Use of Inhaled Anti-inflammatory Medication in Children With Asthma in Managed Care Settings

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Background: Many factors affect use of inhaled therapy in asthma. Relatively little is known about current patterns of use of anti-inflammatory medication in children with asthma and whether variations occur with age and use of bronchodilator medication.

Objective: To study the factors associated with dispensing of anti-inflammatory (controller) asthma medication to children in 3 managed care organizations (MCOs).

Methods: Using automated databases, a 1-year cross-sectional study of children with asthma aged 3 to 15 years cared for in 3 MCOs was used to evaluate the association of age and other factors with controller medication use.

Results: A total of 13352 children were studied. Significantly fewer children aged 3 to 5 years were dispensed any (≥1) controller medication than older children (P < .001). Among children dispensed 6 or more β-agonists, only 39% also received 5 or more controller dispensings, with adolescents significantly less likely than younger children to receive 5 or more controllers (33%; P < .001). Significant differences were seen among MCOs in proportions of patients dispensed controller medication. In a multiple logistic regression model, controlling for frequency of β-agonist dispensing and MCO, significantly lower dispensing of any controller medication was seen for those aged 3 to 5 years (odds ratio [OR], 0.8; 95% confidence interval [CI], 0.7-0.9) and for girls (OR, 0.9; 95% CI, 0.8-0.96). In contrast, for repeated (≥5) controller dispensing there were significantly fewer dispensings to adolescents (OR, 0.7; 95% CI, 0.6-0.9) and girls (OR, 0.8; 95% CI, 0.7-0.9).

Conclusions: There may be differences in the use of preventive asthma medication in children that are affected by age, sex, and health care organization. Few children with frequent symptoms are using controllers regularly, as is recommended by national guidelines.


Asthma remains the most common chronic disease in children and a major cause of morbidity and health care costs nationally and internationally.1,2 The Guidelines for the Diagnosis and Treatment of Asthma, developed by the National Asthma Education and Prevention Program (NAEPP) in 1991,3 and recently revised,4 emphasize the use of preventive or anti-inflammatory (controller) medications for the treatment of all children with persistent asthma. These guidelines have been widely disseminated, with a recent survey of 700 health care providers, including 512 physicians, showing that 89% of physicians say that they are aware of the guidelines, with 80% attempting to follow them at least “most of the time” in their everyday practice.5 However, it has been demonstrated that process of translating their recommendations into clinical practice in the United States has been slow.6,7 In recent years, significant increases in a number of countries in the use of anti-inflammatory therapy, principally inhaled corticosteroids (ICSs), have been associated with reductions in asthma morbidity and mortality.8,9 In the United States there have been few published studies in the clinical literature on dispensing patterns for controller therapy for asthma in general pediatric populations and the factors associated with their use. Using data from 1993, shortly after the release of the NAEPP guidelines, Buchner et al7 found that fewer than one third of children and adolescents with asthma managed in 5 geographically diverse managed care organizations (MCOs) received 1 or more prescriptions for anti-inflammatory medicine during a year, with fewer than 12% receiving sufficient canisters to suggest long-term use. Goodman et al9 found that children in one MCO were more likely to have been dispensed 3 or more controller inhalers per year in 1984, prior to the re-


**POPULATION AND METHODS**

**SETTING**

This is a 1-year cross-sectional analysis of data collected for the PAC-PORT II trial, a multicenter trial of implementation strategies for the NAEPP guidelines for the diagnosis and management of children with moderate to severe asthma. As part of the initial phase of this project, clinical care for children with asthma within the primary care practice settings at each of the health plans was characterized.

All subjects were members of one of the MCOs participating in the PAC-PORT II, located in 3 geographically varied US metropolitan areas. Each MCO provides a number of managed care products. We report data from 4 different care delivery systems within the 3 MCOs. The 4 systems are herein referred to as MCOs 1 to 4. MCO 1 is organized as a staff-model, closed panel MCO with approximately 400,000 enrollees. MCOs 2 and 3 are 2 formerly separate divisions of approximately equal size that have now been amalgamated into one organization, with an overall enrollment of approximately 1.2 million people. We report results from these 2 divisions separately. MCO 2 is a group-model MCO and MCO 3 is a network-model system. Data for MCO 4 come from only the staff-model system of this mixed-model MCO with about 400,000 members. Approximately 90% of all members have prepaid drug coverage that provides up to a month's supply of medicine for a nominal copayment ($5-$10 per prescription).

