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Patterns of Inhaled Antiinflammatory Medication Use in Young Underserved Children With Asthma

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ABSTRACT

BACKGROUND. Asthma guidelines advocate inhaled corticosteroids as the cornerstone treatment of persistent asthma, yet several studies report underuse of inhaled corticosteroids in children with persistent asthma. Moreover, few studies use objective pharmacy data as a measure of drug availability of asthma medications. We examined factors associated with the use of inhaled corticosteroids in young underserved children with persistent asthma using pharmacy records as their source of asthma medications.

METHODS. This was a cross-sectional analysis of questionnaire and pharmacy record data over a 12-month period from participants enrolled in a randomized clinical trial of a nebulizer educational intervention.

RESULTS. Although exposure to ≥1 inhaled corticosteroids refill was high at 72%, 1 of 5 children with persistent asthma had either no medication or only short-acting β agonist fills for 12 months. Only 20% of children obtained ≥6 inhaled corticosteroids fills over 12 months. Obtaining ≥3 inhaled corticosteroids fills over 12 months was significantly associated with an increase in short-acting β agonist fills and receiving specialty care in the regression models while controlling for child age, asthma severity, number of emergency department visits, having an asthma action plan, and seeking preventive care for the child’s asthma.

CONCLUSIONS. Overreliance on short-acting β agonist and underuse of inhaled corticosteroid medications was common in this group of young children with persistent asthma. Only one fifth of children obtained sufficient controller medication fills.
Asthma is the leading chronic illness among US children,1–4 with the youngest children consistently having the highest emergency department (ED) visit rates.6 Airway inflammation occurs early in the clinical stages of asthma,8 and inhaled corticosteroids (ICSs) have been demonstrated to decrease bronchial hyperreactivity and inflammation, as well as reduce asthma morbidity and mortality.6–8 National and international asthma guidelines advocate ICS as the cornerstone of treatment for persistent asthma,10–12 yet several studies demonstrate underuse of ICS in children.13–16 Reasons for nonadherence to ICS therapy include health care system factors, such as lack of follow-up care,17–19 physician underdiagnosis of asthma severity,20 and lack of specialty care.21 Social, psychological, and economic factors include young child age, parental distrust and worry about adverse effects of medications,22,23 parental misunderstanding of the role of antiinflammatory agents in treating asthma, overrelaxation on short-acting β-agonist (SAB) medications to relieve acute symptoms,24 and medication costs. Although these social, psychological, and economic factors may be modifiable for medication adherence, they require behavioral, as well as educational, interventions for patients to change their medication use patterns.25 Despite multiple reports of nonadherence to ICS in children, few studies have used objective pharmacy data to measure drug availability of preventive, as well as quick relief, medication use in these children.24,26–28 The aim of this article was to describe factors associated with use of ICS in young underserved children with persistent asthma using pharmacy records as the source of their medication use. We hypothesized that low SAB use, receiving specialty care, older child age, and decreased parental concern about ICS adverse effects would be associated with increased ICS use.

METHODS

Participants
Child study participants were recruited from pediatric practices affiliated with 2 urban university hospitals, including pediatric primary care (30%), pulmonary/allergy (50%), and ED (20%) practices between October 2001 and May 2003. Inclusion criteria were children aged 2–9 years with persistent asthma, regular nebulizer use, and ≥1 ED visit or hospitalization within 12 months of enrollment. All of the participants were enrolled in a randomized clinical trial to evaluate the effectiveness of an educational intervention focused on parent and child symptom recognition, appropriate home treatment of symptoms, and nebulizer practice on asthma morbidity, medication use, and health care use outcomes.29 Parents were administered a questionnaire face to face in the ED or clinic at the time of recruitment and via telephone at 6 and 12 months. For this analysis, we pooled all of the participants and examined ICS use by parent self-report and review of pharmacy records. The institutional review boards of the Johns Hopkins University Medical Institutions and the University of Maryland School of Medicine approved the study protocols. We obtained informed consent from all of the participating parents, including consent for collection of the child’s pharmacy records, and obtained child assent from children ≥7 years of age.

