Asthma Control and Medication Use Behaviors Among Children with

Written Asthma Action Plans at Home and School –

2010 Behavioral Risk Factor Surveillance System Child Asthma Call-Back Survey

Meggie Inouye

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Committee:

Stephen Hawes, PhD, MS

Jennifer Sonney, MN, ARNP

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Abstract

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Chair of Supervisory Committee:

Stephen Hawes, PhD, MS

Department of Epidemiology, Global Health, and Health Services

Objectives. To estimate the proportion of US children that have a written asthma action plan

(WAAP) at home and school and the association of asthma control and medication use behaviors.

Design. A cross-sectional analysis of the 2010 child Asthma Call Back Survey (ACBS).

Results. Among the ACBS survey participants, 44.5% (95% CI=40.5-48.7) were ever given a

WAAP and 34.4% (95% CI= 30.4-38.6) had a WAAP at school. Children that had routine care were

more likely to have ever been given a WAAP (adjusted relative risk (aRR) 1.8, 95% CI 1.1-2.9) and

to have a WAAP at school (ARR 4.1, 95% CI= 2.7-6.1). Children with not well-controlled asthma

were more likely to have ever been given a WAAP (ARR 1.6, 95% CI 1.1-2.3) and to have a

WAAP at school (ARR 1.8, 95% CI 1.2-2.7). There was not a significant difference in asthma

medication use behaviors between those having a WAAP or not and those with a WAAP on file at school or not.

Conclusions. Children with not well-controlled or poorly controlled asthma were more likely to have ever been given a WAAP and to have a WAAP on file at school; this likelihood persisted after controlling for socio-economic factors and routine care visits.

Introduction

In the United States an estimated 7 million (9.5%) children age 0-17 years old currently have asthma (Centers for Disease Control and Prevention (CDC), 2013b). Asthma is relatively uncontrolled in pediatrics with 5.4% of U.S. children under 15-years old (roughly 57% of children with asthma) having experienced an asthma exacerbation in the past 12 months (CDC, 2013a). Asthma is one of the leading causes of school absenteeism (CDC, 2013d) and has been shown to have a significant effect on a child's ability to play, sleep, learn, and take part in normal activities key to development (Williams, 2006).

Asthma is a chronic respiratory disorder of the airways that involves a complex interaction of airflow obstruction, bronchial hyper-responsiveness, and underlying inflammation (National Asthma Education and Prevention Program (NAEPP), 2007). Although treatment cannot prevent the underlying severity of asthma, comprehensive asthma management targets disease control through reduction of airway inflammation, avoidance of triggers, and timely use of appropriate medications to prevent and treat exacerbations (Childhood Asthma Management Program Research Group, 2000; Guilbert et al., 2006). Quality asthma care involves not only diagnosis and treatment to achieve asthma control, but also long-term regular follow up care to maintain control. Long-term care should include monitoring to asses control, adjustments of medication therapies, education on addressing environmental factors that cause worsening symptoms, and education on self-management skills and tools (National Heart, Lung, and Blood Institute, 2012).

In 2007, the National Asthma Education and Prevention Program (NAEPP) published Expert Panel Report 3 (EPR-3) guidelines indicating that clinicians should teach self-management strategies including the use of a written asthma action plan (WAAP) at home and school (NAEPP, 2007). A WAAP is a document that describes day-to-day prevention practices in addition to clear steps a patient should take if there is deterioration in asthma control. Making the WAAP available at

school allows the school personal to confidently initiate appropriate management of exacerbations (McLaughlin et al., 2006).

Asthma self-management education has been shown to improve health outcomes and reduce related morbidity and health care costs (Schermer, et al., 2002; Thoonen, et al., 2003; Shames, et al, 2004; Teach, et al. 2006). However, the independent role of WAAP as a self-management tool is controversial. A systematic review of randomized controlled trials (Zemek, Bhogal, & Ducharme, 2008) examined the independent effect of WAAP in children and concluded that there was limited data to support that the provision of a WAAP is superior to none. Only one randomized control trial in the systematic review showed that the independent effect of a WAAP improved overall control in children with moderate persistent asthma (Agrawal, et al., 2005). In 2010, Ducharme et al. followed this systematic review with a randomized control trial in which children with asthma who were treated in an Emergency Room were discharged with or without a WAAP and were followed for 28 days. Ducharme et al. (2010) concluded that the provision of a written asthma action plan significantly increased patient adherence to inhaled and oral corticosteroids, increased adherence to recommendations for medical follow up, and increased asthma control.

More recently, a community based, urban randomized control trial showed there was no significant association between use of WAAP and improvement in asthma control, caretaker quality of life, or urgent health services utilization (Sunshine, Song, & Krieger, 2011). The authors' discussion suggests that asthma action plans may not be as effective over time as originally believed, at least among patients with less severe asthma, and that one should consider the additional costs (Polisena, et al., 2007), the unclear perceived benefit (Wisnevesky, et al., 2008) and the limited time on the part of providers (Cabana et al., 2008) to administer written asthma action plans. This study spurred editorial conversation arguing that the literature base on the utility of asthma action plans was sparse and encouraged providers to continue to distribute and provide

education on WAAP according to NAEPP EPR-3 established guidelines (Mosnaim, 2011).

My current study uses the 2010 child Asthma Call Back Survey (ACBS) from the Center for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) as the most comprehensive state-level, population based asthma survey to date. The ACBS was used to estimate the prevalence of having been given a WAAP by a healthcare provider and having a WAAP on file at school among children with asthma in participating US states. This study provides an updated estimate compared to a 2001-2009 National Health Interview Survey analysis showing that 44.3 % of children with asthma reported ever been given a WAAP (Zahran, Bailey, & Garbe, 2011). Although the characteristics of children with asthma receiving various self-management education components including WAAP have been described in previous studies (CDC, 2007; Shah, et al., 2008; Zahran et al., 2012), these studies did not consider the predictors or effect of having a WAAP or asthma management plan at school. This study also assesses the relationship of WAAP possession at home and at school to asthma control and asthma medication use behaviors including multiple components related to the use of short-acting beta agonists (SABA) inhalers, inhaled corticosteroids, and oral system corticosteroids.

