Adherence of Pediatric Asthma Patients With Oral Corticosteroid Prescriptions Following Pediatric Emergency Department Visit or Hospitalization

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Objective: To determine caregiver adherence to oral corticosteroids prescribed in the emergency department for pediatric patients with an acute asthma exacerbation and to identify caregivers' perceived barriers to adherence with prescribed oral corticosteroids.

Methods: We conducted telephone interviews 7 to 9 days following a patient's presentation to an urban children's hospital emergency department for an acute asthma exacerbation. The telephone interview conducted with caregivers of pediatric asthma patients included questions regarding whether caregivers filled a prescription for an oral corticosteroid, the number of days the caregiver gave the medication, and the perceived barriers to adherence by the caregiver.

Results: During the study period, oral corticosteroid prescriptions were written for 161 of 172 patients completing the phone interview (93.6%). Of these patients, 98.7% reported filling the prescription, with caregivers of female patients and adolescent patients less likely to fill prescriptions than caregivers of male and younger patients. Asthma patient caregivers, however, reported adherence to the prescribed length of oral corticosteroid therapy only 64% of the time. Caregivers worried about the side effects of oral corticosteroids 60% of the time.

Conclusions: Efforts to increase corticosteroid adherence in children with acute asthma exacerbations should consider the causes for variation in caregiver adherence with length of therapy as well as caregiver perceptions regarding corticosteroid side effects.

Key Words: asthma, adherence, corticosteroids

Asthma affects greater than 3 million children 14 years old or less in the United States.[1,2] Children with asthma account for more than 550,000 emergency department visits each year,[1] with nearly 1 in 3 children with asthma visiting the emergency department at least once annually.[3] Compared to children without asthma, asthmatic children have 2.2 times the number of emergency department visits and 3.5 times the number of hospitalizations each year.[4]

The early administration of oral corticosteroids during an acute asthma exacerbation results in improved airway flow, decreased rates of hospitalization, and fewer relapses.[5–13] Corticosteroids play an important role in the management of asthma patients who present to an emergency department,[5–11] and patients discharged with a course of oral corticosteroids have decreased rates of relapse.[7–9,12] Asthma guidelines, formulated by the National Institutes of Health, recommend the early use of oral corticosteroids in the acute treatment of asthma in children with moderate to severe asthma not responding to β-agonist therapy. These guidelines also recommend continuing children on a 3- to 10-day course of oral corticosteroids following discharge from the emergency department.[6]

Successful emergency department management of children with asthma, however, must take into account patient and family adherence with prescribed oral corticosteroids and other medications.[13] Adherence to prescribed oral corticosteroids following acute asthma exacerbations includes not only the filling of the prescription by the family, but also administering the medication to the child at the prescribed dose, at the prescribed time, and for the prescribed length of therapy. Previous studies have focused on adherence to inhaled corticosteroids, and few have addressed adherence to oral corticosteroids following emergency department visits. Cooper and Hickson[14] found that only 44% of children enrolled in Tennessee Medicaid filled steroid prescriptions following an emergency department visit for an acute asthma exacerbation. Cooper and Hickson described variations in the rates of corticosteroid prescriptions filled among older children, children in rural settings, and black children. Leickly et al[15] found among inner-city children with asthma self-reported adherence rates of 85.8% to the medical treatment plan and 84.4% to oral steroids prescribed in the emergency department. Several stated barriers to asthma medication use have been identified in focus groups conducted with parents of children who have asthma. These

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include fear of side effects, dependence upon medications, costs, the usefulness of medications, access to care, lack of education about treatment, and perceived severity of symptoms.[16]

The purpose of this study was to explore differences in oral corticosteroid prescription filling rates based upon demographic variables for children who had an emergency department visit or hospitalization for an acute asthma exacerbation. We hypothesized that family demographic characteristics and caregiver barriers to adherence would affect filling and taking of corticosteroids for study children.

METHODS

A prospective cohort study design included all children aged 2 to 17 years old with a history of asthma who presented to the Vanderbilt Children's Hospital emergency department with an acute exacerbation requiring β-agonist therapy. The Vanderbilt Children's Hospital emergency department serves a 7-county standard metropolitan statistical area with a population slightly exceeding 1,000,000 persons.[17] With 35,000 visits per year, the pediatric emergency department serves as the primary center for moderate to severe illness in the catchment area.