Measures

Asthma Severity
Children were assigned an asthma severity level based on national guidelines10–12 using frequency of day and night symptoms based on responses to specific questions: “During the past 6 months on average, how many days per week did your child cough, wheeze or experience shortness of breath to limit exercise, ability to play sports or play with friends?” and “During the past 6 months on average, how many nights per month did your child wake up at night with cough, wheeze, shortness of breath, or tightness in chest?” Children who met enrollment criteria for mild, moderate, or severe persistent asthma based on daytime symptoms (>2 times per week) or nighttime symptoms (>2 times per month)10,11 were included in the study. Ten children originally classified as mild intermittent by symptom report were reclassified as mild persistent based on premedication severity, for example, symptom frequency and daily antiinflammatory medication use.12

Asthma Medication Use
Medication use was measured by: (1) examining parental self-report of medication use at baseline, 6, and 12 months; and (2) pharmacy records across the 12-month follow-up. Pharmacy records were obtained from all of the pharmacies used per child as reported by the caregiver over the 12-month period.27 At each of the 3 data collection points, caregivers were asked to identify any pharmacy used in the previous 6 months. Every pharmacy identified at any data collection point was contacted by faxing a copy of the consent forms requesting a complete list of all asthma medications dispensed during the study period. Pharmacies not responding within 1 week were contacted by telephone or in person. Pharmacy records were considered complete if every pharmacy identified by caregivers submitted data for the specified period, indicated that they had no record of the child, or had no prescriptions during the specified period requested. The number of asthma-related prescriptions filled or refilled, including the number of metered dose inhalers, dry powder inhalers, nebulizer ampules and oral medications, was used to examine the actual pattern of asthma medication availability by child over the 12-month period. The pharmacy database captured the dis-
pensing date, product name, strength, dosage form, and quantity dispensed. Before double key entry in the database, all of the pharmacy records were reviewed by an asthma nurse specialist (K.M.) to ensure that complete data retrieval and discrepancies in data entries were adjudicated. Quick relief medications were defined as SABs, whereas controllers included ICSs, leukotriene modifiers, mast cell stabilizers, and long-acting β-agonists. Common ICS medications encountered were fluticasone (Flovent), budesonide (Pulmicort Turbuhaler and Respules), and fluticasone/salmeterol (Advair) inhalers. Oral corticosteroid (OCS) prescription fills were analyzed separately.

For children included in the final analysis (N = 180), we analyzed the frequency and amount of medication dispensed as conducted in previous studies and chose not to adjust for relative potency or the number of canisters dispensed per prescription fill. Correlation between the number of ICS prescriptions and the amount of ICS medications (ie, number of canisters dispensed) was high (Spearman coefficient = 0.95; P < .0001), indicating that each ICS prescription fill represented 1 canister of ICS dispensed. ICSs were selected as the outcome medication, because ICSs were the most frequently reported antiinflammatory medications (51% of all controller prescriptions) and are the recommended therapy for persistent asthma. Multivariate models excluded children only on leukotriene modifiers, mast cell stabilizers, or long-acting β agonists because of low use of these medications in this sample.

Parental worry about adverse effects of asthma medications was ascertained on a Likert scale by asking “How worried are you about side effects of asthma medications?” with responses of very, very worried, very worried, fairly worried, somewhat worried, a little worried, hardly worried, or not worried. Responses were coded as no for “not worried” and yes for all of the other responses.

Asthma Morbidity, Health Care Use, and Asthma Care
Parents were administered questionnaires at baseline and 6 and 12 months after random assignment to ascertain symptom frequency, activity limitation, health care use, and type of asthma care received in the previous 6 months. Symptom frequency was based on responses noted under asthma severity. Activity limitation was ascertained by asking, “Has your child’s activities been limited due to asthma symptoms of cough, wheeze, shortness of breath or chest tightness/discomfort over last 6 months?” and coded as yes or no. Number of hospitalizations, ED, preventive asthma care, and specialty care visits; difficulty paying for medications; and having an asthma action plan during the previous 6 months were ascertained at each time point.

Treatment Group
Children were randomly assigned into 2 groups defined as receiving the nebulizer educational intervention (“intervention”) or standard asthma education (“control”). As reported previously, there was no treatment effect noted on asthma morbidity, health care use, or medication use by group assignment.