Methods

Survey Data Description

The Behavioral Risk Factor Surveillance System (BRFSS) survey is a yearly, state-based, ongoing, random digit dialing telephone survey of civilian, non-institutionalized adults aged ≥ 18 years conducted in all 50 states, the District of Columbia, and 3 territories (CDC, 2013c). The survey is comprised of standardized core questionnaire, optional modules, and state-added questions that states may choose to administer. The BRFSS survey contains a Random Child Selection module and the Child Asthma Prevalence module, which were used to identify households with a child who had asthma to administer the child Asthma Call-back Survey (ACBS).

The child Asthma Call-Back Survey is an optional module of the BRFSS and was conducted in 29 states in 2010. The following 17 states choose to participate in the child ACBS survey in 2010 and had 75 or more participates: Connecticut, Georgia, Hawaii, Indiana, Maryland, Michigan, Mississippi, Montana, Nebraska, New Jersey, New Mexico, Oklahoma, Pennsylvania, Texas, Utah, Vermont, and Washington. Many states do not choose to add optional modules because of cost or more pressing need for other health-related data. A total of 2,300 caregivers of children with asthma from the 17 states noted above chose to participate in the child ACBS in 2010. The overall child response rate via adult proxies was 53.7%.

BRFSS survey respondents with an affirmative response to the question "Has the child ever been told by a doctor, a nurse, or another health professional that the child has asthma?" were asked to participate in the child ACBS approximately 2 weeks after the initial BRFSS telephone survey. The child ACBS obtains in–depth information about the child's asthma symptoms and episodes/attacks, self-management education, health care utilization and access, medication use, and comorbidities according to adult family member proxies (CDC, 2012).   Only one child per household could participate in the ACBS. A sampling weight was assigned to each survey respondent in the ACBS to adjust for variations in respondent's probability of selection, disproportionate selection of population subgroups relative to the state's population distribution (including age-race-sex distribution), nonresponse at the BRFSS interview and ACBS interview, and lost participants between the two interviews. More information on weight calculations can be found in the 2006 -2010 ACBS History and Analysis Guidance report at http://www.cdc.gov/brfss/acbs.

Study subjects of this analysis were children (age 0-17 years) whose parent or guardian agreed to participate in the ACBS following the BRFSS survey and reported that a doctor or health professional had indicated that their child had asthma (n=2,300). Of those, children that that were

old enough to attend school and were not home schooled (N=2,041) at the time of the survey were

included in the school WAAP analysis. The nature of asthma as a chronic disease merits the

inclusion of all survey participants regardless of lack of recent symptom activity. This study uses

subjects from a publically available data set and does not require exempt status or Institutional

Review Board (IRB) review as outlined in University of Washington Human Subjects Division

Public Data Sets document found at http://www.washington.edu/research/hsd/docs/1125.

Statistical Analysis

In the ACBS, a written asthma action plan (WAAP) was defined as "a form with instructions

about when to change the amount or type of medicine, when to call the doctor for advice, and when

to go to the emergency room". Figure 1 shows an example of a typical WAAP. A child was

considered to have a WAAP if an affirmative response to "Has a doctor or other health professional

ever given you or your child an asthma action plan?" was reported. A child was considered to have

a WAAP at school if an affirmative response to "Does your child have a written asthma action plan

or asthma management plan on file at school" was reported. Socio-economic characteristics (e.g.

sex, age, race/ethnicity, health insurance status, annual household income, and experience as cost as

a barrier to care) and routine care visits of survey respondents who met the definition of ever having

asthma were categorized.

Asthma control characteristics were defined following the guidelines in the National Asthma

Education and Prevention Program (NAEPP) Expert Panel Report 3 (EPR 3). Asthma control was

classified as well controlled, not well controlled, and very poorly controlled using a five parameter

combined variable: days with symptoms, night awakenings, limited activity, use of short acting beta

2- agonists (SABA), and oral systemic corticosteroid use as described in Figure 2 (NAEPP, 2007).

Each one of the above was also defined individually according to binomial cut points distinguishing

between well-controlled and not well-/poorly controlled characteristics. A combined SABA

medication variable included use of albuterol, alupent, levalbuterol, Maxair, Pirbuterol, Proventil, Pro-air HFA, Ventolin, and. Xopenex. A combined oral systemic corticosteroids variable included use of methylprednisolone, Pedipred, prednisolone, prednisone, and Prelone. Asthma control characteristics also included general indicators of poor control (e.g. number of attacks/episodes in the last 3 months, duration of most recent attack/episode, missed school days, urgent visits, emergency department visits, and hospitalizations in the last year).

Medication use behaviors were defined according to desirable behaviors as established in NAEPP EPR-3 guidelines. Medication use behaviors included use of spacer with SABA inhaler, use of SABA inhaler during an attack, frequency of SABA inhaler use, number of SABA canisters in the last 3 months, use of inhaled corticosteroids on a regular schedule every day, and use of any oral corticosteroids in the last 3 months. A combined inhaled corticosteroid variable included Advair, Aerobid, Asmanex, Beclomethasone, Budesonide, Flovent, Flunisolide, Fluticasone, mometasone furoate, Pulmicort, QVAR, Symbicort, and triamcinolone acetonide.

All analyses were conducted using Stata/IC (v. 13.0) (StataCorp, College Station, TX, USA) to account for the complex survey design. Statistical significance was determined as <0.05 for primary analysis and <0.01 for secondary analyses by a non-directional z-test. State samples were weighted to represent the state population prevalence and 95% confidence intervals of children with asthma having been given a WAAP or having a WAAP on file at school according to covariates of interest. Pearson chi^2 estimates of meaningful differences between those ever haven been given a WAAP or not and having a WAAP at school were reported. Logistic regression assessing linear classification level associated with having been given a WAAP and having a WAAP at school was conducted to test for trends in increasing order for continuous variables that were divided into 3 or more categories of interest. Binomial logistic regression was performed to determine unadjusted relative risks in comparison to decided referent categories. Multivariable logistic regression was

performed to obtain adjusted relative risks, adjusting for socio-demographic characteristics and routine care visits.