Dispensing of national guidelines, than in 1993 shortly following guideline release. They reported that use of inhaled controller medications was particularly low in adolescents who were high β-agonist users. National survey data have found no change in reported use of inhaled controller therapy when the results from 1991 through 1994 are compared with the period 1988 through 1991. The authors reported that children younger than 6 years were more likely to receive inadequate therapy, and that most children receiving inadequate controller therapy were not poor. In a small study of inner-city children, 39% with a recent hospitalization or daily use of β-agonists were using inhaled anti-inflammatory medication regularly. Several recent studies focusing on adults have also indicated undertuse of ICSs in people with asthma. These studies in pediatric populations date only from the period shortly following the initial dissemination and promotion of the guidelines. In addition, they are limited by the use of self-reported data using questions that do not allow estimation of whether children are regular or sporadic users of medication, or by the use of data from a single MCO. There is little recent information regarding the pattern of use of inhaled controller therapy in children now that sufficient time has elapsed since the release of the guidelines to allow for dissemination and integration into clinical practice.

This study examines children enrolled in 4 different care delivery systems within 3 geographically diverse MCOs that care for a total population of approximately 2 million people. These organizations are participating in the multicenter Pediatric Asthma Care–PORT (PAC-PORT II) trial of strategies to improve pediatric asthma health outcomes. Our aim was to examine some of the factors associated with the patterns of use of asthma controller therapy. We anticipated that adolescents would be less likely to be regular users of controllers, whereas preschool-age children would be less likely to be initiated on ICSs than older children, because no nebulized ICS formulations were available during the study period and because of concern regarding the potential side effects of ICSs in young children. We examined whether these practice patterns were continuing despite more than a decade since the initial dissemination of the guidelines.

**STUDY POPULATION**

The study population consisted of all children enrolled in the 4 MCOs aged 3 to 15 years with at least 1 diagnosis of asthma (International Classification of Diseases, Ninth Revision, Clinical Modification codes 493.00-493.99) listed for a hospitalization, emergency department visit, or ambulatory encounter (ie, provider-diagnosed asthma), from July 1, 1996, to June 30, 1997. Only persons who were continuously enrolled for the 12-month study observation period (ie, July 1, 1996 to June 30, 1997) and who had prepaid drug coverage were included as eligible for analysis.

**MEDICATIONS**

The frequency of controller therapy dispensing was calculated for each type of drug for each individual by summing the number of prescriptions dispensed. Asthma

During the study period (July 1, 1996, to June 30, 1997), asthma outreach programs were in various stages of development in the 3 MCOs. These programs were scheduled to include patient and staff education and follow-up programs for individuals with more serious asthma.

The study MCOs maintain computerized information systems that capture basic demographic data and claims files for all hospitalizations and emergency department visits. Automated pharmacy records maintained by or available at all sites contain detailed information on all medications dispensed via prescription at all pharmacies.

**RESULTS**

Eligibility criteria were satisfied by 13,352 children, with 3082 children from MCO 1, 2852 from MCO 2, 6033 from MCO 3, and 1385 from MCO 4. The average age of the children was 9.3 years, and there was a predominance of boys (59%) in the sample overall. The distribution of age and sex was similar across MCOs.

**ANALYSIS BY AGE**

Dispensing of controller therapy varied among age groups. Significantly fewer children aged 3 to 5 years received 1 or
controller therapy included ICSs (referred to as “inhaled steroids”) and inhaled cromolyn sodium or nedocromil (referred to as “cromolyn”). Oral antileukotrienes were rarely dispensed at any age, and have been omitted from the analysis. β-Agonists included inhaled or pediatric oral preparations and included anticholinergics, but excluded long-acting β-agonists such as salmeterol, as use of these drugs during the period under study was minimal.

STATISTICAL ANALYSIS

The main outcome of interest was frequency of asthma controller therapy dispensing. The frequency of β-agonist dispensing served as a surrogate for asthma severity and was used as the main variable for stratification in the analysis. Potential covariates included age, sex, and MCO. Information on race was unavailable for a substantial proportion of the population and was therefore not considered in this analysis. Pharmacy data included any initial dispensing and refills of all prescription medications.

