Published in final edited form as:

Ann Allergy Asthma Immunol. 2009 December ; 103(6): 469–473. doi:10.1016/S1081-1206(10)60262-1.

Detection and Home Management of Worsening Asthma Symptoms

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Abstract

Background—Asthma guidelines recommend early home treatment of exacerbations. However, home treatment is often suboptimal and delayed.

Objective—To describe antecedent symptoms and signs of asthma exacerbations noticed by parents, and learn when and how parents intensify asthma treatment.

Methods—Parents of children 2-12 years old with asthma exacerbations requiring urgent care in the past 12 months completed telephone questionnaires. For some questions, multiple responses were possible and percentages for the frequency of responses may sum to more than 100%.

Results—One hundred and one parents were enrolled and interviewed; 94% were the children's mothers. 70% of the children were African American and 64% had Medicaid insurance. Parents reported multiple antecedent symptoms and signs (median number per child = 3, range 1-6). These included respiratory symptoms (79%), allergy/cold symptoms (43%), behavioral changes (24%), and other non-specific symptoms (29%). Twenty-three parents reported late respiratory symptoms such as gasping for breath, and using accessory muscles to breathe as the earliest antecedent signs. Treatment was most often intensified when the parent noticed cough (55%), shortness of breath (54%), and wheeze (25%), and included adding albuterol (92%), oral corticosteroid (17%), inhaled corticosteroid (8%) or other non-asthma medications (16%).

Conclusions—Although parents described antecedent symptoms and signs of impending asthma exacerbations they consistently noticed in their children, many waited for lower respiratory signs to be present before intensifying treatment. Oral corticosteroids were used infrequently. Interventions to improve the ability of parents and children to accurately recognize worsening symptoms and initiate timely, effective treatment are needed.

Keywords

Childhood asthma; asthma exacerbation

Introduction

Two of every three children with asthma in the United States (US) has at least one disease exacerbation each year.¹ Exacerbations often result in missed school days, emergency department (ED) visits (750,000 visits per year) and hospitalizations (198,000 per year). Many of these health care encounters may be preventable with early and aggressive intensification of treatment.

The National Asthma Education and Prevention Program (NAEPP) asthma guidelines strongly recommend that patients and families of children with asthma learn how to recognize early signs of worsening asthma and how to promptly initiate early and appropriately aggressive therapy with albuterol.^{2, 3} A short course of oral corticosteroids is recommended for children at increased risk for asthma mortality and those with a more severe attack has been shown to reduce ED visits.⁴ Initially, home management with albuterol should be guided by an asthma action plan (AAP), a written plan developed in partnership with the child's physician or nurse with intensification of care determined in consultation with the physician. Despite widespread dissemination of the NAEPP guidelines over the past decade, home use of albuterol and oral corticosteroids is often delayed.⁵⁻⁸ The reasons for this gap between guideline recommendations and home care are not well understood.

We conducted structured interviews with parents of young children with asthma who had had at least one exacerbation requiring urgent care in the last year to learn: 1) If and how they monitor their child's asthma symptoms, 2) What antecedent signs and symptoms of an asthma exacerbation they notice, and 3) When and how they intervene if symptoms are worsening. Better understanding of home management of worsening symptoms is an important first step in the development of more effective interventions to improve outcomes of acute exacerbations such as reduction in morbidity and mortality.

Methods

Selection and Enrollment of Participants

Parents were eligible to participate if they reported that their child was diagnosed with asthma by a physician at least 1 year ago, was 2 to 12 years old, and reported at least one asthma exacerbation requiring urgent care in the past 12 months. Urgent care included a course of oral steroids, an unscheduled office visit, an ED visit or hospitalization for treatment of an acute asthma exacerbation. Parents were ineligible if they could not speak English or if the child was currently participating in another asthma study.

Potentially eligible parents were identified from two sources: receipt of asthma care at the ED of our Children's Hospital in the preceding month, or receiving care from the After Hours Call Center associated with the hospital and subsequently participating as a member in the control group of a randomized control trial to evaluate asthma coaching that had concluded in the prior nine months. For the latter source, only parents who had agreed to contact for possible participation in future asthma studies were approached. All potentially eligible parents were contacted by phone by a member of the study team and invited to participate. The study was approved by the Human Research Protection Office of

Washington University School of Medicine. Consent to participate in the study was implied by completion of the survey. Parents received a \$15 gift voucher for participation.