Results

WAAP possession by socio-demographics and health care characteristics

Among the 2,300 children with asthma, 44.5% (95% CI = 40.5-48.7) were ever given a written asthma action plan (WAAP). Socio-economic and health care characteristics by WAAP possession are shown in Table 1. A significantly higher proportion of the children who did have a WAAP reported one or more routine visits in the past year (64.9%) compared to children with asthma who did not have a WAAP (48.2%) (p-value <0.001). Sex, age, race/ethnicity, health insurance type, household income, and experience of barriers to care among children with asthma who did have a WAAP did not differ significantly from children who did not have a WAAP.

Among the 2,041 children with asthma that were old enough to attend school and were not home schooled, 34.4% (95% CI = 30.4-38.6) had a WAAP on record at school. Socio-economic and health care characteristics by WAAP possession at school are shown in Table 2. A significantly higher proportion of the children who did have a WAAP at school reported one or more routine visits in the past year (84.9%) compared to children with asthma who did not have a WAAP on file at school (37.5%) (p-value <0.001). Having a WAAP at school varied by race, as those with a WAAP at school were more likely to be black, non-Hispanics (27.7%) and less likely to be Hispanic (9.0%) compared to those without a WAAP at school (11.3% and 17.3%, respectively, p-value<0.001). Sex, age, health insurance type, annual household income, and experience of barriers to care among children with asthma who did have a WAAP on file at school did not differ significantly from children who did not have a WAAP on file at school.

WAAP possession by asthma control characteristics

Table 3 shows asthma control characteristics among children with asthma that have ever been

given a WAAP. There was a significant trend with regards to increased WAAP possession

associated with decreasing level of asthma control (p-value 0.005). When compared to children with

asthma who were never give a WAAP, children with a WAAP were more likely to have had 3 or

more attacks/episodes in the last 3 months (35.8% vs. 24.8%, p-value 0.003). Proportions of days

with symptoms, night awakenings, duration of attacks, limited activity due to asthma, missed school

days, urgent visits, Emergency Department (ED) visits, and hospitalizations did not significantly

differ between those that were ever given a WAAP and not.

Table 4 shows asthma control characteristics among children having a WAAP on file at

school. There was a significant trend with regards to a decreased asthma control classification level

associated with increased frequency of WAAP on file at school (p-value < 0.001). A significantly

greater proportion of children with WAAP on file at school had more than 8 days a month with

symptoms (17.5% versus 9.4%; p-value 0.003), experienced 2 or more night awakenings in the last

month (23.2 % versus 8.6%; p-value <0.001), had limited activity (62.8% versus 30.7%; p-value

<0.001), had 3 or more attacks in the last 3 months (44.2% versus 32.8%; p-value <0.001), missed

more than 6 days of school in the last year due to asthma (19.5 versus 10.6; p-value 0.003) had one

or more urgent visits in the last year (42.9% versus 18.7%; p-value <0.001), and had one or more

ED visits in the last year (19.0% versus 9.4%; p-value 0.001). There was a significant trend with

regards to increased duration of most recent attack/episode associated with a increased probability

of having a WAAP on file at school (p-value < 0.001). Proportions of hospitalizations did not

significantly differ between those with a WAAP on file at school and not.

 WAAP possession by medication use behaviors

Tables 5 and 6 show medication use behaviors among children having ever been given a

WAAP and children having a WAAP on file at school. Proportions of behaviors related to short

acting beta agonist (SABA) inhalers, inhaled corticosteroids, and oral corticosteroids did not

significantly differ between those that were ever given a WAAP or not and having a WAAP on file

at school or not.

Regression analyses of socioeconomic factors and health care characteristics

The following socio-economic factors and health care characteristics were analyzed

individually and were included in all multivariable adjusted analyses: sex, age, race/ethnicity, health

insurance, annual household income, experience of cost as a barrier to care in the last 12 months,

and 1 or more routine care visits. Table 7 presents the bi-variable and multivariable logistic

regression analyses of socio-economic factors and health care characteristics associated with having

been given a WAAP among children with asthma. Children with asthma with public insurance were

more likely to have ever been given a WAAP compared to children with asthma with private

insurance (aRR 1.7; 95% CI= 1.0-3.0). Children with asthma with a higher household income levels

compared to household incomes of <$25,000 were more likely to have ever been given a WAAP

($50,000- <$75,000 aRR 3.7, 95% CI= 1.7-7.9; ≥$75,000 aRR 2.0, 95% CI= 1.1-2.9). Children with

asthma having routine care within the last year compared to those who did not were significantly

more likely to have ever been given a WAAP (aRR 1.8, 95% CI= 1.1-2.9).

Table 7 also presents the bi-variable and multivariable logistic regression analyses of socio-

economic factors and health care characteristics associated with children with asthma having a

WAAP on file at school. Compared to children with asthma age 0-4 years old, older age was

significantly associated with having a WAAP on file at school (age 5-10 aRR 2.0, 95% CI= 1.0-3.6;

age 11-14 aRR 2.0, 95% CI=1.0-4.1) but the association was not appreciably different between

categories of school-age children (ages 5-10, 11-14, or 15-17). Compared to white children, black

children were significantly more likely to have WAAP on file at school (aRR 2.2, 95% CI= 1.4-

3.7). Children with asthma having routine care within the last year compared to those without

routine care were significantly more likely to have a WAAP on file at school (aRR 4.1, 95% CI=

2.7-6.1).

Table 8 presents bi-variable and my primary multivariable logistic regression analyses of the associations of asthma control with having been given a WAAP. Children with not well-controlled controlled asthma were more likely to have ever been given a WAAP (aRR 1.6, 95% CI =1.1-2.4) compared to those with well-controlled asthma. There was not a significant difference of likelihood of having been given a WAAP according to other assessed aspects of asthma control (e.g. asthma control level, days with symptoms, night awakenings, limited activity, number of attacks episodes, duration of attacks/episodes, missed school days, urgent visits, ED visits, or hospitalizations).