Differences in the proportion of children dispensed any controller therapy in each stratum were assessed for significance by χ² tests and Mantel-Haenszel methods. β-Agonist dispensing rates were collapsed into 4 categories (0, 1-2, 3-5, ≥6 dispensings). These categories were viewed as proxies for measurements of disease severity. This method has been successfully used in previous studies to stratify risk of morbidity.17,18 Leone et al19 reported a monotonic relationship between a pharmacy-based severity classification and future inpatient resource utilization for asthma. Six or more dispensings of β-agonists provides at least 1200 inhalations, at an average during 1 year of more than 3 inhalations per day. The current guidelines are clear in their recommendation that children who require frequent use of β-agonists should also be maintained with controller medication. Age was also divided into 9 groups (3-5, 6-8, 9-11, and 12-15 years). These categories were chosen so that preschool-age children and adolescents could be examined separately, and to ensure groups of approximately equal size.

Controller medications were not weighted for potency, as fluticasone propionate accounted for only 5% of controller dispensings and budesonide was not being used during this period, and recommended doses of other ICSs are similar to each other. Multiple logistic regression was used to model controller therapy dispensing. We were interested in the total number of children receiving controllers and those getting them more regularly. We examined repeated dispensings, since current management recommendations are for long-term use in children with persistent asthma. Therefore, separate models were developed for the outcomes of (1) any controller dispensing, (2) 3 or more controller dispensings, and (3) 5 or more controller dispensings. Three controller canisters during 1 year would provide less than 2 inhalations per day, while 5 controller canisters are the minimum number that could indicate nearly daily use of medication, at an average of 2 to 3 inhalations per day. Differences by patient age were evaluated by stratified analysis and by inclusion of interaction terms in the logistic model.

Approval for this study was obtained from institutional review boards at each study site.

more dispensings of a controller therapy than did children in older age groups (P<.01) (Figure 1). Although a similar proportion of 3- to 5-year-olds were dispensed cromolyn as 6- to 8-year-olds, fewer younger children were dispensed ICSs (Figure 1). In all age groups the proportion of children receiving controllers increased with more frequent dispensing of β-agonists. Overall, 60% of children who received 3 or more β-agonists also received some controller medication (Figure 2), and this figure increased to 77% in those with 6 or more β-agonist dispensings (Figure 3). The pattern of age differences in controller use changed among children with more frequent dispensing of β-agonists. Among children who received 6 or more β-agonists, a similar proportion of 3- to 5-year-olds (70%) as older children (74%) received a controller medication (Table 1). Preschool-age children in the 3 or more and 6 or more β-agonist groups continued to receive cromolyn more frequently than older children, and more frequently than they were dispensed ICSs. However, in multivariate analysis, controlling for frequency of β-agonist dispensing, sex, and MCO, 3- to 5-year-olds were less likely to receive a dispensing of controller therapy than older children (odds ratio [OR], 0.8; 95% confidence interval [CI], 0.7-0.9; P=.01) (Table 2).

The pattern of repeated (≥3 or ≥5) controller dispensings showed few children received controllers regularly, even among children with frequent β-agonist use (Table 3). Only 12% of all children were dispensed 5 or more canisters of controller over 12 months. Few children at any age who were infrequent β-agonists users were regular users of controllers (Table 4). Among those dispensed 6 or more β-agonists, 58% received 3 or more, and 39% received 5 or more controllers of any type. Significantly fewer adolescents (12- to 15-year-olds) than younger children who received 6 or more β-agonists were dispensed either 3 or more (54% vs 61%; P=.001), or 5 or more controllers (33% vs 43%; P<.001). Only 21% of adolescents in this group of frequent β-agonists users received 5 or more dispensings of ICSs. This pattern was confirmed in multivariate analysis, controlling for other factors as above. Children aged 12 to 15 years were significantly less likely to be dispensed 3 or more (OR, 0.8; 95% CI, 0.70-0.94; P=.005) or 5 or more controllers (OR, 0.7; 95% CI, 0.6-0.9; P<.001) than younger children. Children 6 to 8 years old were more likely to receive repeated (≥5) controller dispensings than preschool-age children (OR, 1.3; 95% CI, 1.1-1.6; P = .008). When the analysis was restricted to only those who had been dispensed some controllers (n = 5237), a similar pattern was seen. Using 3- to 5-year-olds as the reference group, the OR for repeated (≥5) controller dispensings in 12- to 15-year-olds was 0.6 (95% CI, 0.5-0.8; P<.001), and for 6- to 8-year-olds was 1.3 (1.1-1.6; P= .03) (data not shown).