The Survey

Parents completed a telephone interview conducted by one of two trained interviewers, guided by a tool developed for this study. The interviewers were both experienced, female, lay asthma coaches with personal experience of asthma management. The sequence of questions was as follows. Demographic information was gathered and then parents reported the child's recent impairment (daytime and nighttime asthma symptoms, activity limitations and albuterol use in the past month), and 12-month morbidity (oral steroid bursts, ED visits and hospitalizations). Questions enquired about medications used for asthma in the past week and the availability of oral corticosteroids at home. To assess symptom monitoring behaviors we inquired about the frequency (daily or as needed) of specific monitoring activities: listening for coughing or wheezing in the daytime or nighttime or asking the child about albuterol use at school (subjective measures); and using a peak flow meter (PFM), a symptom diary, or a stethoscope (objective measures). Parents reported from whom they received advice about how to manage an asthma attack, if they had ever had an AAP and who provided it. Open-ended questions were used to elicit the signs and symptoms of worsening asthma symptoms first noticed by the parent (antecedent signs) ("What do you hear? What do you see? What do you notice in your child before an asthma attack starts? What always happens?"). Open-ended questions were used to help the parent describe the child's most recent asthma attack ("How did it start?" "What did you notice that made you decide to give an asthma medicine?"). We also asked when the attack occurred, about use of albuterol, inhaled corticosteroids (ICS), oral systemic corticosteroids, and other prescribed and over-the-counter (OTC) medicines use during this recent attack. Finally, we asked for suggestion for help with future management of an asthma attack.

Definitions—Cough, wheeze, shortness of breath and chest tightness or pain were considered to be respiratory symptoms.^{2,3} Gasping for breath and using accessory muscles to breath were further categorized as late respiratory signs. Reports of a runny nose, stuffy nose, watery eyes, red eyes, "cold symptoms" or "allergy symptoms" were categorized as allergy/cold symptoms. Becoming tired, quiet, sitting around, and having less energy or becoming irritable, moody or whiney were categorized as behavioral signs.

Statistical Analysis

Descriptive statistics are reported as means and standard deviations or medians and interquartile (IQ) ranges for continuous variables, and percentages for categorical variables. Where multiple responses were possible percentages may sum to > 100%. Differences in behaviors by race (African American vs. other), health insurance status (Medicaid vs. other), the child's age group (< 6 years vs. ≥ 6 years old), the parent's education (high school or less vs. higher education) and experience with asthma care (self or other family member with asthma vs. no experience) were compared using the chi-squared test or Fisher's exact test as appropriate. Specific behaviors examined included: using an objective monitoring strategy (at least some of the time), having an AAP, having oral corticosteroids at home and using them in the recent exacerbation, and identifying late respiratory signs as antecedent signs of an exacerbation. Unless otherwise stated, no significant differences were found. A probability of $p < 0.05$ (two-tailed) was used to establish statistical significance. All statistical analyses were done using STATA 9.0 (Stata Corporation, College Station, TX).

Results

Study Population

One hundred and one parents were enrolled and interviewed between August 2006 and April 2007 (Mean duration of interview = 26 minutes, SD 5.4 minutes). Ninety-four percent of respondents were mothers (fathers 4%, other 2%), and 58% had at least some college education (Table 1). Forty-seven percent of respondents reported their children used at least one controller medication daily (17 used an ICS, 7 a leukotriene receptor antagonist, and 23 both). In the year prior to the interview, parents reported their child had 1 course of prednisone (84%), an ED visit (92%) or hospitalization (35%) for asthma care. The median time for the child's most recent exacerbation was 4.5 weeks prior to the study interview (IQ range 3 to 12 weeks).

Previous Acute Asthma Care Instruction

Parents reported receiving instructions for home management of an asthma attack from multiple sources including the pediatrician (76%), the ED (30%), an asthma specialist (20%), the After Hours Call Center (10%), and during a hospital admission (8%) (multiple responses were possible). Sixty-five percent of parents reported they had been given a written AAP (Medicaid, 57%, Other insurance, 81%, $p=0.018$). The AAP was provided by the pediatrician (36%), an asthma specialist (17%) or the ED (15%). Fifty-four percent of parents reported they had oral corticosteroids for home use for a subsequent exacerbation (African American, 47%, Others, 68%, $p=0.08$) prescribed by the pediatrician (35/54) or the ED (20/54).

Asthma Monitoring Activities

Seventy-two percent of parents said they monitored the child's asthma symptoms daily using at least one subjective or objective strategy (Table 2). Parents with older children were more likely to use an objective monitoring strategy at least sometimes (≤ 6 years, 42%, > 6 years, 73%, $p=0.002$), as were parents with experience caring for other family members with asthma (no experience, 26%, experience, 65%, $p=0.004$). Thirty-five percent of parents reported using PFM, but only 8% used a PFM at least 2-3 times a week.

Antecedent warning signs

All parents reported at least one antecedent symptom or sign that they always noticed in their child before an asthma attack (median 3 signs, IQ range 2 to 4), but these varied (Table 3). Eighty (79%) parents identified a respiratory sign or symptom, most commonly cough (62%). Twenty-four percent of parents reported noticing at least one behavioral change, 43% reported allergy/cold signs or symptoms, and 29% reported at least one other non-specific sign or symptom such as vomiting, stomach pain, a change in the child's voice, and dark circles under their eyes. Eleven parents (11%) reported their child's antecedent signs comprised only behavioral changes or non-specific signs and symptoms.