Data Analysis
Subjects were categorized into 2 groups based on their number of ICS fills over 12 months: 0–2 vs ≥3 fills. Based on National Asthma Education and Prevention Program guidelines, we aimed to dichotomize using ≥6 ICS prescriptions; however, only 20% of children obtained ≥6, and 40% had ≥3 ICS fills over the 12-month study period. Based on this distribution of ICS fills, we chose to dichotomize using 0–2 vs ≥3 ICS fills. Differences between ICS groups were examined using standard χ² tests, and relative risks were calculated for categorical variables (asthma severity and caregiver educational level). One-way analysis of variance was used to examine group differences for continuous variables (number of SAB fills). Multivariate logistic regression was used to assess independent effects in models for obtaining ≥3 ICS fills over 12 months. Variables significant at the .05 level in the bivariate analysis and those with theoretical importance (ie, treatment group, child age, and asthma severity) were entered simultaneously into the multiple logistic regression models. Several logistic regression models were run to adjust for potential confounders. The models were examined for goodness of fit using the Hosmer and Lemeshow test. Two-sided tests were used, and P values ≤ .05 were considered significant. All of the data analyses were performed using SAS V.8.0 and Stata V.7.0 software.

RESULTS
Characteristics of Patient Population
A total of 513 children were recruited, with 254 children eligible, 33 parents refused to participate, and 221 (85%) consented and were randomly assigned into the study (Fig 1). At the 12-month follow-up, 180 children (81%) had complete interview and follow-up pharmacy record data for analysis. Most children excluded from follow-up analysis had incomplete pharmacy records (N = 30). Children excluded from follow-up (N = 40) did not significantly differ from children with complete data (N = 180) by age, gender, race/ethnicity, parental education level, or baseline asthma severity.

Children included in this analysis were primarily black (89%), male (64%), received Medicaid (82%), lived with their biological mother (91%), and were young, with a mean age of 4.5 years (SD: 2.1; Table 1). Most caregivers reported a high school education or higher (76%) and employment outside the home.
(53%), and 47% reported household incomes of less than $20,000. Few families (11%) reported any problems paying for their child’s asthma medications at baseline or at the 12-month follow-up.

Asthma morbidity in this group was high (Table 1), with most children classified with mild (63%) or moderate-to-severe persistent (32%) asthma. ED visits and hospitalizations were high, yet confined to a small proportion of the sample (ED visits: 38%; hospitalizations: 8%) with an overall mean of 1.83 ED visits and a mean of 0.36 hospitalizations during the previous 6 months. Almost two thirds (64%) of parents reported asthma-related activity limitation in their child, half received asthma specialty, and less than half (41%) reported having a written asthma action plan in the home. No significant differences were noted for sociodemographic and health characteristics between children with complete follow-up data (N = 180) and the total baseline sample (N = 221; Table 1).

**Mortality**

Three deaths occurred in study children (ages 4, 6, and 9 years) because of asthma complications, and 2 of the deaths occurred in children categorized with severe persistent asthma. All of these children received Medicaid insurance and reported ≥1 ED visit within 6 months of enrollment, and only 1 received specialty care. All of the children had been hospitalized once, including 1 child hospitalized 5 times within 6 months of study enrollment. Excessive quick relief medication use (9 fills over 6 months) was noted in 1 child. Only 1 of the 3 children received antiinflammatory medication over the 12 months.

**Relationship Between Prescribed Asthma Medication Filled and Asthma Severity**

Specific asthma medication fill regimens are shown in Table 2 for a subset of children (N = 174; 97%) with complete pharmacy data and severity assignment at 12 months. Six children had incomplete severity data at 12 months. Most children (78%) had a combination of ≥1 antiinflammatory and a quick relief medication (SAB) available at some point during the 12-month study period (Table 2). Although exposure to ≥1 ICS medication was high at 72%, 1 of 5 children had either no medication or only SAB medication available during the 12-month follow-up. OCS medication availability was high, with 59% of children obtaining ≥1 OCS medication fill over the 12-month study period, and children classified with mild persistent asthma had an increased number of OCS fills as compared with children with moderate-to-

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**FIGURE 1**

Flow diagram of subject progress through randomized trial.
severe but not significant asthma (mild persistent: 63%; moderate/severe: 50%; \( P > .05 \); Table 2).

As shown in Fig 2, only 20% of children obtained \( \geqslant 6 \) ICS fills over 12 months. The frequency of SAB fills ranged from 0 to 26 fills with 20% of children obtaining \( \geqslant 6 \) SAB fills over 12 months. Sam-
ple medications were reported by 38 parents (21%), primarily for Albuterol or Xopenex (32%), Flovent or Pulmicort (29%), or Singulair (29%).