ANALYSIS BY SEX

Over the year of the study, a significantly lower proportion of girls (37%) received any controller therapy than did boys (41%; P<.001). A difference of similar magni-

A similar pattern was seen for repeated (≥5) controller dispensing (10% vs 13%; P > .001). Among children dispensed 6 or more β-agonists, significantly fewer girls than boys received any controllers (75% vs 79%; P=.006) or repeated (≥5) controller dispensings (39% vs 43%; P=.005). In the group with 6 or more β-agonist dispensings, the sex discrepancy for repeated controller dispensing was greatest in children aged 3 to 5 years (34% vs 48%; P < .001) and was also seen in 9- to 11-year-olds (41% vs 46%), but was absent in 12- to 15-year-olds (35% vs 36%). In the multivariate analyses, controlled for age, organization, and β-agonist use, girls were significantly less likely than boys to receive any controller therapy (Table 2). Girls were also less likely than boys to receive 5 or more dispensings (OR, 0.8; 95% CI, 0.7-0.9; P = .004), or 3 or more dispensings (OR, 0.9; 95% CI, 0.80-0.97; P = .01) of controllers. In the analysis restricted only to those dispensed some controller, a similar result was found, with girls significantly less likely to receive repeated (≥5) controller dispensing (OR, 0.8; 95% CI, 0.7-0.95; P = .03).

**EFFECT OF ORGANIZATION**

Differences in controller use were evident among MCOs. Children at MCO 1 were more likely than children at MCO 4 to receive ICSs (33% vs 23%; P < .05) and less likely to get cromolyn (15% vs 25%; P < .05). This pattern was seen across all age groups. Differences in controller use among MCOs persisted among children dispensed 6 or more β-agonists. At MCO 3, 69% who received 6 or more β-agonists were also dispensed at least 1 controller, compared with 85% at MCO 1 and 83% at MCO 4. The multivariate model for any controller dispensing showed children at MCO 3 were significantly less likely than children cared for at other MCOs to receive any controllers (Table 2). Those cared for at either MCO 1 or 2 were more likely than those from MCO 4 to be dispensed any controller. However, the model for repeated (≥5) controller dispensing showed different results. Children from MCO 3 were significantly more likely (OR, 1.3; 95% CI, 1.1-1.7; P = .02) and those at MCO 1 less likely (OR, 0.8; 95% CI, 0.6-0.99; P = .05) than those at the reference group of MCO 4 to be dispensed 5 or more controllers. A similar result was evident for dispensing of 3 or more controllers. When the analysis was restricted to those with some controller dispensing, MCO 3 children were significantly more likely to have repeated controller dispensing (OR, 1.7; 95% CI, 1.3-2.1; P < .001) than those from MCO 1 (OR, 0.7; 95% CI, 0.6-0.98; P = .03) or the reference group of MCO 4.

**COMMENT**

Nearly a decade after the distribution of national guidelines for the management of asthma, few children with symptomatic asthma use controller therapy regularly in the diverse managed care settings that we studied. The current NAEPP guidelines clearly recommend the regular use of controller medication for children whose high β-agonist use indicates symptoms throughout the year. Six or more β-agonists per year will provide on average more than 3 inhalations per day of quick-relief medication. Few of these children will not have persistent asthma. Although nearly three quarters in this group were dispensed a controller at least once, only around two fifths had 5 or more dispensings of controller. Among these children with more frequent β-agonist use, only a little more than half were dispensed 5 or more controllers; in no age category did the proportion dispensed 5 or more
controllers reach 50%, and in adolescents this proportion dropped to one third. Conversely, there were few children who were regular users of controllers but infrequent β-agonist users, suggesting that the group with persistent asthma who was well controlled was small.