Children were considered to have a history of asthma if their primary caregivers reported a previous diagnosis of asthma and/or reported the use of a bronchodilator within the 6 months before presentation to the pediatric emergency department. Children below the age of 2 were excluded from the study because they may have wheezing secondary to a viral infection, such as bronchiolitis.[18–20] Oral corticosteroids are not the standard of care for children with wheezing secondary to bronchiolitis or other viral infection.[18–20]

Nurses and physicians who worked in Vanderbilt Children's Hospital Emergency Department participated in the enrollment process. They were instructed on the proper consent procedures and enrollment criteria through in-services delivered by one investigator (KB). When an eligible patient presented to the ED, the study was explained to the primary caregiver, and the caregiver was given the opportunity to read and complete the consent form. The consent form solicited several phone numbers where the caregiver could be reached and the best time of day to reach the caregiver. Patients were enrolled during the period from September 1, 2002, to January 8, 2003. One investigator (KB) reviewed the medical records of all consented patients to confirm eligibility. Of the 220 patients for whom consent was requested, 4 were not eligible because they were under the age of 2 years, 6 were ineligible because they did not meet the study definition of having a history of asthma, and 5 families declined to participate after receiving information about the study.

Demographic characteristics of children in the cohort were identified from medical record review. Demographic characteristics included age, sex, race, and primary payer. Patient disposition was recorded as ''discharged'' to home or ''admitted'' to the hospital. No patients were transferred to other facilities for care. Copies of all discharge prescriptions for oral corticosteroids were obtained from the medical record for both emergency department visits and hospitalizations, and the number of days' supply of medication was recorded.

Phone interviews were conducted with the child's primary caregiver 7 to 9 days after discharge and included information regarding whether the parents filled an oral corticosteroid prescription (if written), the number of days the oral corticosteroid medication was given, and the caregivers' perceived barriers to adherence. Up to 5 attempts were made to contact each family. Interview questions were designed to address barriers to compliance identified from previous research.[14–16,21–32] Caregivers were first asked whether they received an oral corticosteroid prescription and whether they filled the oral corticosteroid prescription. For caregivers who reported that they filled an oral corticosteroid prescription, 11 questions (Table 3) concerning barriers to adherence were asked. A standard response scale of ''a lot,'' ''a little,'' ''some,'' or ''not at all'' was offered to each caregiver. Two questions assessed adherence to the prescribed length of therapy. The instrument was piloted on 15 caregivers of asthmatic children who were not a part of the study cohort. Based on the piloting of the instrument, interview items were revised for ease of understanding. Pharmacy records of the first 30 enrolled patients completing the interview were reviewed to confirm self-report of oral corticosteroid prescription filling.

The primary outcome measures included self-reported filling of an oral corticosteroid prescription and adherence with the length of prescribed therapy. Adherence with the length of prescribed therapy was determined by comparing the actual number of days the oral corticosteroid prescription was written for to the number of days the caregiver reported giving the oral corticosteroid prescription. Study subjects were considered adherent if the number of days the oral corticosteroid prescription was written for equaled the reported number of days the oral corticosteroid was given. Adherence data were stratified based on the number of days the oral corticosteroid was prescribed.

Sample size estimates were based on comparisons of patient caregiver self-report of oral steroid prescription fillings stratified by race found in the study by Cooper and Hickson[14] and a review of the literature on differences in adherence to prescribed medications.[15,21,25,26,33] We calculated that a sample size of 169 patients would be needed to detect anticipated differences ($\alpha = 0.05$, 80% power).

Comparisons of demographic characteristics and self-reported barriers to adherence (fear of side effects, perceived need for medication, financial constraints, etc) were performed using χ^2 analysis based on reported filling and adherence to the prescribed oral corticosteroid regimen. The difference between demographic strata is reported as well as 95% confidence intervals (CIs). All analyses were performed using STATA statistical software, Version 7.0 (Stata Corporation, College Station, Tex) on a personal computer (Dell Dimension L550, Dell Computer Corporation).

The Vanderbilt University institutional review board reviewed and approved the study before its initiation.