There was a trend in the correlation between the average total number of ICS and SAB prescriptions filled over the 12 months (total ICS prescriptions: mean: 43.3; SD: 8.4; total SAB prescriptions: mean: 54.8; SD: 11.9; Spearman’s coefficient: 0.52; \( P = .09 \)).

**Factors Associated With ICS Use**

The unadjusted relative risks and 95% confidence interval (CI) for factors associated with \( \geq 3 \) ICS fills are shown in Table 3. Factors significantly associated with \( \geq 3 \) ICS fills were older child age, receiving specialty care, having an asthma action plan, making a physician appointment even when the child is well (seeking preventive care), decreased number of ED visits during the previous 6 months at baseline, and increased number of SAB fills over the 12-month study period. The number of care-

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**TABLE 3** Unadjusted Relative Risks (95% CI) for Health and Sociodemographic Factors Associated With Number of ICS Prescriptions Filled Over 12 Months (\( N = 169 \))

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>0–2 ICS Fills (( N = 97 ), n (%))</th>
<th>( \geq 3 ) ICS Fills (( N = 72 ), n (%))</th>
<th>Total (( N = 169 ), n (%))</th>
<th>RR (95% CI)/ANOVA Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sociodemographic characteristics</strong></td>
<td></td>
<td></td>
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<tr>
<td>Child gender</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>68 (70.1)</td>
<td>39 (54.2)</td>
<td>107 (63.3)</td>
<td>1.46 (1.0–2.1)</td>
</tr>
<tr>
<td>Child race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Black</td>
<td>87 (89.7)</td>
<td>63 (87.5)</td>
<td>150 (88.8)</td>
<td>1.13 (0.7–1.9)</td>
</tr>
<tr>
<td>White/other (ref)</td>
<td>10 (10.3)</td>
<td>9 (12.5)</td>
<td>19 (11.2)</td>
<td></td>
</tr>
<tr>
<td>Child age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>5.04 (1.8)</td>
<td>5.96 (2.1)</td>
<td>5.55 (2.1)</td>
<td>( F = 3.18^* )</td>
</tr>
<tr>
<td>Parent educational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than HS graduate</td>
<td>29 (29.9)</td>
<td>19 (26.4)</td>
<td>48 (28.4)</td>
<td></td>
</tr>
<tr>
<td>HS graduate or higher</td>
<td>68 (70.1)</td>
<td>53 (73.6)</td>
<td>121 (71.6)</td>
<td>1.11 (0.7–1.7)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $20 000</td>
<td>43 (63.2)</td>
<td>36 (69.2)</td>
<td>79 (65.8)</td>
<td></td>
</tr>
<tr>
<td>More than $20 000</td>
<td>25 (36.8)</td>
<td>16 (30.8)</td>
<td>41 (34.2)</td>
<td>1.17 (0.7–1.8)</td>
</tr>
<tr>
<td>Type of health insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical assistance</td>
<td>79 (81.4)</td>
<td>59 (81.9)</td>
<td>138 (81.7)</td>
<td></td>
</tr>
<tr>
<td>Private insurance/self-pay/other</td>
<td>18 (18.6)</td>
<td>13 (18.1)</td>
<td>31 (18.3)</td>
<td>0.98 (0.6–1.5)</td>
</tr>
<tr>
<td><strong>Asthma health characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Severity</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mild persistent</td>
<td>60 (65.9)</td>
<td>45 (63.4)</td>
<td>105 (64.8)</td>
<td>1.06 (0.7–1.5)</td>
</tr>
<tr>
<td>Moderate/severe persistent</td>
<td>31 (34.1)</td>
<td>26 (36.6)</td>
<td>57 (35.2)</td>
<td></td>
</tr>
<tr>
<td>Activities limited because of asthma within past 6 mo</td>
<td>58 (60.4)</td>
<td>42 (58.3)</td>
<td>100 (59.5)</td>
<td>0.95 (0.7–1.4)</td>
</tr>
<tr>
<td>Asthma management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialty care in past 12 mo</td>
<td>37 (38.1)</td>
<td>48 (66.7)</td>
<td>85 (50.3)</td>
<td>0.51 (0.3–0.7)^*</td>
</tr>
<tr>
<td>Asthma action plan in home</td>
<td>64 (66.0)</td>
<td>58 (80.6)</td>
<td>122 (72.2)</td>
<td>1.60 (1.0–2.6)^*</td>
</tr>
<tr>
<td>Make appointment with child’s physician even when child well</td>
<td>69 (71.1)</td>
<td>64 (88.9)</td>
<td>133 (78.7)</td>
<td>2.17 (1.1–4.1)^*</td>
</tr>
<tr>
<td>Worried about side effects of asthma medicines</td>
<td>25 (25.8)</td>
<td>20 (27.8)</td>
<td>45 (26.6)</td>
<td>1.06 (0.7–1.6)</td>
</tr>
<tr>
<td>Difficulty paying for medications</td>
<td>6 (8.5)</td>
<td>9 (13.1)</td>
<td>15 (8.3)</td>
<td>1.02 (0.5–1.9)</td>
</tr>
<tr>
<td>Treatment group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>61 (64.9)</td>
<td>33 (35.1)</td>
<td>94 (52.2)</td>
<td>1.23 (0.9–1.7)</td>
</tr>
<tr>
<td>No. of admissions for asthma in last 6 mo, mean (SD)</td>
<td>0.13 (0.4)</td>
<td>0.08 (0.4)</td>
<td>0.11 (0.43)</td>
<td>0.05 (0.58)</td>
</tr>
<tr>
<td>No. of ED visits in past 6 mo, mean (SD)</td>
<td>1.09 (1.9)</td>
<td>0.59 (1.1)</td>
<td>0.88 (1.6)</td>
<td>4.11 (0.11)</td>
</tr>
<tr>
<td>No. of regular, nonacute care visits to pediatrician in past 12 mo, mean (SD)</td>
<td>2.33 (5.8)</td>
<td>1.94 (1.8)</td>
<td>2.17 (4.5)</td>
<td>0.31</td>
</tr>
<tr>
<td>No. of OCS courses in past 6 mo, mean (SD)</td>
<td>1.13 (1.7)</td>
<td>0.86 (1.4)</td>
<td>1.02 (1.6)</td>
<td>1.26</td>
</tr>
<tr>
<td>No. of SAB fills in past 12 mo, mean (SD)</td>
<td>2.19 (1.9)</td>
<td>5.69 (4.9)</td>
<td>3.68 (3.5)</td>
<td>41.9^*</td>
</tr>
</tbody>
</table>

