

ORIGINAL ARTICLE

Pharmacy Fill Patterns in Young Urban Children with Persistent Asthma

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Background. Medication adherence impacts healthcare utilization. Pharmacy records are useful to establish fill patterns. **Objective.** Use pharmacy records to establish medication patterns fill patterns for comparison to healthcare utilization. **Methods.** Pharmacy records of 175 children with persistent asthma were collected and compared to healthcare utilization. **Results.** Majority of subjects had significant healthcare utilization, low numbers of rescue medications, and poor controller medication fill rates. Those with more rescue medications had more healthcare utilization and more controller medications. **Conclusions.** Pharmacy fill patterns demonstrate few rescue and/or controller medication fills. Those with more rescue medications reported increased healthcare utilization despite controller medications.

Keywords asthma, urban populations, prescription-drug, pediatrics

INTRODUCTION

Asthma is a chronic disease of airway inflammation that affects 7.5% of the general population, 1 of 10 children in Maryland, (1) and 1 of 5 Baltimore City children (2). Increased use of rescue medications such as short-acting β_2 -agonists (SABA) and/or oral corticosteroids (OCS) is an indicator of poor asthma control. Poor asthma control is associated with activity restriction and increased healthcare utilization especially in younger inner-city children. Adams reported that children with more than five prescriptions of rescue medications per 12 months had more asthma-related emergency department (ED) visits and hospitalizations than children with “midrange use” of 1 to 5 prescriptions in a 12-month period (3).

Persistent asthma management based on National Asthma Education and Prevention Program (NAEPP) guidelines (4) requires adherence to a daily medication routine to provide adequate asthma control and prevent exacerbations. Adherence to medication regimens is frequently assessed through self-reporting (5–8), despite the inherent inaccuracy of this approach. Others have relied on health maintenance organizations/managed care organizations (MCOs) computerized information systems to gather information on health care utilization (3, 9, 10), yet the results are limited to one or two select MCOs. In an attempt to gather more objective information to assess medication adherence, several groups have used pharmacy fill histories as a source of objective data (11,

12). The purpose of this project is to use pharmacy records to establish medication patterns fill patterns for comparison to healthcare utilization.

METHODS

Study Design

This is a cross-sectional analysis of pharmacy refill data collected from subjects enrolled in a nebulizer education intervention clinical trial (13). This study was approved by the Institutional Review Boards at the University of Maryland, School of Medicine and the Johns Hopkins University. To be eligible for study inclusion, subjects had to reside in the Baltimore metropolitan area, had to meet NAEPP guidelines for persistent asthma based on daytime and nocturnal symptoms (4), had to have used a nebulizer at least 3 of the past 30 days, and have had either an asthma-related admission or ED visit in the last 12 months. After consent was obtained, caregivers of 175 children who met inclusion criteria were interviewed about measurements of asthma control including asthma-related healthcare utilization and activity restriction. Caregivers were interviewed at baseline and every 6 months for the duration of the study regarding their child’s asthma-related ED visits and hospitalizations, activity restriction (“Has asthma limited activities such as running and playing in the last 6 months?”), as well as any pharmacies they had used to fill medications in the prior 6-month period. Data presented are from the first 6-month study time period.

Pharmacy Refill Data

Pharmacy fill records were collected on each subject from every pharmacy identified by the caregiver at each data collection point. Pharmacy records were considered complete if fill records were received from all pharmacies that were identified by the caregiver. Medication fill histories were