RESULTS

Of 205 families consenting to participate in the emergency department, 172 (84%) completed the follow-up interview (Fig. 1). The most common reasons for failure to complete an interview were inability to establish contact after 5 attempts (n = 14) and refusal to participate (n = 9). Children whose caregivers did not participate in the follow-up interview did not differ from children whose caregivers did participate with respect to demographic characteristics or asthma outcome (hospitalization vs. no hospitalization). Of the asthma patients whose caregiver completed the follow-up interview, 40.2% were white, 39.6% were female, and 52.9% had Tennessee Medicaid as their primary insurance. Asthma patients between the ages of 2 and 9 represented 77.9% of the patients enrolled. The rate of hospital admission for asthma patients enrolled in the study was 22.1%.

Oral corticosteroid prescriptions were written at the time of emergency department or hospital discharge for 161 (93%) of 172 patients who completed the study. The positive predictive value of primary caregiver self-report of receiving an oral steroid prescription was 100%. The negative predictive value was 85%. Of the 159 primary caregivers reporting that they received an oral corticosteroid prescription at the time of discharge, 2 (1%) reported that they did not fill the prescription (Fig. 1). In the first 30 patients completing the interview, prescription filling was confirmed for 90% (95% CI: 73% to 98%).

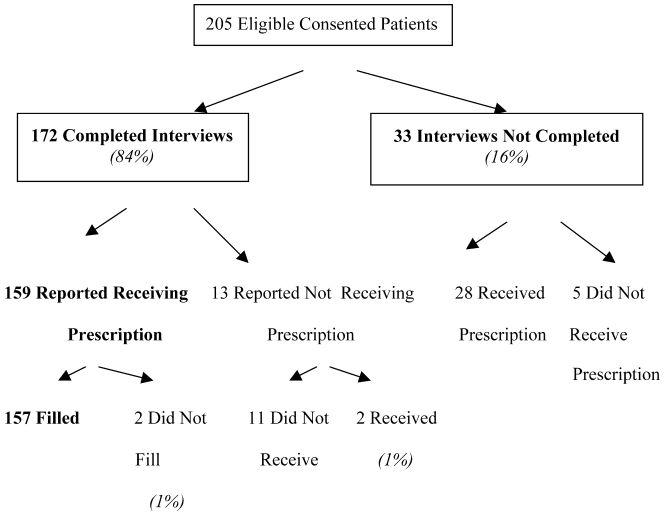

FIGURE 1. Overview of study enrollment, children with an urban emergency department visit for an acute asthma exacerbation.

In univariate comparisons of children whose caregivers reported filling versus not filling oral corticosteroid prescriptions, male children were more likely to have an oral corticosteroid prescription filled than female children (Table 1). Caregivers of asthma patients admitted to the hospital were more likely to fill the prescription for an oral corticosteroid. In stratified analyses, children discharged directly to home from the emergency department were slightly less likely to fill prescriptions (Table 1). Differences in filling based on gender and age persisted.

Asthma patient caregivers were adherent to the prescribed length of the oral corticosteroid regimen 64% of the time. There were no statistically significant differences between the demographic characteristics of asthma patients with adherent caregivers and asthma patients with non-adherent caregivers (Table 2). The caregivers of both admitted and nonadmitted asthmatic children were adherent 65% of the time. Certain groups were at higher risk for nonadherence. These included patient caregivers who worried about side effects, caregivers who believed the corticosteroid was not helpful in the treatment of asthma, caregivers who felt the child did not need the prescription, and those who claimed they did not understand how oral corticosteroid medications worked.

For children who received prescriptions, 76% of the oral corticosteroid prescriptions were written for 4 or 5 days of therapy and 16% were written for greater than 5 days of therapy, 8% were written for fewer than 4 days. Adherence to therapy greater than 5 days was significantly ($P < 0.03$) greater than adherence to shorter courses of therapy. Suspensions were written for 71% of prescriptions and prednisone tablets for 29%. Medication formulation did not affect adherence with length of therapy.