\( RR \) indicates risk ratio; ANOVA, analysis of variance; ref, reference. Excluded are 11 children with fills for leukotriene modifier, mast cell stabilizer, and long-acting \( \beta \) agonist medications only.

\( ^* P < .05 \).
givers reporting “worry about side effects of asthma medicines” did not differ by number of ICS fills ($P = .54$) or by child age ($P = .44$). Treatment group assignment within the original study was not associated with ≥3 ICS fills over the 12 months in the bivariate analysis or logistic models. In the multivariate logistic regression models, obtaining ≥3 ICS fills over 12 months was independently predicted by increased use of SAB medication and receipt of specialty care within the past 12 months after controlling for child age, gender, number of ED visits during the last 6 months, having an asthma action plan, and asthma severity (Table 4). A trend was noted in seeking preventive care for the child (range odds ratios: 2.15–2.25; CI: 0.9–5.3). The Hosmer and Lemeshow test demonstrated reasonable goodness of fit for both models presented.

**DISCUSSION**

Despite the majority of study children with persistent asthma receiving some exposure to ICS, 60% received substandard, non–National Asthma Education and Prevention Program guideline-based care defined as <3 ICS fills over 12 months comparable to the 39% reported in a previous study of low-income, non-Medicaid uninsured children with asthma,

yet considerably lower than other claims-based studies of Medicaid insured children

or children presenting to EDs. This study confirms the overreliance of young children with persistent asthma on quick relief medication for asthma treatment reported in children with asthma-related ED visits and the low use of ICS medications as noted in several studies.