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evaluated for number of prescriptions filled for rescue medications including SABA or OCS and controller medications including inhaled corticosteroids (ICS) and leukotriene modifiers (LTM). There was very little long-acting beta-agonist or cromolyn use and no xanthine use in this group, and these drug categories were not included in analysis. Since patients used multiple drugs and/or different dosage forms of one drug within a medication class, we assigned a reference drug for each medication class to “normalize” and compare medication use between patients. All SABA were converted to the equivalents of the number of albuterol 17 gm metered dose inhaler (MDI). Each albuterol MDI is equivalent to 300 mL of nebulized albuterol solution. “High SABA” was defined as three or more albuterol MDIs dispensed in the 6-month period. This clinically relevant cutoff allowed the subjects to fill the equivalent of two SABA MDI prescriptions, one for use at the primary residence and another for school or day care before they were considered High SABA fillers. All subjects were categorized into No, Low, or High OCS. High OCS was defined as greater than 1 OCS prescription dispensed in the 6-month period, which allowed for at most, one asthma exacerbation, per 6-month period. Controller medication fill was defined as the dispensing of at least one prescription for LTM or ICS during the 6-month study period. For example, subjects who filled at least one ICS and one LTM prescription were counted as filling two controller prescriptions. All data were collected from October 2001-June 2004 and outcome data presented were collected from the 6-month interviews.

Statistical Analysis

Data were analyzed using SAS PC version 8.2 (Cary, NC, USA) statistical program. Initially, frequency distributions were examined for all socio demographic, health, asthma morbidity, and pharmacy fill variables including SABA and OCS fills. The χ^2 test of independence was used to compare categorical variables such as activity restriction and OCS fills by low versus high SABA group and asthma outcomes by OCS fills. Student's *t* test was used for comparisons of continuous variables, i.e., age of subjects by SABA group.

RESULTS

Of the original 221 subjects from the nebulizer intervention trial, 193 (87.3%) completed a 6-month questionnaire, and of those, 175 subjects (90.7%) had complete pharmacy refill data during the 6-month study period.

Sociodemographic and Health Characteristics

The subjects ranged in age from 2 to 9 years (mean 5.15 ± 2.1 years). Subjects were primarily male (61.7%) and African American (88%) with 81% receiving their health care through Medicaid. Although subjects were at least mild persistent at recruitment, at the 6-month questionnaire, 9.1% were mild intermittent, 57.1% were mild persistent, 20.0% were moderate persistent, and 13.7% were classified as severe persistent. At the 6-month data collection point, 17.2% of the group reported at least one asthma-related hospitalization (mean 0.25 ± 0.6 , range 0–3), and 47.4% had at least one ED visit (mean $1.37, \pm 2.8$ range 0–28) in the prior 6-months. A total of 58% of caregivers reported that the child experienced activity restrictions due to asthma.

TABLE 1.—Short-acting beta-agonist (SABA) and controller medicines (CON) prescriptions filled in the 6-month study period.

	All <i>n</i> = 175 %(<i>n</i>)	Low SABA (<3 MDI/6 mo) <i>n</i> = 152 %(<i>n</i>)	High SABA (≥ 3 MDI/6 mo) <i>n</i> = 23 %(<i>n</i>)	<i>p</i> value
ICS only	26.3 (46)	28.3 (43)	13.0 (3)	NS
LTM only	10.3 (18)	9.9 (15)	13.0 (3)	NS
ICS & LTM	35.4(62)	30.3 (46)	69.6 (16)	0.0002
No CON	28.0 (49)	31.6 (48)	4.3 (1)	0.0067
1 CON fill	18.3 (32)	19.7 (30)	8.7 (2)	NS
2 CON fills	12.6 (22)	14.5 (22)	0	NS
3 CON fills	8.0 (14)	7.2 (11)	13.0 (3)	NS
4+ CON fills	33.0 (58)	26.9 (41)	73.9 (17)	<0.001

NS = not statistically significant.

Pharmacy Fill Data and Asthma Outcome Measures

Every subject had at least 1 SABA fill during the study period. Subjects categorized with a low number of SABA fills (<3 fills over 6 months) accounted for 86.9% ($n = 152$) of the entire group. Within the “Low SABA” group, 31.6% ($n = 48$) had no controller medication fills, while 68.4% ($n = 104$) filled some combination of ICS and/or LTM (Table 1). The Low SABA group had a mean of 0.22 (± 0.6) asthma-related hospitalizations, 1.34 ED visits (± 2.8), and 55.3% of the group reported asthma-related activity restrictions.