Table 8 also presents bi-variable and my primary multivariable logistic regression analyses of the associations of asthma control with having a WAAP on file at school. Children with asthma classified as not well controlled not well controlled (aRR 1.7, 95% CI= 1.1-2.6) or poorly controlled (aRR 2.5, 95% CI= 1.4-4.2) were more likely to have a WAAP on file at school than children with well-controlled asthma. Children with 2 or more night awakenings a month due to asthma were more likely to have a WAAP on file at school (aRR 1.9, 95% CI = 1.2-3.1) compared to those with less than 2 night awakenings. Children that reported limited activity due to asthma were more likely to have a WAAP on file at school (aRR 1.6, 95% CI = 1.1-2.3) compared to those that did not report limited activity. Children that reported that their most recent attack/episode lasted for minutes were more likely to have a WAAP on file at school (aRR 2.1, 95% CI= 1.3-3.5) than those that did not report an attack/episode.

Table 9 presents bi-variable and my secondary multivariable logistic regression analyses of the association between medication use behaviors and having been given a WAAP and having a WAAP on file at school. Children with asthma that had a WAAP on file at school were more likely to use 2 or more canisters of a SABA inhaler in the last 3 months (aRR 1.8, 95% CI = 1.1-3.1). No significant associations were detected between spacer use with SABA inhalers, SABA inhaler use

during an attack, frequency of SABA inhaler use, inhaled corticosteroid use on a regular schedule

every day, or oral corticosteroids taken in the last 3 months and ever having a WAAP or having a

WAAP on file at school.

Discussion

Among children with asthma in 2010 ACBS participating states, 44.9% reported ever having

been given a WAAP. This WAAP distribution is similar to the 2001-2009 National Health

Interview Survey analysis that showed 44.3 % of children with asthma reporting ever been given a

WAAP (Zahran, Bailey, & Garbe, 2011). This study also shows that among children with asthma in

2010 ACBS participating states, 34.4% reported having a WAAP at school, thus, 76.6% of children

receiving a WAAP shared it with their school. These percentages provide estimates that were not

recently established and are of significance to school nurses, families, primary care and pulmonary

specialty providers. Recent studies have explored school based asthma care in which a WAAP

provided key guidance to school nurses to facilitate care, improving quality of life and decreasing

asthma disease associated burden (Blaakman et al., 2014; Cicutto, To, & Murphy, 2013).

Having a routine visit in the last year was strongly associated with having been given a

WAAP and having a WAAP at school. This finding provides evidence of primary care and specialty

providers carrying out asthma management education recommended by NAEPP guidelines during

routine visits. Additionally, there were associations between having a WAAP on file at school and

urgent/ED visits. On the other hand, there was not a significant association between ever having

been given a WAAP or having a WAAP on file at school and hospitalizations even though EPR-3

guidelines suggest that a WAAP should be given or reviewed at every point of care (NAEPP, 2007).

Having asthma that was not well controlled or poorly controlled or experiencing symptoms

indicating poor control were also associated with having ever been given a WAAP and even more

strongly associated with having a WAAP on file at school. Because of the cross-sectional nature of

this study, it is difficult to interpret this finding. On one hand this may indicate that WAAP may not actually be contributing to increased asthma control or symptom management. Alternatively, this may suggest that providers are identifying children with the most severe asthma and providing the extra level of care by taking the time to complete a WAAP and facilitating the delivering to the child's school. There is need for further rigorous prospective observational or randomized studies to test both the independent effect of having been given a WAAP and having a WAAP at school on asthma control.

The analysis of asthma medication use behaviors showed children with asthma that had a WAAP on file at school were more likely to use 2 or more canisters of a SABA inhaler in the last 3 months, another strong indicator that having a WAAP at school was associated with poorly controlled asthma. However, there was not any difference in medication use behaviors that indicate appropriate asthma self-management such as inhaler spacer use or consistent inhaled corticosteroid use. Further randomized controlled trials and observational studies should be carried out measuring the effect of having been given a WAAP on behaviors related to asthma management and medication use.

There are several limitations to this study due to the nature of the data used. The cross-sectional study design limits the assessment of causation and the direction of associations. The ACBS does not have specific information about the types of WAAP given (i.e. symptom based self-assessment or peak flow meter self-assessment). The ACBS does not have specific information about the baseline severity of each child's asthma disease. Adult proxies used in the ACBS may have inaccurate recall due to possible lack of knowledge of about the child health outcomes or asthma rescue inhaler education status. ACBS respondents may not remember details about asthma teachings or asthma symptoms and may inaccurately report resulting in bias. Telephone interviews have inherent limitations. It has been observed that many landlines and cell phones have caller

identification and many choose not to answer there phones if there is a an unknown caller further

biasing that sample. Households that do not have landlines are not in the sampling frame for the

2010 ACBS, which may bias the results. The CDC reports that future ACBS surveys will include

cell phone data and a future study could employ similar analysis methods to reach a stronger

prevalence measure of children with asthma having been given a WAAP and having a WAAP on

file at school.

The case for use of written asthma action plans (WAAP) in management of children with

asthma remains controversial in the literature and this study. A low proportion of ever having been

given a WAAP is likely related to lack of strong evidence for WAAP use. However, the fact that

three quarters of those ever given a WAAP have a WAAP on file at school shows that the

transference of this document to the school from either the home or the clinic is happening most of

the time. This study does show that children with not well-controlled/poorly controlled asthma and

children with symptoms indicating poor control are more likely to have ever been given a WAAP

and more likely to have a WAAP on file at school. However, there is no evidence in this study that

having ever been given a WAAP or having a WAAP on file at school is associated with medication

use behaviors that indicate appropriate asthma self-management such as inhaler spacer use or

consistent inhaled corticosteroid use.