Although children with asthma may go through periods of controlled and uncontrolled disease based on exposures to allergens and pollutants, exercise, and respiratory infections, early identification and treatment of symptoms in young children is critical to prevent exacerbations and reduce morbidity. Although more than half of parents reported activity limitation in their child because of asthma, fewer than half obtained adequate ICS fills to prevent symptoms. Parents may be either tolerating a substandard level of symptom control or inaccurately reporting their child’s level of asthma control. Alternatively, the low ICS use may reflect reluctance of providers to prescribe antiinflammatory medication for young children, reluctance of parents to fill an ICS prescription, or both, particularly if the child is asymptomatic. Identification of children requiring controller medication relies on an accurate diagnosis of asthma severity, including functional effect, and may improve control of symptoms. Misclassification of severity by physicians in children with moderate disease may also have contributed to the underuse of antiinflammatory medication in this sample and is not uncommon. Most children in this sample had ≥2 opportunities (ie, nonurgent care visits) to be evaluated by health care providers and to receive a prescription for controller medication.

Explanations for the low ICS fills found in this sample include parents opting to use ICS medications appropriately on a short-term/sporadic basis for symptom relief or consistent use at a low dose over a 12-month period, scenarios we were unable to determine with our data. Either scenario implies that parents adhere to regimens that accommodate their social, psychological, and economic values. Parental worry about adverse effects was not associated with number of ICS fills or child age; however, there were significantly fewer ICS fills noted in the younger age group (age < 6 years).

Contrary to our hypothesis, higher quick relief medication fills were significantly associated with increased ICS fills in this sample. Perhaps there is a subgroup of children with appropriate ICS use who remain symptomatic and require increased β-agonist use (eg, children with improper administration technique, frequent pretreatment for exercise, or exposure to viral illness or allergens).

**TABLE 4** Adjusted Odd Ratios (95% CI) for Logistic Regression Model Independently Predicting at Least 3 ICS Prescriptions Filled Over 12 Months

<table>
<thead>
<tr>
<th>Factor</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odd Ratio (95% CI)</td>
<td>Odd Ratio (95% CI)</td>
</tr>
<tr>
<td>No. of fills for SAB medication in past 12 mo (continuous)</td>
<td>1.46 (1.2–1.7)a</td>
<td>1.46 (1.2–1.7)a</td>
</tr>
<tr>
<td>Specialty care within past 12 mo</td>
<td>2.89 (1.3–6.5)b</td>
<td>3.01 (1.3–6.7)b</td>
</tr>
<tr>
<td>Make appointment with doctor even if child is well (seek preventive care)</td>
<td>2.25 (1.0–5.3)c</td>
<td>2.15 (0.9–5.1)c</td>
</tr>
<tr>
<td>Child Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6–8 vs 2–5</td>
<td>1.04 (0.9,1.2)</td>
<td>1.04 (0.9–1.2)</td>
</tr>
<tr>
<td>No. of ED visits in last 6 mo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2 vs 0</td>
<td>1.20 (0.5–2.8)</td>
<td>1.3 (0.6–3.1)</td>
</tr>
<tr>
<td>≥3 vs 0</td>
<td>1.35 (0.5–3.8)</td>
<td>1.6 (0.6–4.3)</td>
</tr>
<tr>
<td>Have asthma action plan</td>
<td>0.76 (0.3–1.7)</td>
<td>0.76 (0.3–1.7)</td>
</tr>
<tr>
<td>Severity of asthma at baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild persistent vs mild intermittent</td>
<td>2.65 (0.3–24.6)</td>
<td></td>
</tr>
<tr>
<td>Moderate/severe persistent vs mild intermittent</td>
<td>5.89 (0.4–37.8)</td>
<td></td>
</tr>
<tr>
<td>Hosmer and Lemeshow goodness of fit</td>
<td>$\chi^2 = 2.74, P = .95$</td>
<td>$\chi^2 = 9.62; P = .29$</td>
</tr>
</tbody>
</table>

a $P < .0001$; b $P < .01$; c $P = .07–.08$. 

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allergens) resulting in concurrent use of quick relief and preventive medications. Parental misunderstanding of quick relief medication use, overtreatment of mild symptoms, and family sharing of asthma medicines by relatives who lack health insurance may also explain overreliance on quick relief medicines. Health care provider factors contributing to overuse of quick relief medication include lack of awareness of increased number of SAB fills because of multiple prescribers, long-term refills, or telephone refills provided by nonmedical office or pharmacy staff. In addition, more than half of all children filled ≥1 OCS prescription over the 12-month period, with a slightly higher number of children with mild persistent asthma obtaining an OCS fill as compared with children with more severe disease. This may be a marker for uncontrolled asthma or may represent misclassification of children with mild persistent asthma.