As anticipated, children of preschool age were less likely to be initiated on anti-inflammatory medication, and fewer adolescents were regular users of anti-inflammatories. Our results provide similar findings to earlier studies of overall controller use that were conducted during the first years

<table>
<thead>
<tr>
<th>Frequency of Controllers</th>
<th>3-5 (n = 374)</th>
<th>6-8 (n = 548)</th>
<th>9-11 (n = 534)</th>
<th>12-15 (n = 843)</th>
<th>Total (N = 2299)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1</td>
<td>263 (70)</td>
<td>406 (74)</td>
<td>401 (75)</td>
<td>630 (75)</td>
<td>1700 (74)</td>
</tr>
<tr>
<td>≥3</td>
<td>216 (58)</td>
<td>335 (61)</td>
<td>338 (63)</td>
<td>454 (54)</td>
<td>1343 (58)</td>
</tr>
<tr>
<td>≥5</td>
<td>156 (42)</td>
<td>252 (46)</td>
<td>217 (41)</td>
<td>274 (32)</td>
<td>899 (39)</td>
</tr>
</tbody>
</table>

Table 1. Frequency of Children With Asthma in Different Age Groups Who Were Dispensed Controllers at Differing Rates, Among Only Those With 6 or More β-Agonist Dispensings

<table>
<thead>
<tr>
<th>OR (95% CI)</th>
<th>P</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group, y</td>
<td>3-5</td>
<td>0.8 (0.7-0.9)</td>
<td>.01</td>
</tr>
<tr>
<td>MCO</td>
<td>1</td>
<td>1.2 (1.0-1.4)</td>
<td>.04</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td>0.9 (0.8-0.96)</td>
<td>.003</td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td>1.0</td>
<td>. .</td>
</tr>
</tbody>
</table>

Table 2. Results of Multiple Logistic Regression Analysis Showing Adjusted Odds Ratios for Any (≥1) and Repeated (≥5) Controller Therapy Dispensings

<table>
<thead>
<tr>
<th>Frequency of Controller Dispensing</th>
<th>Zero (n = 3432)</th>
<th>1 to &lt;3 (n = 5550)</th>
<th>≥3 to 5 (n = 2188)</th>
<th>≥6 (n = 2202)</th>
<th>All Children (N = 13372)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2922 (85)</td>
<td>3794 (68)</td>
<td>865 (40)</td>
<td>519 (24)</td>
<td>8100 (61)</td>
</tr>
<tr>
<td>≥1 to &lt;3</td>
<td>292 (9)</td>
<td>1213 (22)</td>
<td>527 (24)</td>
<td>374 (17)</td>
<td>2406 (18)</td>
</tr>
<tr>
<td>3 to &lt;5</td>
<td>103 (3)</td>
<td>280 (5)</td>
<td>426 (19)</td>
<td>422 (19)</td>
<td>1231 (9)</td>
</tr>
<tr>
<td>≥5</td>
<td>115 (3)</td>
<td>243 (4)</td>
<td>370 (17)</td>
<td>892 (40)</td>
<td>1620 (12)</td>
</tr>
</tbody>
</table>

Table 3. Numbers of Children With Asthma in Different Categories of Frequency of Controller Dispensing, Stratified by Frequency of β-Agonist Dispensing