Caregivers were queried about their perceived barriers to adherence (Table 3). Overall, 60% of caregivers worried about the side effects of oral corticosteroids. Other common barriers included trouble giving the prescription to the child, lack of understanding how the medication worked, and lack of family support. Caregivers of white patients and the caregivers of patients over age 9 worried more about the side effects of oral corticosteroids. The caregivers of patients younger than 9 years expressed worry about hyperactivity and growth problems, whereas the caregivers of children older than 9 years reported concerns about appetite and

TABLE 1. Comparison of Asthma Patients Filling Oral Corticosteroid Prescriptions Following a Visit to the Pediatric Emergency Department

Characteristic		% Caregivers Filling Script, All Children	% Difference (95% CI)	% Caregivers Filling Script, Children not Admitted to the Hospital	% Difference (95% CI)
Race	White	95.7%	7.3% (−1.3 to 15.9)	94.6%	10% (−1.0 to 20.9)
	Nonwhite	88.4%		84.6%	
Sex	Male	95.1%	9.8% (1.3 to 18.5)	93.5%	11.1% (0.2 to 21.8%)
	Female	85.2%		82.4%	
Age, years	2 to 9	93.2%	9.1% (−1.1 to 19.2)	91.5%	12.9% (0.2 to 26.1)
	10 to 17	84.2%		78.6%	
Insurance	Commercial	93.8%	4.1% (−4.6 to 12.9)	91.8%	4.7% (−6.4 to 16.0)
	Medicaid/self-pay	89.7%		87.1%	
Admitted	Yes	100%	11.2% (1.1 to 21.3)		
	No	88.8%			

mood changes, weight gain, bone damage, and organ problems. Access to the pharmacy did not appear to be a barrier reported by any demographic group enrolled in the study. Work and other stressors were rarely reported as interfering with filling the oral corticosteroid prescription.

Primary caregivers had trouble giving the oral corticosteroid 26% of the time. In this respect, the biggest problem encountered by caregivers was the taste of the medication. Caregivers of asthma patients younger than 6 considered themselves to have less knowledge about the use of oral corticosteroids in acute asthma exacerbations; however, 77% of caregivers stated they had at least ''a little'' knowledge about the use of oral corticosteroids.

DISCUSSION

In this study of over 200 children following an emergency department visit with either discharge or hospitalization for an asthma exacerbation, we found a higher than expected rate of corticosteroid prescription filling, with 98% of caregivers reportedly filling a corticosteroid prescription when it was written. The high rate of oral corticosteroid filling is important as children taking oral corticosteroid medications during an acute asthma exacerbation have decreased rates of relapse and hospitalization.[5–13,34–38] It is important to note that we also found that over one third of the caregivers reported lack of adherence with the recommended duration of therapy following prescription filling. Furthermore, both adherent and nonadherent caregivers identified several important barriers to corticosteroid use.

Several factors may account for the high rate of oral corticosteroid prescription filling noted in this study. First, a confirmed oral corticosteroid prescription was written for 93% of asthmatic children following asthma-related emergency department visits. In prior studies, the actual rate of prescribed oral corticosteroids was not available,[14] therefore the rate of filling for oral corticosteroid prescriptions may have been falsely low secondary to some patients not receiving a prescription at discharge. In the current study, researchers were able to verify that an oral corticosteroid prescription had been written and given to the patient because carbon copies of all prescriptions are included in the medical record.

A second factor that may have contributed to a high rate of oral corticosteroid prescription filling includes education delivered to all asthmatic children and their families.

TABLE 2. Comparison of Asthma Patients Adherent to Prescribed Length of Therapy Following Discharge From the Emergency Department or Hospital

Characteristic		Total % Caregivers Adherent*	% Difference 95% CI
Race	White	68.2%	4.8%
	Nonwhite	63.4%	(−10.5 to 19.9)
Sex	Male	66.7%	3.4%
	Female	63.3%	(−12.1 to 18.8)
Age, years	2 to 9	66.4%	6.4%
	10 to 17	60.0%	(−14.2 to 27.0)
Insurance	Commercial	57.4%	13.0%
	Medicaid/self-pay	70.4%	(−2.3 to 28.3)
Admitted	Yes	65.8%	0.5%
	No	65.3%	(−17.0 to 18.0)

*Adherence is defined as number of days' supply from the oral steroid prescription equaling the number of days caregivers reported giving oral steroid.