Subjects categorized as “High SABA” group (3 or more albuterol MDI/6 months) accounted for 13.1% ($n = 23$) of the entire sample. Within the High SABA group, significantly more subjects filled a controller compared to the Low SABA group ($p = 0.0067$), and significantly more of the High SABA group filled combinations of controllers ($p = 0.002$) (Table 1). Subjects in the High SABA fill group were more likely to have at least 4 controller prescriptions (ICS and/or LTM) in the study period than those in the Low SABA fill group (73.9% vs. 26.9%, $p < 0.001$). High SABA users were significantly older (6.0 vs. 5.0 years, $p = 0.05$) and reported more asthma-related activity restriction (77.3% vs. 55.3%, $p = 0.05$). There were no significant differences between groups for mean number of asthma-related admissions and ED visits.

Oral corticosteroid fills for the entire group were divided into three levels: No OCS ($n = 95$), Low OCS ($n = 54$), and High OCS ($n = 26$). A significant number of subjects with no OCS fills also never filled controller medication compared to those who filled OCS one or more times ($p = 0.01$). Those that never filled OCS were also significantly more likely to be Low SABA fillers than to fill SABA ≥ 3 times ($p = 0.004$) (Figure 1). There was no difference between the three OCS groups in terms of age, ED visits, or activity restriction, but the high OCS group had more asthma-related admissions (Table 2).

DISCUSSION

Our data indicate that the very few of the young urban children with persistent asthma in this sample had overfilled rescue medications such as SABA and/or OCS. Only 13% of subjects filled SABA three or more times and only 14.8% had more than one OCS prescription fill in the 6-month study period.

Because rescue medication fill rates are sometimes used as a proxy for asthma control in children with persistent asthma,

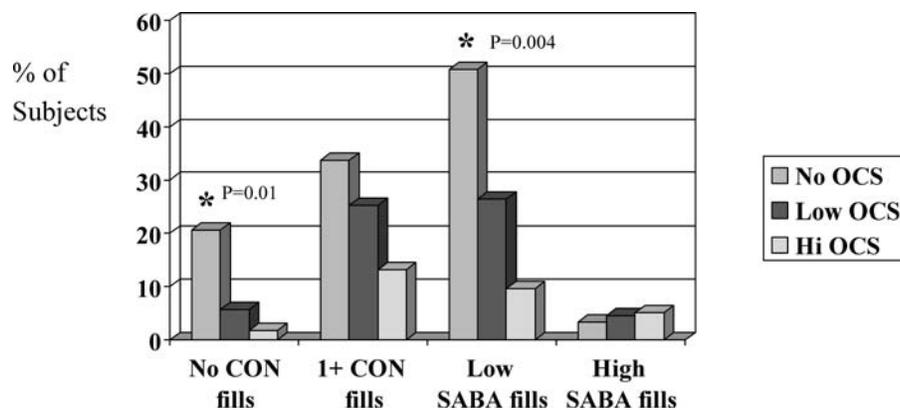


FIGURE 1.—Oral corticosteroid (OCS), contriller medication (CON), and short-acting β_2 -agonists (SABA) fills ($n = 175$).