<table>
<thead>
<tr>
<th>Frequency of β-Agonists</th>
<th>3-5 (n = 3059)</th>
<th>6-8 (n = 3313)</th>
<th>9-11 (n = 3101)</th>
<th>12-15 (n = 3879)</th>
<th>Total (N = 13352)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to &lt;3 (n = 8962)</td>
<td>62 (3)</td>
<td>89 (3)</td>
<td>116 (4)</td>
<td>54 (2)</td>
<td>321 (4)</td>
</tr>
<tr>
<td>3 to 5 (n = 2289)</td>
<td>58 (13)</td>
<td>124 (20)</td>
<td>101 (18)</td>
<td>99 (15)</td>
<td>382 (17)</td>
</tr>
<tr>
<td>≥6 (n = 2299)</td>
<td>156 (42)</td>
<td>252 (46)</td>
<td>217 (41)</td>
<td>274 (33)</td>
<td>899 (39)</td>
</tr>
<tr>
<td>All Children</td>
<td>276 (9)</td>
<td>465 (14)</td>
<td>434 (14)</td>
<td>427 (11)</td>
<td>1602 (12)</td>
</tr>
</tbody>
</table>
after the initial dissemination and promotion of the national guidelines.7,9,10 Halterman et al10 found that in the years 1991 to 1994, 26% of children with moderate-to-severe asthma reported using inhaled controller therapy in the previous month. However, unlike these authors we found significant sex differences in controller use. In addition, although preschool-age children were less likely to be initiated on controller therapy, similarly to the findings of Goodman et al,4 we found that adolescents are less likely to use them regularly. The varied nature of the practice types in the MCOs we studied, as well as their geographic diversity, suggests that our results can be extrapolated more generally. Our findings indicate that current systems of care for children with asthma lead to less than ideal asthma management, and that the passage of time is not substantially altering this situation. The sharp discrepancy seen among frequent β-agonist users between any dispensing of a controller and more regular use suggests that attention needs to be focused more on the barriers to long-term use of controllers by patients and families than on simply getting clinicians to prescribe “a controller” for chronic asthma.

A number of factors may explain why children with more frequent symptoms are apparently not receiving adequate asthma therapy. That there are many children who have both frequent dispensings of bronchodilators and one dispensing of controller, but do not receive refills of controllers, suggests that limited patient adherence plays a major role.20,25 Adherence with treatment declines in adolescence, and most deaths from childhood asthma occur in adolescents.13 External influences can have major effects; in a recent study,22 26% of adolescent inhaler users were not allowed to carry their medication on their person while at school. It is also possible that less frequent physician visits could explain the lower regular use of controllers in adolescents. Adolescents initiate visits to physicians at much lower rates than do younger children.23 It is also possible that physicians do not, or are unable to, schedule routine and timely follow-up visits to monitor the clinical situation for children started on controller medication, as is recommended in the guidelines.4 Hence, children, especially adolescents, may be using prescriptions with long-term refills or requesting telephone refills without physicians’ complete awareness of their frequent β-agonist use. More effective systems of monitoring and of providing feedback to physicians of patterns of patient drug usage are possible methods for improving this situation.

Concern about adverse effects may also reduce the ICS use, both from a reluctance of physicians to prescribe ICSs and of families to continue using them.24 Such concerns do not explain the concomitant underuse of alternative medications such as cromolyn. An alternative explanation why children may be dispensed 1 or 2 controllers per year is that physicians may be using them to manage exacerbations. This management strategy is unproven and would not accord with current guideline recommendations.23

Most cases of asthma in children are identified by the age of 5 years.26 Therapy for preschool-age children differs from that for older children in several ways. Overall, controller use is lower in children aged 3 to 5 years, adjusted for β-agonist use, and this age difference is greater in those needing less frequent bronchodilator treatment. Cromolyn is used more often in younger children, a pattern seen with more frequent β-agonist use as well as in children needing less bronchodilator treatment. There are several likely reasons for these differences. Delivery methods for ICSs currently available in the United States may limit their use in this younger age group.27 Although the use of metered-dose inhalers with close-fitting masks has been shown to be effective28,29 and some experts would recommend them as the first-choice device,30 the lack of a corticosteroid formulation for use via nebulizer in the United States may lead clinicians to favor cromolyn in preschool-age children. The severity of asthma may be underestimated in younger children.28,30 Less frequent β-agonist use (1-3 dispensings per year) may indicate intermittent asthma in which controllers are not indicated, and intermittent disease may be more common in preschool-age than older children. Finally, concern over the potential long-term adverse effects of ICSs may cause physicians to use cromolyn in young children. However, the majority of preschool-age children dispensed 6 or more β-agonists were not using cromolyn regularly. In young children (<5 years old) with frequent symptoms, low use of ICSs is not being compensated by increased use of cromolyn.