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Table 1

Socio-demographic and health care characteristics for having been given a written asthma action plan (WAAP) among children with asthma: Asthma Call-Back Survey 2010

Characteristics	Given WAAP n= 954; 44.5%[b] (95% CI =40.5-48.7)			Never given WAAP n= 1,296; 55.5%[b] (95%CI =51.3-59.5)			Design-based Pearson X^2	Test for trend
	[a]	% [b]	95% CI	[a]	%[b]	95% CI	P-value	P-value
Sex							0.882	
Male	564	59.3	(56.0-65.0)	763	58.7	(53.5-63.7)		
Female	386	40.7	(35.0-46.6)	526	41.3	(36.3-46.5)		
Age group								0.631
0-4	81	21.3	(14.6-30.0)	152	16.5	(12.6-21.4)		
5-10	280	34.8	(29.0-41.2)	388	49.9	(35.0-45.3)		
11-14	277	21.6	(17.9-26.0)	338	21.6	(17.6-25.2)		
15-17	274	22.2	(17.9-27.3)	373	22.4	(18.7-26.5)		
Race and ethnicity							0.447	
White, non-Hispanic	685	58.0	(52.6-63.2)	903	59.7	(54.3-64.9)		
Black, non-Hispanic	117	21.2	(17.4-25.6)	119	15.3	(11.8-19.5)		
Other/multiracial, Non-Hispanic	73	4.9	(3.2-7.5)	140	7.8	(5.5-11.1)		
Hispanic	75	15.8	(11.0-22.3)	125	17.2	(12.9-22.5)		
Health insurance							0.308	
Private	603	62.0	(56.0-67.7)	801	61.0	(55.8-65.9)		
Public	231	29.9	(24.8-35.4)	332	28.9	(24.5-33.9)		
Other	83	6.2	(3.8-9.7)	105	5.6	(4.0-7.8)		
None	32	1.9	(1.2-3.1)	53	4.4	(2.3-8.3)		
Annual Household Income								0.919
<$25,000	193	22.6	(18.7-27.1)	290	24.2	(20.2-28.7)		
$25,000 to <$50,000	208	20.0	(15.6-25.3)	247	22.2	(17.5-27.7)		
$50, 000 to <$75,000	154	22.3	(15.1-31.7)	193	12.4	(9.3-16.3)		
≥$75,000	358	35.0	(29.6- 40.9)	486	41.2	(36.2-46.4)		
Experienced cost as barrier to care in previous 12 months (y/n)	68	10.1	(6.2-16.2)	88	11.7	(7.6-17.6)	0.654	
Routine care visits (y/n)	588	64.9	(57.4-71.7)	615	48.2	(43.1-53.3)	<0.001	

[a]Unweighted frequency.
[b]Weighted percent.
CI= Confidence interval; OR= Odds ratio.
Missing data is less than 5% for all variables of interest.

Table 2

Socio-demographic and health care characteristics for having a written asthma action plan on file at school among children with asthma: Asthma Call-back Survey 2010

Characteristics	WAAP at school n= 657; 34.4%[b] (95%CI= 30.4-38.6)			No WAAP at school n= 1394; 65.6 %[b] (95% CI = 61.4-69.6)			Design-based Pearson X^2	Test for trend
	[a]	%[b]	95% CI	[a]	%[b]	95% CI	P-value	P-value
Sex							0.149	
Male	367	55.3	(48.4-62.0)	846	61.4	(56.6-66.2)		
Female	289	44.7	(38.0-51.6)	541	38.5	(33.8-43.3)		
Age group								0.465
0-4	44	8.1	(5.4-12.1)	75	11.2	(6.3-19.2)		
5-10	223	46.4	(39.3-53.7)	412	38.2	(32.9-43.7)		
11-14	191	24.0	(19.4- 29.2)	398	23.8	(20.2-27.9)		
15-17	174	21.5	(16.0-28.2)	455	26.8	(22.6-31.3)		
Race and ethnicity							<0.001	
White, non-Hispanic	465	57.5	(50.6-64.1)	998	64.2	(57.7-70.2)		
Black, non-Hispanic	93	27.7	(21.4-35.0)	119	11.3	(8.9-14.4)		
Other/multiracial, Non-Hispanic	47	5.8	(3.3-10.0)	144	7.1	(5.1-9.7)		
Hispanic	50	9.0	(6.1-13.2)	123	17.3	(11.6-25.2)		
Health insurance							0.316	
Private	402	58.8	(51.7-65.6)	915	67.9	(63.5-72.1)		
Public	185	30.0	(24.4-36.3)	298	23.8	(20.0-28.1)		
Other	42	6.8	(3.4-13.1)	122	5.2	(4.0-6.8)		
None	22	4.4	(1.3-13.4)	55	3.1	(2.1-4.4)		
Annual Household Income								0.075
<$25,000	157	24.3	(19.1-30.5)	259	19.9	(16.4-23.9)		
$25,000 to <$50,000	137	21.8	(16.0-29.0)	271	19.6	(15.8-24.0)		
$50, 000 to <$75,000	115	17.3	(12.4-23.5)	203	18.3	(12.4-26.1)		
≥$75,000	216	36.6	(30.3-43.2)	584	42.2	(36.8-47.9)		
Experienced cost as barrier to care in previous 12 months (y/n)	53	11.1	(6.5-18.3)	84	10.5	(7.0-15.2)	0.852	
Routine care visits (y/n)	504	84.9	(79.9-88.9)	566	37.5	(33.0-42.3)	<0.001	

[a] Un-weighted frequency.
[b] Weighted percent.
CI= Confidence interval; OR= Odds ratio.
Missing data is less than 5% for all variables of interest.

Table 3

Asthma control characteristics for having been given a written asthma action plan (WAAP) among children with asthma: Asthma Call-Back Survey 2010