TABLE 3. Caregivers' Perceived Barriers to Adherence With Corticosteroid Therapy for Children Following an Emergency Department Visit for Asthma

Barrier	% Who Endorsed This Barrier*	95% CI
Worry about side effects	60.4%	53% to 68%
Trouble giving prescription to child	25.8%	19% to 33%
Do not understand how prescription works	23.3%	17% to 30%
Family support not present	17.6%	12% to 24%
Trouble paying for prescription	8.2%	4% to 12%
Work interferes with filling prescription	7.5%	3% to 11%
Trouble getting to pharmacy	6.9%	3% to 11%
Too busy to fill prescription	5.0%	2% to 8%
Felt child did not need prescription	2.5%	0 to 5%
Felt prescription will not make child better	1.9%	0 to 4%
Not confident on how to administer	0.6%	0 to 2%

*Parents endorsing each barrier felt that it represented a barrier to adherence ''a lot,'' ''a little,'' or ''some.''

Vanderbilt Children's Hospital emergency department provides asthma teaching by a trained respiratory therapist to any child who presents with an asthma exacerbation. Therefore, the study population may have had more education and better understanding of the disease process leading to increased filling of oral corticosteroid prescriptions.

Third, children may have had more severe disease in our tertiary care referral center. If a child is perceived as sicker by the primary caregiver, the caregiver may be more likely to fill a prescription for an oral corticosteroid medication.[39]

Finally, the study may have shown a higher rate of oral corticosteroid filling secondary to self-report bias. Caregivers may have overestimated adherence if they thought that the interview was assessing this outcome. We attempted to minimize this source of bias by describing the study as a study of asthma care in general. The interview did not place special emphasis on filling of prescriptions and taking medication.

The caregivers of adolescent patients in this study were less likely to fill oral corticosteroid prescriptions. Our findings are consistent with previous literature citing adolescents as being less adherent to care plans secondary to issues of independence and a desire not to be different from peers.[13] Caregivers who have difficulty getting an adolescent asthma patient to take the oral corticosteroid medication might be less likely to obtain the medication. The primary caregivers of hospitalized patients were more likely to fill oral corticosteroid prescriptions. Primary caregivers of asthma patients admitted to the hospital might perceive their children as being sicker, could have observed the beneficial effects of the oral corticosteroid, and continued to receive additional asthma education.

Despite the high rate of initial corticosteroid prescription filling, 36% of caregivers did not administer the medication for the prescribed duration of therapy. Reasons for this lack of adherence may be the caregiver's concerns about side effects or a lack of understanding about the role of oral corticosteroids in acute asthma exacerbations. Groups at higher risk for nonadherence were more likely to express worries about side effects and to not understand how corticosteroids work in the treatment of asthma. Even among adherent caregivers, 63% worried about side effects and 20% felt that they had no knowledge about how oral corticosteroids worked. Adherence to oral corticosteroids was different depending on the prescribed length of therapy. Shorter courses of medication are considered to aid with adherence. However, we found a higher rate of adherence in caregivers receiving oral steroid prescriptions greater than 5 days in duration. An explanation for this result may be that fewer prescriptions were written for greater than 5 days, and patients with longer courses of therapy may have had more severe asthma leading to increased adherence.

Limitations of this study include sample size and generalizability. The study was powered to detect differences in corticosteroid prescription filling based on prior literature.[15,21,25,26,33] To detect significant differences among adherence would have required larger sample size. In addition, the study was conducted on a sample of children receiving care in a tertiary care children's hospital emergency department, which might have higher rates of prescription writing due to focused education efforts or due to the higher proportion of children with more severe disease.

In this study, only 30 oral corticosteroid prescriptions were validated through pharmacy records. Self-reporting by caregivers was relied upon for assessing oral corticosteroid prescription filling in the remaining patients. Self-report is subject to bias; however, by performing the interview in a nonthreatening environment over the phone, we attempted to reduce this bias. A convenience sample of 30 prescriptions was chosen for ease of access, and this sample was felt to be representative of the study population.

Further research into barriers to adherence with asthma medications is needed. The emergency department provides care for many asthmatic children and thus provides opportunities to deliver asthma education and address barriers to adherence. By systematically addressing these barriers, future researchers can improve healthcare delivery to children with asthma.

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