Although the relative differences in use of controllers between boys and girls are small, this discrepancy would still lead to large absolute numbers of inadequately treated girls with asthma. Several reasons can be postulated as to why we found differences in the frequency of controller dispensing in girls and boys. Dysnaptic growth of airways and lung parenchyma may show sex differences, leading boys to have smaller airways for the same lung volume than do girls, with consequently more frequent airway obstruction.31 Symptoms of wheezing are more likely to be treated as asthma than symptoms such as persistent nocturnal cough,32 and there may be sex differences in types of asthma symptoms. Kühni and Semnhauser33 found that in Swiss children, for all asthma symptoms except wheeze, approximately twice as many boys as girls received bronchodilator treatment. Boys have also been reported to be more likely than girls to receive medication, regardless of the frequency of wheezing.34 Psychosocial influences may be important. Physicians, parents, and children may have different perceptions of symptoms and different attitudes toward treatment of girls and boys. For instance, exercise limitation in boys may be perceived as a problem that requires treatment more often than it does in girls. In this regard, it is interesting to note that a previous study based on self-report did not show sex differences in use of controller therapy.10 The large sex difference for repeated controller use among preschool-age children dispensed 6 or more β-agonists, a group for whom symptoms are likely to be a significant problem that will attract the attention of parents and physicians, suggests a role for psychosocial factors. Quality improvement efforts may need to focus on sex differences in asthma management, and further work is needed to explore this area.

The strength of our study lies in the diverse practice-type settings of the MCOs studied, as well as their geographic spread. However, this study has a number of limitations. The absence of individual clinical data limits the conclusions that can be drawn regarding the appropriateness of medication regimens for many children in our study, as we lack an independent definition of severity. However, in the
group of children with frequent β-agonist dispensings, we can be confident that the large proportion not regularly using controllers represents less than ideal use of asthma therapy. We used medication dispensing as a surrogate for actual medication consumption. The effect of this may be varied, as some children will not use the dispensed medication, while others will obtain medicine from non-pharmacy sources, such as physician samples or family members. It is likely that our estimates of the amount of medication for regular use is an overestimation of the actual duration of use, as some medication will not be used and some will be used at higher doses than 2 to 3 puffs a day but for shorter periods. The advantage of this method over patient self-report is that recall bias and the tendency for people to give socially desirable responses are limited. The reliability of the automated data in capturing the dispensing of medications has been demonstrated previously in these systems.35 The proportion of children receiving no prescription therapy for asthma was similar to that found by Buchner et al using similar methods of claims data analysis in MCOs. No adjustment was made for dosage of controller medication, nor was any weighting performed to adjust for potency of different inhaled steroids. The effect of this is probably minimal as the use of fluticasone or budesonide is very small, and the recommended doses of other ICs are very similar. A lack of data on factors such as race, smoking, and detailed socioeconomic status measures is also a limitation of the study’s conclusions. The cross-sectional design and the absence of data from other periods make it difficult to discern temporal trends in dispensing patterns.

In the diverse managed care settings we studied, most children with frequent symptoms, as judged by their use of bronchodilators, have received some pharmacotherapy to combat airway inflammation. However, at any age the majority of children with frequent need for bronchodilators are not using sufficient controller medication to be considered “regular” users of preventive therapy, as recommended in national guidelines. Adolescents are at particular risk for suboptimal asthma management. Clinicians also need to be aware of potential sex differences in asthma management. Organizations and clinicians need to focus on strategies that encourage greater medication adherence with regular maintenance asthma therapy among patients and families.

Accepted for publication December 12, 2000.

Funding for this study was provided by Pediatric Asthma Care–PORT II, grant HS08368; the Agency for Healthcare Research and Quality; the National Heart, Lung, and Blood Institute; and Rhône Poulenc Rorer Pharmaceuticals. Dr Adams is a recipient of the Thoracic Society of Australia and New Zealand/Allen and Hanbury’s Respiratory Research Fellowship. Dr Fuhlbrigge is supported by a Mentored Clinical Research–PORT II, grant HS08368; the Agency for Healthcare Research and Quality; the National Heart, Lung, and Blood Institute; and Rhône Poulenc Rorer Pharmaceuticals. Dr Adams is a recipient of the Thoracic Society of Australia and New Zealand/Allen and Hanbury’s Respiratory Research Fellowship. Dr Fuhlbrigge is supported by a Mentored Clinical Research Fellowship. Dr Fuhlbrigge is supported by a Mentored Clinical Research Fellowship. Dr Fuhlbrigge is supported by a Mentored Clinical Research Fellowship.

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