One notable result is the level of asthma mortality (1.4%) in this group of inner-city children as compared with the national asthma mortality rate of 0.7/100 000 in all children with asthma <18 years old. Misuse of quick relief medications has been associated with increased morbidity and mortality; however, excessive use was only noted in 1 of the 3 asthma deaths in this study. One of 4 children with moderate-to-severe persistent asthma was undertreated for asthma either by obtaining no asthma medication or obtaining only SAB fills, and only 1 of the 3 children who died received any antiinflammatory medication fills over 12 months.

We are unable to rule out poor access to quality care as a major factor associated with inappropriate ICS fill rates in this study as noted in other large inner city child samples. However, access to specialty care was significantly associated with increased ICS fills consistent with a recent study demonstrating that specialty care among a privately insured cohort and a population-based sample was associated with increased use of antiinflammatory medications, as well as quality of life. Although specialty care has been associated with less overuse of β-agonists and reduced ED care, this was not evident in our data.

Limitations
There are some elements of the study design that may limit our findings. Because asthma severity was based on parent recall of symptoms and antiinflammatory medication use, severity may be imprecise, and there may be some misclassification of asthma severity. However, the severity classifications were consistent for persistent asthma at baseline and 12 months. If severity misclassification did occur, severity was most likely underestimated, resulting in an underestimation of the association between severity and medication use in this study. Although we were able to obtain pharmacy records regarding the number of prescriptions dispensed over a 12-month period, we are limited in determining actual medication use by the child or sharing of medication among household members. Prescription records do indicate drug availability and have been shown to be a reliable source of drug exposure. Moreover, pharmacy data do not account for samples provided to the parent; thus, our data may underestimate the amount of albuterol use but is less likely to underestimate the low ICS use in this sample. Last, generalizability beyond this group of children is limited because of the selection bias in this sample. We purposely recruited children with more severe or uncontrolled asthma to maximize our ability to detect a difference in the original educational intervention trial. This sample was selected from a base of high-risk, inner-city children with persistent asthma who attended both primary and specialty care sites.

Implications
Despite these limitations, there are several important study implications. In our sample, overreliance on SABs and underuse of ICS medications was common and is substandard asthma care for children. One of 5 children with persistent asthma had either no medication or only SAB medication available during the 12-month follow-up. Routine asthma care visits incorporating use of pharmacy records to monitor overuse of SAB and underuse of ICS medications, ascertaining parental symptom recognition skills, and referral to asthma specialist when indicated may enhance child adherence to antiinflammatory medication to improve daily asthma management.

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CONSUMER-DIRECTED HEALTH CARE

“For the past century, a premise of health policy has been that patients are ill equipped to judge the merits of tests, treatments, and providers. Conventional wisdom says that physicians should fill this gap by acting as patients’ agents, telling them about the risks and benefits of clinical alternatives and ignoring costs when assessing these alternatives. But a diverse group of business leaders and public officials intends to overturn this wisdom and radically transform the physician’s role. To motivate patients to take charge of their own care, they’re aiming for a wholesale shift of medical costs to consumers. To empower patients to take charge, they’re developing sophisticated ways to spread information about treatment efficacy, provider quality, and price. This past August, President George W. Bush ordered Medicare and other federal health programs to report publicly on the prices and the quality of care provided by doctors and hospitals. Within a few days, Aetna announced that it would post on its Web site quality ratings of specialists, along with the prices it has negotiated with doctors. Later this year, Revolution Health, a firm created by America Online co-founder Steve Case, former Secretary of State Colin Powell, and others, is expected to launch a Web-based venture offering information about costs, quality, and efficacy—to ‘put patients in control of their health care decisions.’ These steps are a shock to an industry that treats prices as competitive secrets and is, at best, ambivalent about measuring and comparing quality.”

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Noted by JFL, MD
Patterns of Inhaled Antiinflammatory Medication Use in Young Underserved Children With Asthma
Arlene M. Butz, Mona Tsoukleris, Michele Donithan, Van Doren Hsu, Kim Mudd, Ilene H. Zuckerman and Mary E. Bollinger

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