Asthma control characteristics	Given WAAP n= 954; 44.5%[b] (95% CI =40.5-48.7)			Never given WAAP n= 1,296; 55.5%[b] (95%CI =51.3-59.5)			Design-based Pearson X^2	Test for trend
	[a]	% [b]	95% CI	[a]	% [b]	95% CI	P-value	P-value
Asthma control level								0.005
Well controlled	422	41.4	(34.7-48.4)	708	54.3	(49.0-59.4)		
Not well controlled	364	40.2	(34.4-46.3)	434	32.8	(28.0-38.0)		
Poorly controlled	168	18.4	(14.0-23.6)	154	12.9	(9.8-16.7)		
Days with symptoms							0.580	
≤ 8 days/month	803	86.5	(82.2-90.0)	1,135	87.9	(84.1-90.9)		
>8 days/month or throughout the day	139	13.5	(10.1-17.8)	140	12.1	(9.1-15.9)		
Night Awakenings							0.058	
≤1/month	795	80.8	(75.2-85.3)	142	86.7	(82.8-89.7)		
≥2/month	157	19.2	(14.7-24.8)	1,133	13.4	(10.3-17.2)		
Limited Activity due to asthma							0.022	
No	504	50.2	(43.6-56.7)	794	60.0	(54.7-65.1)		
Yes	448	49.8	(43.3-56.4)	498	40.0	(34.9-45.3)		
Number of attacks/episodes in last 3 months							0.003	
0-2	632	64.2	(58.3-69.7)	970	75.2	(70.6-79.3)		
≥3	314	35.8	(30.3-41.7)	311	24.8	(20.7-29.4)		
Duration of most recent attack/episode								0.306
None	540	55.6	(49.3-61.8)	843	63.2	(57.8-68.3)		
Minutes	141	14.6	(10.9-19.3)	169	11.9	(8.8-15.9)		
Hours	92	11.0	(8.7-13.7)	97	7.6	(5.3-10.7)		
Days	127	15.3	(11.7-19.8)	126	11.8	(8.7-15.9)		
Weeks	36	3.4	(2.2-5.4)	334	5.5	(2.9-10.1)		
Missed school days [c]							0.825	
0-5	771	85.9	(81.9-89.1)	1,054	85.2	(80.4-89.0)		
≥6	127	14.1	(10.9-18.1)	132	14.8	(11.0-19.6)		
Urgent visits [c] (y/n)	257	31.2	(25.6-37.3)	248	25.5	(20.8-30.8)	0.147	
ED visits [c] (y/n)	134	19.0	(14.0-25.2)	121	13.9	(10.2-18.7)	0.014	
Hospitalization [c] (y/n)	23	5.0	(2.6-9.3)	16	2.6	(1.3-5.3)	0.110	

[a] Un-weighted frequency.
[b] Weighted percent.
[c] Occurring in the last year due to asthma
CI= Confidence interval; ED= Emergency Department; OR= Odds ratio.
Missing data is less than 5% for all variables of interest.

Table 4

Asthma control characteristics for having a WAAP on file at school among children with asthma: Asthma Call-Back Survey 2010

	WAAP at school n= 657; 34.4%[b] (95%CI= 30.4-38.6)			No WAAP at school n= 1394; 65.6 %[b] (95% CI = 61.4-69.6)			Design-based Pearson X^2	Test for trend
Asthma control characteristics	[a]	%[b]	95% CI	[a]	%[b]	95% CI	P-value	P-value
Asthma control level								<0.001
Well controlled	208	26.7	(21.7-32.8)	839	64.0	(59.3-68.5)		
Not well controlled	302	50.0	(43.2-56.8)	420	27.4	(23.5-31.8)		
Poorly controlled	147	23.1	(18.1-29.1)	135	8.6	(6.4-11.3)		
Days with symptoms								
≤ 8 days/month	536	82.5	(76.3-87.3)	1,241	90.6	(87.5-93.0)	0.003	
>8 days/month or throughout the day	112	17.5	(12.7-23.7)	133	9.4	(7.0-12.5)		
Night Awakenings								<0.001
≤1/month	530	76.8	(70.7-82.0)	1,249	91.4	(88.7-93.5)		
≥2/month	120	23.2	(18.0-29.3)	132	8.6	(6.5-11.3)		
Limited Activity due to asthma								<0.001
No	272	37.2	(30.9-43.9)	920	69.2	(64.8-73.4)		
Yes	382	62.8	(56.1-69.1)	471	30.7	(26.6-35.2)		
Number of attacks/episodes in last 3 months								<0.001
0-2	390	55.8	(48.7-62.6)	1,082	67.2	(73.5-81.6)		
≥3	261	44.2	(37.4-51.3)	298	32.8	(18.4-26.4)		
Duration of most recent attack/episode								<0.001
None	305	38.8	(32.6-20.7)	960	70.8	(66.2-75.0)		
Minutes	145	27.3	(20.7-35.1)	152	8.6	(6.7-11.0)		
Hours	72	9.8	(6.8-13.8)	93	6.7	(4.6-9.7)		
Days	102	21.0	(15.9-27.1)	123	10.7	(8.0-14.3)		
Weeks	20	3.1	(1.4-7.0)	40	3.2	(2.0-5.1)		
Missed school days [c]							0.003	
0-5	537	80.5	(74.9-85.1)	1,256	89.4	(85.9-92.1)		
≥6	113	19.5	(14.9-25.1)	131	10.6	(7.9-14.1)		
Urgent visits [c] (y/n)	200	42.9	(36.0-50.0)	224	18.7	(15.1-22.9)	<0.001	
ED visits [c] (y/n)	96	19.0	(14.0-25.2)	112	9.4	(6.9-12.8)	0.001	
Hospitalization [d] (y/n)	23	5.0	(2.6-9.3)	16	1.8	(0.8-3.6)	0.028	

[a] Un-weighted frequency.
[b] Weighted percent.
[c] Occurring in the last year due to asthma
CI= Confidence interval; ED= Emergency Department; OR= Odds ratio.
Missing data is less than 5% for all variables of interest.

Table 5

Medication use behaviors for having been given a written asthma action plan (WAAP) among children with asthma: Asthma Call-Back Survey 2010

Medication use behaviors	Given WAAP n= 954; 44.5%[b] (95% CI =40.5-48.7)			Never given WAAP n= 1,296; 55.5%[b] (95%CI =51.3-59.5)			Design-based Pearson X^2
	[a]	% [b]	95% CI	[a]	% [b]	95% CI	P-value
SABA[c] inhalers (n= 667)[c]							
Use of spacer with SABA inhaler (Y/N)	203	58.8	(51.0-66.4)	146	56.8	(48.0-65.2)	0.729
Use of SABA inhaler during attack (Y/N)	325	92.3	(86.4-95.8)	275	91.9	(85.6-95.6)	0.894
Frequency of SABA use in last 3 months (days/week)							0.391
≤2 days per week	169	51.8	(44.1-59.6)	170	56.8	(47.4-65.7)	
≥3 days per week	184	48.1	(30.4-55.9)	139	43.2	(34.3-52.6)	
Number of SABA canisters in last 3 months							0.168
≤1	247	70.4	(62.8-77.0)	238	77.1	(67.8-84.3)	
≥2	105	29.6	(23.0-37.1)	71	22.0	(15.7-32.2)	
Inhaled corticosteroids used on a regular schedule every day (n= 407)[c] (Y/N)	198	80.7	(71.5-87.5)	132	75.0	(61.3-85.0)	0.360
Oral corticosteroids in the last 3 months (Y/N)	38	4.8	(2.9-7.6)	27	4.4	(2.6-7.2)	0.803

[a] Un-weighted frequency.