Of the 80 parents who identified antecedent respiratory signs 67 (84%) noticed additional antecedent signs or symptoms (32 allergy/cold, 14 behavioral, 21 non-specific). Twenty-three parents identified gasping for breath or using ancillary muscles as antecedent respiratory signs.

Management of most recent asthma attack

Parents described home management of their child's most recent asthma attack. For 82% of children, parents noticed that the attack started with the child's usual antecedent signs. During this attack parents reported initiating treatment with albuterol (92%), an oral

corticosteroid (17%; 6 years, 86%, >6 years, 27% $p=0.011$), an inhaled corticosteroid (8%, 5 started treatment and 3 doubled their child's usual dose) and other non-asthma medications such as an antihistamine or OTC cough or cold medication (16%). Three percent of parents reported that they waited a day or more before giving any medication and 5% never gave any medication.

Among the 96 parents who reported giving a medication within the first 4 hours after noticing worsening symptoms (62 [65%] within 20 minutes, 79 [82%] within an hour), treatment was most commonly initiated in response to respiratory symptoms (Table 4). Ninety percent gave albuterol administered either by nebulizer (52) or metered-dose inhaler (38; 24 with a holding chamber and 14 without). The reported dosing frequency for albuterol varied: every 20 to 30 minutes ($n=11$), every 1 to 3 hours ($n=27$), and every 4 to 6 hours ($n=30$). Eleven parents reported giving albuterol more often than every 20 minutes, and 11 gave only one dose (median 2 doses, IQ range 1 to 3). Eighty percent of parents felt very confident they were doing the right thing, 17% were somewhat confident and 3% were not at all confident. Sixty percent felt that the child improved with treatment.

For the 45 children treated at home with albuterol for more than 4 hours, the duration of albuterol use before doing something else was added varied from 1 day (27), 2-3 days (6), 4-5 days (4), to 1 week (1) (information about timing was obtained from 7 parents).

When asked specifically, 44 of all parents reported use of the child's AAP during their most recent attack, and 41 had found the AAP to be helpful. Although availability of an AAP did not vary by any demographic factor, fewer African American families reported using it during this attack (47%) compared with other families (80%) ($p=0.006$). Fourteen percent of parents reported use of a PFM to monitor their child's status during the attack.

Seventy-nine percent of parents contacted the health care system for care during the exacerbation: 72 called the child's pediatrician, 7 had an unscheduled office visit (5 had also called the office), 63 went to the ED (27 had called the pediatrician some time before going to the ED, but none had an office visit). One child was hospitalized. Children with Medicaid insurance were more likely to go to the ED compared with other children (71% vs. 50%, $p=0.038$).

Forty-six parents provided suggestions for things that might help them to manage future attacks. These included more education about asthma (37%) and how to use asthma medications (26%) and equipment (24%).

Discussion

Our findings suggest that there are missed opportunities to intensify asthma therapy to relieve symptoms, reduce the duration of exacerbations, and prevent the failures of home care represented by ED use and hospitalization.³ The parents studied here could easily describe antecedent symptoms and signs that consistently preceded an asthma attack in their child. However, one in four parents reported late respiratory signs, such as gasping for breath and retractions, as signs to alert them that an attack was imminent. Lack of knowledge of the level of symptom intensity that requires additional treatment may explain delays in home treatment.¹² It is also possible that the parent and physician or nurse may interpret commonly used terms to describe worsening symptoms such as "short of breath" and "wheeze" differently.¹³ Careful review and discussion of the specific meaning of these terms may avoid such ambiguity. Many parents identified allergy or cold symptoms and non-respiratory symptoms as earlier harbingers of worsening asthma, a finding consistent with other studies.^{9, 11} However, few of these parents would intensify treatment until respiratory signs occurred. Parents must be alerted to the multidimensional nature of the

early signs and symptoms of asthma and helped to identify their child's particular antecedent signs and symptoms. Tools such as a symptom list¹⁴ or symptom diary may be helpful in this regard. Personalizing the child's asthma action plan to include intensifying treatment with onset of these non-respiratory signs may reduce morbidity, and should be evaluated.

