ICS, inhaled corticosteroids; LABA, long-acting beta agonist; LAMA, long-acting muscarinic antagonist; OCS, oral corticosteroids.

The predominance of adolescent or adult women with asthma and male children is similar to other studies findings conducted in Colombia and Latin America,<sup>15,16</sup> Spain, and the UK.<sup>17,18</sup> The mean age in the present study was 32.2 years, which is slightly lower than data from studies carried out in Spain (36.8 years) and the UK (37.0 years).<sup>17,18</sup>

The presence of comorbidities in 23.8% of all patients was strongly influenced by the fact that one-third of adolescents and adults with asthma had some concomitant diagnosis, particularly hypertension, diabetes mellitus, allergic rhinitis, atopic dermatitis, and anxiety. Anxiety, which was present in only 0.3% of cases, has been reported in up to 38% of patients with asthma in Spain,<sup>17</sup> while mental disorders have been identified in 4% of patients in the UK.<sup>18</sup> Allergic rhinitis, a condition that may be relatively common in patients with asthma, has also been reported more commonly in Spain (50% of cases) and the UK (86%) (14, 15). Such differences may be explained by patient-specific conditions in different regional settings, variability in the sources of information used, and the recording of diagnoses in medical records, which necessitates improvement and homogenization of the information to ensure useful data for decision-making. Notably, underreporting may have occurred in this analysis considering the high frequency of antihistamine use (20% of patients with asthma).<sup>15</sup>

Salbutamol was the most commonly used inhalator by asthma patients in Colombia, followed by beclomethasone, both of which are indicated in the first steps of treatment, in addition to the use of SABAs as rescue medication and ICSs as a mainstay of management in most cases.<sup>9</sup> This finding constitutes a possible deviation from overuse with a very high frequency of SABAs and not LABAs as the international recommendations for asthma management suggest regarding bronchodilators.<sup>9,12</sup> The use of SABA as monotherapy for symptom relief is not encouraged in the recent guidelines.<sup>9</sup> However, the frequency of SABA use corresponds to a nearly 1:1 ratio with ICSs, which are significant drugs for long-term control and affect clinical outcomes.<sup>10</sup> Notably, approximately 5% of patients aged 5–11 years and 25% of those older than 12 years were receiving ICS/LABA combination therapy, which is considered the first-line choice for asthma control in patients with intermittent asthma and mild persistent asthma.<sup>10</sup> The most commonly used combinations of these drugs in patients in Colombia were salmeterol/fluticasone (14.6%) and formoterol/budesonide (11.7%), which is consistent with other reports from countries such as Portugal (11.8%)<sup>19</sup> and the UK (21.4%).<sup>18</sup> A plausible explanation for this similarity lies on the fact that ICS/LABA medications have been widely available for a longer period of time and are the most frequently prescribed by physicians.<sup>15</sup>

Some 55.9% of patients with childhood asthma used an ICS in monotherapy, which should be added to the 5% who took it in combination with a LABA (total 60.9%). Among asthma patients older than 12 years, 37.1% took an ICS alone and 25.4% took an ICS+LABA combination (total 62.5%). Thus, in both groups, about two-thirds were taking a controlled therapy. The ICS usage data are thus slightly lower than the 84.7% at the beginning of follow-up in the United Kingdom<sup>18</sup> but similar to those reported by Reddel et al in Australia.<sup>13</sup> These findings indicate that these medications are the cornerstone of maintenance for patients with asthma during the different steps of treatment,<sup>10</sup> which can achieve control when used regularly.<sup>14</sup>

The use of leukotriene inhibitors in proportions ranging between 11 and 17% depending on whether the patients are younger or older than 12 years, respectively, is more frequent than studies results from Portugal (6.7%) and the UK (3.5%), which differs from values in Colombia, probably because these drugs are freely available in the country and are included in the healthcare system's benefit plan.<sup>18,19</sup> Theophylline use in 1.4% of adolescents and adults is also remarkable due to its poor benefit/risk ratio and narrow therapeutic margin,<sup>20</sup> this drug is no longer prescribed in the UK, where only 0.1% of patients use this agent.<sup>18</sup>

The use of antimicrobials in more than 28% of patients older than 12 years may be due to infections of any kind but also to acute exacerbations of asthma with associated respiratory infections, which is consistent with the concurrent use of systemic corticosteroids in more than 11% of cases.<sup>9</sup> However, we could not identify the specific indication for these antimicrobials.

The frequency of systemic corticosteroid use is high, which is probably explained by outpatient management of asthma exacerbations and not disease control or prophylaxis. Notably, however, this information warrants further analysis, especially the use of control therapies that prevent or reduce the frequency of exacerbations and their effectiveness in a real-life setting. Additionally, the increase in the use of omalizumab at 12 and 24 months despite its

use in few cases is interesting as evidence of the need for a therapeutic approach for patients with severe asthma given that access to this type of agent may depend on the region, country, type of insurer, or even sex, as described above.<sup>21</sup>

The group of patients requiring management with triple therapy, including LABA + LAMA + ICS, had an average age exceeding 60 years and were mainly consisted of women, which, in addition to being an indicator of the proportion of more difficult-to-control cases, may be an indicator of patients having a dual condition, such as concomitant chronic obstructive pulmonary disease, that has not been adequately diagnosed.<sup>7,9,22–24</sup>

Some limitations of this type of study, which used databases related to medical prescriptions, were identified, such as the lack of clinical data on confirmatory spirometry, symptom control, the precise timing of exacerbations in patients, asthma severity staging, and the control level of each patient. We could not identify it therapies with SABA as rescue were prescribed with additional ICS, as currently recommended. The drugs that patients were able to procure beyond the health system are not known and were not registered in the database. Due to the fact that the information was obtained from a medication dispensing database for people affiliated with the healthcare system, the results should be extrapolated only to populations with similar insurance characteristics. Some strengths were also identified related to a large number of patients evaluated, the 12- and 24-month follow-ups, and the identification of different variables regarding asthma therapy utilization, which were previously undescribed in Colombia.

## Conclusions

In conclusion, the present study showed that patients older than 5 years and diagnosed with asthma were being treated mainly with a single drug, including control therapy with a ICS alone or together with either a SAMA or a LABA to a lesser extent, which was maintained at 12 months from baseline in more than 50% of adolescent and adult patients. In addition, a significant proportion of cases required combination therapy with three different drugs (ICS/LABA/LAMA), while biological agents were used infrequently. There was a broad use of antimicrobials, which requires additional studies exploring its indication and clinical outcomes. The development and the implementation of educational programs targeted at general practitioners, who mostly treat asthma patients in their routine clinical practice, would improve asthma medication use.

## Data Sharing Statement

Sharing Statement: protocols.io.

Access Availability: [dx.doi.org/10.17504/protocols.io.b5gmq3u6](https://dx.doi.org/10.17504/protocols.io.b5gmq3u6).

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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CYGN and MLC are full-time employees for GSK Colombia. CYGN reports personal fees from GSK Colombia, during the conduct of the study and outside the submitted work.

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AGM and LFVR declare no conflicts of interest in relation to this work.

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