[b] Weighted percent.

[c] n = the number of children prescribed the medication of interest

CI= Confidence interval; SABA= Short acting beta2-agonists.

Missing data is less than 5% for all variables of interest.

Table 6

Medication use behaviors for WAAP on file at school among children with asthma: Asthma Call-Back Survey 2010

	WAAP at school n= 657; 34.4%[b] (95%CI= 30.4-38.6)			No WAAP at school n= 1394; 65.6 %[b] (95% CI = 61.4-69.6)			Design-based Pearson X^2
Medication use behaviors	[a]	%[b]	95% CI	[a]	%[b]	95% CI	P-value
SABA[c] inhalers (n= 667)[d]							
Use of spacer with SABA inhaler (Y/N)	175	54.5	(45.0-63.6)	132	51.6	(43.0-60.2)	0.656
Use of SABA inhaler during attack (Y/N)	291	91.6	(83.9-95.8)	258	93.7	(88.9-96.5)	0.492
Frequency of SABA inhaler use in last 3 months (days/week)							0.446
≤2 days per week	159	50.2	(40.7-59.8)	153	55.1	(46.2-63.7)	
≥3 days per week	155	49.7	(40.2-59.3)	139	44.8	(36.3-53.7)	
Number of SABA canisters in last 3 months							0.024
≤1	224	67.2	(57.5-75.6)	222	79.4	(71.9-85.2)	
≥2	89	32.8	(24.4-42.5)	69	20.6	(14.6-28.2)	
Inhaled corticosteroids used on a regular schedule every day (n= 389)[c] (Y/N)	155	76.5	(64.4-85.3)	148	82.0	(71.8-89.0)	0.356
Oral corticosteroids in the last 3 months (Y/N)	31	6.5	(3.7-11.1)	24	3.4	(1.9-6.0)	0.107

[a] Un-weighted frequency.
[b] Weighted percent.
[c] n = the number of children prescribed the medication of interest
CI= Confidence interval; SABA= Short acting beta2-agonists.
Missing data is less than 5% for all variables of interest.

Table 7

The association between the characteristics of children with asthma and having been given a written asthma action plan (WAAP) -2010 Child Asthma Call-back Survey (ACBS)

	Given a WAAP		WAAP on file at school	
Characteristics	RR (95% CI)	aRR[a] (95% CI)	RR (95% CI)	aRR[a] (95% CI)
Sex				
Male	Referent	Referent	Referent	Referent
Female	1.0 (0.7-1.4)	0.9 (0.6-1.3)	1.3 (0.9-1.8)	1.2 (0.8-1.7)
Age group				
0-4	Referent	Referent	Referent	Referent
5-10	0.7 (0.4-1.2)	0.6 (0.3-1.0)	1.7 (0.7-3.8)	2.0 (1.0-3.6)
11-14	0.7 (0.4-1.3)	0.7 (0.4-1.4)	1.4 (0.6-3.1)	2.0 (1.0-4.1)
15-17	0.8 (0.4-1.4)	0.8 (0.4-1.4)	1.1 (0.5-2.6)	1.9 (0.9-3.8)
Race and ethnicity				
White, non-Hispanic	Referent	Referent	Referent	Referent
Black, non-Hispanic	1.4 (0.9-2.0)	1.5 (0.9-2.5)	2.7 (1.7-4.2)	2.2 (1.4-3.7)
Other/multiracial, Non-Hispanic	0.7 (0.4-1.3)	0.7 (0.4-1.5)	0.9 (0.5-1.8)	0.9 (0.4-1.7)
Hispanic	0.9 (0.5-1.9)	0.9 (0.4-1.8)	0.6 (0.3-1.1)	0.8 (0.4-1.6)
Health insurance				
Private	Referent	Referent	Referent	Referent
Public	1.0 (0.7-1.5)	1.7 (1.0-3.0)	1.5 (1.0-2.1)	1.5 (0.8-2.4)
Other	1.1 (0.6-2.0)	1.0 (0.5-1.9)	1.5 (0.7-3.4)	1.0 (0.6-1.9)
Uninsured	0.4 (0.2-1.0)	0.6 (0.2-1.9)	1.6 (0.5-5.9)	2.1 (0.5-8.5)
Annual Household Income				
<$25,000	Referent	Referent	Referent	Referent
$25,000 to <$50,000	1.0 (0.6-1.5)	1.5 (0.8-2.7)	0.9 (0.5-1.6)	1.2 (0.7-2.4)
$50, 000 to <$75,000	1.9 (1.0-3.6)	3.7 (1.7-7.9)	0.8 (0.4-1.5)	1.6 (0.8-3.2)
≥$75,000	0.9 (0.6-1.3)	2.0 (1.1-2.9)	0.7 (0.5-1.1)	1.3 (0.7-2.6)
Experienced cost as barrier to care in previous 12 months (Y/N)	0.9 (0.4-1.7)	0.9 (0.5-1.7)	1.1 (0.5-2.2)	0.7 (0.4-1.3)
Routine care visits (1 or more in last year) (Y/N)	2.0 (1.3-2.9)	1.8 (1.1-2.9)	9.3 (6.2-14.1)	4.1 (2.7-6.1)

[a] The model adjust for all other variables in the table

RR= Relative Risk; aRR= Adjusted relative risk; CI= Confidence Interval

Table 8

The association between asthma control and having an asthma action– 2010 child Asthma Call-back Survey (ACBS)