we expected to find medication fill patterns similar to those found and/or hypothesized by others (14, 15). We anticipated that subjects with a low number of rescue fills would be more likely to be on controller medications and report appropriate asthma control such as very low rates of asthma-related hospitalizations, visits, and activity restriction. On the contrary, our data indicate that those with no/low numbers of rescue medication fills were less likely to fill controllers than those with high numbers of rescue medication fills. In our sample, 28% of children with persistent asthma never filled a prescription for a controller medication. While this is substantially better than previous reports for other populations of innercity children (8, 16–19), it is very concerning. In addition, many of our subjects reported asthma-related admissions and ED visits and more than half of the subjects with a low number of SABA fills experienced activity restriction. This apparent incongruency between asthma medication use and activity restriction is consistent with prior reports (20). One explanation for the underuse of all medications in this group may be related to poor perception of symptoms on the part of the caregiver or poor communication of symptoms by the young subjects to their caregivers (21). It is also unclear if asthma-related activity restriction is recognized by caregivers as a treatable symptom of asthma or if caregivers and healthcare providers do not have appropriate expectations of exercise capability in children with asthma despite the NAEPP guidelines describing maintenance of normal activity levels as one of the goals of asthma therapy (4).

Of note is that 13.1% of subjects with high numbers of SABA fills had enough SABA available for more than 1 dose a day (assuming 2 puffs/dose) or greater than 10 doses per week for the entire 6-month time period. The high numbers of SABA fills is concerning because regular beta-agonist use is associated with increased risk of death or near death in adults (22) and ED visits and asthma-related admissions in children (3). While the subjects in the High SABA fill group did not report increased ED visits or asthma-related admissions compared to the Low SABA fill group, the High SABA fill group did report significantly greater activity restriction. It also interesting to note that, this group of High SABA fillers did not overfill SABA to the exclusion of controllers. The subjects with high numbers of SABA fills were not only more likely to have filled at least one controller prescription, they also filled more controller prescriptions during the 6-month period. Other studies (3, 10, 23) have reported that controller use increases as reliever use increases. Because we were unable to determine the timing of prescription fills, we are unable to determine the temporal relationship between rescue prescription fills and controller fills including if the rescue medication use started to increase over the 6-month study period, prompting controller medication refills.

Several limitations to use of pharmacy fill records must be considered. For this study, the completeness of pharmacy fill records was dependent on the caregivers reporting all of the pharmacies used in the prior 6 months. In addition, pharmacy records only indicate that a medication is available,

TABLE 2.—Oral corticosteroid (OCS) prescriptions filled and measurements of asthma control in the 6-month study period.

	All $n = 175$ Mean Range	No OCS $n = 95$ Mean \pm std deviation Range	Low OCS $n = 54$ Mean \pm std deviation Range	High OCS $n = 26$ Mean \pm std deviation Range	<i>p</i> values
Age (years)	5.25 yrs 2–9	5.08 \pm 2.2 2–9	5.33 \pm 1.9 2–9	5.00 \pm 2.0 2–8	NS
ED visits	1.37 0–28	1.27 \pm 3.4 0–28	1.24 \pm 1.37 0–5	2.00 \pm 2.37 0–10	NS
Admissions	0.25 0–3	0.14 \pm 0.43 0–2	0.22 \pm 0.54 0–3	0.69 \pm 0.97 0–3	$P < 0.0001$
Activity restriction	%(n) 58 (101)	%(n) 48.4 (46)	%(n) 48.2 (26)	%(n) 53.8 (14)	NS

NS = not statistically significant.

not if medication was administered or shared among household members. Additionally, these records do not capture the dispensing of medications, including samples, from clinics, emergency department visits, or hospitals. Thus, some of our subjects may have had access to asthma medication that we did not capture in our refill data

CONCLUSIONS

In this group of young urban children with persistent asthma, two patterns of medication availability emerged. The majority reported asthma-related activity restriction but very little rescue medication fills and poor controller medications fill rates. More than a quarter of the subjects demonstrated no prescription fills of controller medications. The remainder of the subjects had high SABA and/or OCS fills and reported significant activity restriction and asthma-related admissions despite controller medications fills. In both groups, asthma-related activity restriction was a universal finding. Additional studies are necessary to determine if the poor asthma control demonstrated by this group is related to underprescribing, underdosing, or underuse of asthma medications in a high-risk group of children.

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