Home use of asthma medications could be improved. Use of non-asthma medications (such as antihistamines or OTC medications) to treat the child's worsening symptoms was common in the study population, and may delay use of effective treatment. Delivery of albuterol without a holding chamber may reduce treatment effectiveness, and prolonged treatment without symptom improvement may delay contact with the health care system and initiation of oral corticosteroids. Despite prior use, availability at home, and calls to the physician's office during the exacerbation, few parents started oral corticosteroids at home, a finding consistent with other studies.^{8, 15} Providing a home supply of oral corticosteroids for children at risk of needing them in the future could facilitate use of this effective treatment. A careful assessment of exactly which medications are used and how they are administered and dosed could identify suboptimal home management strategies. Education and training about effective use of asthma medications must be ongoing for all families of children with asthma. Our data suggest that many parents would welcome such help.

Self-monitoring of disease status is key to effective management of any chronic condition. Most parents in the study population routinely checked for worsening asthma symptoms by watching their child, listening for cough and wheeze, and enquiring about albuterol use at school. While this finding is consistent with other studies,^{16, 17} the accuracy of symptom severity assessment by both parents and children is poor, particularly when symptoms are severe.¹⁸ To avoid delays in care and inappropriate home management, parents and children must learn how to accurately assess symptom severity. This may require training with a reference standard, possibly a PFM particularly when symptoms appear to be escalating. Regular monitoring of asthma control with the asthma control questionnaire^{19,20} or asthma control test²¹ may be an effective strategy to identify when management needs to be reassessed and adjusted.

There are some limitations to our study. Most importantly, we relied on self-reported data from a volunteer sample. Although most respondents reported their behaviors during a recent asthma attack, these data are likely influenced by volunteer, recall, and social desirability biases. Unfortunately, we do not have data to assess the magnitude of these biases as we were unable to complete chart reviews and did not record the non-response and refusal rates. Despite the likely influence of these biases to increase reporting of favorable responses, we identified several opportunities for improvement. We did not assess the severity of the attack described, but two thirds of the study population reportedly went to the ED or pediatricians office for treatment. Our study sample is demographically diverse, but it is from one geographic area and our results may not be generalizable to other populations.

Conclusion

These findings identify actions that clinicians, particularly primary care providers, can take to reduce asthma morbidity associated with acute exacerbations. Parents receive information about asthma management from many sources and it is important that this information is correct, consistent, and unambiguous. The primary care provider could identify specific opportunities for improvement by routinely reviewing the details of symptom monitoring and home management of worsening symptoms, helping the parent to identify earlier opportunities for intensification of treatment, making sure they understand how and when to use asthma medications, how to assess treatment response and when to seek additional help. This education may be best accomplished through routinely discussing an appropriate action plan and providing written copies for home use.

Acknowledgments

Funding: NHLBI grant HL 072919

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Table 1
Patient and Family Characteristics of 101 Participants

Characteristic	N (%), Mean (SD) or Median (range)
Patient Characteristics	
Male gender	61 (60%)
Age (years)	6 years (2.25 – 12.5)
Race	
Caucasian	27 (27%)
African American	70 (70%)
Other	3 (3%)
Missing	4 (1%)
Ethnicity: Hispanic	1 (1%)
Years with asthma (Mean, SD)	4.2 (2.8)
Family Characteristics	
Medicaid insurance	65 (64%)
Household	
Two parent	41 (41%)
Single parent	57 (56%)
Other	3 (3%)
One parent not working outside the home	44 (44%)
Respondent's * education	
Did not complete high school	19 (19%)
Completed high school	24 (24%)
Some college	42 (42%)
Bachelors or post graduate degree	16 (16%)
Another family member with asthma	76 (75%)
Respondent with asthma	30 (30%)

* 94% of respondents were the child's mother

Table 2
Asthma Monitoring Activities Reported by Parents (n=101)

	Total	Frequency of Use (N)						
	N (%)	Daily	2-3× per wk	Weekly	Weekly-monthly	As Needed	NR	
Subjective strategies								
Listen at night	86 (85%)	58	7	1	1	17	2	
Listen in day	72 (71%)	41	6	1	0	21	3	
Ask about albuterol use at school	59 (59%)	31	7	4	2	16	0	
Objective strategies								
Peak Flow Meter	35 (35%)	7	1	3	3	20	1	
Stethoscope	34 (34%)	3	3	3	2	21	0	
Symptom Diary	9 (9%)	2	2	1	1	3	0	

NR= Frequency of use was not reported

Table 3
Signs Always Noticed By Parent Before An Asthma Attack and Used to Intensify Asthma Treatment During Their Child's Most Recent Asthma Attack

Sign	Reported as an antecedent sign (N=101)	Triggered Intensified Treatment (N=96)
	%	%
Cough	62%	55%
Short of breath (includes gasping and using ancillary muscles)	42%	54%
Cold/allergy symptoms	42%	17%
Tired, quiet, less energy	30%	3%
Chest tightness or pain	26%	10%
Wheeze	22%	25%
Stomach pain or vomit	7%	4%
Irritable	6%	NR
Other e.g., dark circles under eyes, turns red	33%	21%

NR= not reported