Asthma control characteristics	Given a WAAP		WAAP on file at school	
	RR (95% CI)	aRR[a] (95% CI)	RR (95% CI)	aRR[a] (95% CI)
Asthma control level				
Well controlled	Referent	Referent	Referent	Referent
Not well controlled	1.6 (1.1-2.4)	1.6 (1.1-2.4)	4.3 (3.0-6.4)	1.7 (1.1-2.6)
Poorly controlled	1.9 (1.1-3.1)	1.5 (0.9-2.7)	6.4 (4.0-10.3)	2.5 (1.4-4.2)
Days with symptoms last month				
≤ 8 days/month	Referent	Referent	Referent	Referent
>8 days/month or throughout the day	1.1 (0.7-1.8)	0.9 (0.6-1.4)	2.0 (1.3-3.3)	1.0 (0.6-1.7)
Night Awakenings last month				
≤1/month	Referent	Referent	Referent	Referent
≥2/month	1.5 (1.0-2.4)	1.2 (0.7-1.9)	3.2 (2.1-5.0)	1.9 (1.2-3.1)
Limited Activity due to asthma				
No	Referent	Referent	Referent	Referent
Yes	1.5 (1.1-2.1)	1.4 (0.9-1.9)	3.8 (2.7-5.4)	1.6 (1.1-2.3)
Number of attacks/episodes in last 3 months (frequency)				
0-2	Referent	Referent	Referent	Referent
≥3	1.7 (1.2-2.4)	1.1 (0.6-1.8)	2.8 (1.9-4.0)	1.3 (0.9-1.9)
Duration of most recent attack/episode				
None	Referent	Referent	Referent	Referent
Minutes	1.4 (0.8-2.3)	0.9 (0.6-1.5)	5.8 (3.6-9.4)	2.1 (1.3-3.5)
Hours	1.6 (1.0-2.7)	1.4 (0.8-2.3)	2.6 (1.5-4.7)	1.2 (0.6-2.2)
Days	1.5 (0.9-2.4)	1.2 (0.6-2.2)	3.6 (2.2-5.8)	1.4 (0.8-2.5)
Weeks	0.7 (0.3-1.6)	0.9 (0.4-2.2)	1.8 (0.7-4.7)	0.7 (0.8-1.6)
Missed school days [b]				
0-5	Referent	Referent	Referent	Referent
≥6	0.9 (0.6-1.5)	0.9 (0.5-1.5)	2.0 (1.3-3.2)	1.2 (0.7-2.0)
Urgent visits [b] (Y/N)	1.3 (0.9-1.9)	1.0 (0.7-1.5)	3.3 (2.2-4.8)	1.3 (0.9-2.0)
ED visits [b] (Y/N)	1.8 (1.1-2.8)	1.0 (0.6-1.7)	2.3 (1.4-3.7)	0.9 (0.5-1.5)
Hospitalization [b] (Y/N)	2.5 (0.8-7.5)	1.6 (0.5-5.6)	2.9 (1.1-7.5)	1.7 (0.8-4.0)

[a] The model adjusts for sex, age, race and ethnicity, health insurance coverage, annual household income, experiencing cost as a barrier, and routine care visits.

[b] Occurring in the last year due to asthma

RR= Relative Risk; aRR: Adjusted Relative Risk; CI= Confidence Interval; ED= Emergency Department

Table 9

The association between medication use behaviors and having an asthma action plan- 2010 child Asthma Call-back Survey (ACBS)

Medication use behaviors	Given a WAAP		WAAP on file at school	
	RR (95% CI)	aRR[a] (95% CI)	RR (95% CI)	aRR [a] (95% CI)
SABA inhaler use				
Use of spacer with SABA inhaler (Y/N)	1.1 (0.7-1.8)	1.1 (0.6-1.7)	1.1 (0.7-1.9)	0.9 (0.5-1.4)
Use of SABA inhaler during attack (Y/N)	1.1 (0.5-2.5)	0.9 (0.4-2.1)	0.7 (0.3-1.8)	0.4 (0.2-1.2)
Frequency of SABA inhaler use in last 3 months (days/week)				
≤2 days per week	Referent	Referent	Referent	Referent
≥3 days per week	1.2 (0.8-1.9)	1.2 (0.8-1.9)	1.2 (0.7-2.0)	1.1 (0.7-1.9)
Number of SABA canisters in last 3 months				
≤1	Referent	Referent	Referent	Referent
≥2	1.4 (0.9-2.3)	1.3 (0.7-2.3)	1.9 (1.1-3.2)	1.8 (1.1-3.1)
Inhaled corticosteroids use on a regular schedule every day (Y/N)	1.4 (0.7-2.9)	1.3 (0.6-2.5)	0.7 (0.4-1.5)	0.5 (0.3-1.1)
Oral corticosteroids in the last 3 months (Y/N)	1.1 (0.5-2.3)	1.0 (0.5-2.1)	2.0 (0.9-4.5)	1.7 (0.7-4.2)

[a] The model adjusts for sex, age, race and ethnicity, health insurance coverage, annual household income, experiencing cost as a barrier, and routine care visits.

RR= Relative Risk; aRR: Adjusted Relative Risk; CI= Confidence interval; SABA= Short acting beta2-agonists

Figure 1

Adapted with permission from the National Heart, Lung, and Blood Institute (NHLBI), a program of the U.S. Department of Health and Human Services National Institute of Health. Source http://www.nhlbi.nih.gov/health/public/lung/asthma/asthma_actplan.htm.

Figure 2

Components of control used to classify asthma control

Components of control		Classification of asthma control		
		Well controlled	**Not Well Controlled**	**Very Poorly Controlled**
Impairment	Days with symptoms	≤ 8 days/month	>8 days/month	Throughout the day
	Nights awakenings	≤1/month	>1/month	>4/month
	Limited activity	Not at all	A little/moderate amount	A lot
	Short acting beta-agonist use days/week	≤ 2 days/week	>2 days/week	Several times per day (>1/day)
Risk	Oral systemic corticosteroid use in last 3 months (yes/no) [b]	No		Yes

[a] Level of control is classified by the most severe impairment or risk category based on EPR-3 classification of asthma control guidelines (see Appendix A). Due to data limitations, FEV_1, peak flow, validated questionnaires, and treatment related adverse effects were not considered in this analysis.
[b] EPR-3 guidelines recommend evaluation of oral systemic corticosteroids over 1 year.